PROCEEDINGS
OF
THE FIFTH NORTH AMERICAN CONFERENCE
ON WASTE EXCHANGE

Sponsored by

Ontario Waste Exchange
Canadian Waste Materials Exchange
and
Ontario Research Foundation

May 15-18, 1988

Toronto, Ontario, Canada

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ACKNOWLEDGEMENTS

Conferences don't just happen; it takes a lot of work to organize a successful meeting. I would like to take this opportunity to acknowledge the contribution of the people who made this meeting so successful.

First, to the Conference Steering Committee:

Karen Beliveau	- Alberta Waste Exchange
Lewis Cutler	- Northeast Waste Exchange
Eugene Jones	- Southern Waste Exchange
Gary Mann	- Hevmet Recovery
Mary McDaniel	- Southeast Waste Exchange
Margo Siekerka	- Consultant
Bill Stough	- Great Lakes Regional Waste Exchange
Linda Varangu	- Ontario Waste Exchange

My thanks for organizing such an excellent programme.

Second, to Harry McAdie, Tom Duncan and Rick Izquierdo of Ontario Research Foundation, my thanks for help with hotel arrangements and graphics and printing.

Third, my very, very special thanks to Isobel Duncan and Linda Varangu who worked so hard in the weeks prior to the Conference and at the Conference, and, at the same, kept me from panicking (at least most of the time!)

Bob Laughlin
Conference Chairman

INTRODUCTION

175 registrants gathered in Toronto from May 15 to May 18, 1988, to participate in the Fifth North American Conference on Waste Exchange. The Meeting was hosted by Ontario Research Foundation, the Canadian Waste Materials Exchange and the Ontario Waste Exchange.

The theme for this year's meeting was "Waste Minimization through Technology and the Marketing of Wastes and Surpluses". For one day of the meeting, parallel sessions were run, one being on waste minimization and recycling technologies, and the second on marketing of waste materials.

An exhibition was held in association with the Conference and 12 companies took the time to demonstrate products and services designed to help in waste minimization and exchange.

As well as an excellent technical programme, participants had the chance to renew old friendships and establish new ones, and to enjoy Toronto and the nearby Niagara Penninsula.

Participants from 17 States, 7 Provinces and from Taiwan participated in the Meeting. They were from all levels of government, Federal, Provincial/State and local Municipal, industry, consulting, waste management companies, public interest groups and waste exchanges.

The papers which follow are all of those submitted by the speakers. I am sure that they will be of interest to you. If you have any questions or comments, please contact Bob Laughlin, Canadian Waste Materials Exchange, Ontario Research Foundation, Sheridan Park, Mississauga, Ontario, Canada L5K 1B3, (416) 822-4111.

LUNCHEON SPEECH, TUESDAY, MAY 17, 1988

Christine Hart, MPP
Parliamentary Assistant to
The Ontario Minister of the Environment

Good afternoon.

Jim Bradley regrets that pressing business requires his presence at Queen's Park. I will be delivering a speech on his behalf today at this important waste exchange conference.

I am pleased that Ontario was able to host the conference this year. Your theme of minimizing waste through marketing and technology matches our goals in this area. Our government is fully committed to finding and implementing environmentally sound waste management techniques.

I enjoy speaking with people directly involved in implementing progressive waste management programs. You people are on the front lines in the waste handling initiatives that I am determined to see expand in this province.

Of course, being on the front line is never easy. Changing old, set attitudes is one of the toughest jobs around. Still, those of you dedicated to promoting waste exchange, recycling and recovery in industry really do have an ace up your sleeve.

Quite simply, these waste management techniques make sense. They make environmental sense. They make business sense.

More and more, we are seeing that the 4R options of reduction, reuse, recycling and recovery of waste can have a positive effect on corporate balance sheets.

Look at the facts in Ontario. Over the next ten years, as many as 300 of our municipalities will require additional landfill capacity. Finding suitable landfill sites is a costly, time-consuming and often frustrating process.

Municipalities and private companies also are having to comply with stricter environmental standards for existing sites. Cleaning up leachate, odor and gas problems also cost money.

This reality is being reflected in the tipping fees municipalities levy from haulers of industrial and commercial waste. Landfills that were once free are starting to charge. Those already charging are raising their fees.

Metropolitan Toronto has recently decided to raise its tipping fee for commercial and industrial haulers from 18 dollars a tonne to 50 dollars. Fees at Metro transfer stations are up from 32 dollars a tonne to 65 dollars.

This pattern of dramatically increased disposal fees is widespread across Ontario and, indeed, across North America.

As a result, the traditional bottom-line bias of business and local government toward the landfill option is beginning to change. With a little help from government and waste management professionals, businesses are starting to question their old waste-handling practices. Why pay to dispose of garbage when there are more cost-effective ways to deal with it? They are learning that waste can be put to a use that is not only environmentally sound, but that may even save a dollar or two.

From an environmental perspective, there is no question that the 4Rs approach is <u>the</u> way of the future.

I do not have to dwell on the mess created by improperly managed landfill sites. You know the facts. Incinerators as well have their problems.

While effective enforcement of more stringent government regulations is making incinerators and landfills safer, it is time to regard waste as an opportunity rather than a problem, as a valuable resource rather than a costly nuisance.

My ministry is actively promoting recycling and the other 4Rs in the municipal sector. But we must also address commercial and industrial waste.

Commercial/industrial waste accounts for more than half of the waste going into landfill sites serving Metro Toronto. Recent statistics show that residential waste collection volumes are relatively stable, growing no more than a few percentage points a year. But the load of commercial/industrial waste has shown a steady increase of 10 to 15 per cent a year. It has been largely responsible for increasing Metro Toronto's total waste disposal load from 2 million tonnes in 1984 to 3.2 million tonnes last year.

This phenomenal growth in business garbage is a downside of Ontario's booming economy.

As in the municipal sector, my ministry has embraced the 4Rs as sensible methods for meeting our industrial waste management needs. We are implementing regulations and programs to encourage greater understanding, development and use of these options.

Scrap tires are one example of a waste disposal problem with enormous untapped commercial potential. There is no convenient way to dispose of the 10 million scrap passenger tire equivalents generated annually in Ontario. They can not easily be dumped into landfill. Burning them raises questions about air pollution problems. Stored above ground, they are both a fire hazard and an eyesore.

The fact is that scrap tires have excellent reuse and recycling potential. They can be ground into powder and processed to produce uncured rubber for manufacturing. They can be remoulded to continued use. They can also provide a fuel source.

To alert recyclers to the wealth lying dormant in scrap tire stockpiles around the province, my ministry very recently published an Ontario scrap tire inventory and report. I understand that response is already coming in from those interested in putting this huge waste resource to productive -- and profitable -- use.

To encourage others to take a second look at the potential value of their wastes, my ministry is pursuing other avenues of support. The industrial 4Rs component of our Comprehensive Funding Program is the instrument we use to deliver our encouragement. This year we have committed 1-point-2 million dollars for industrial 4R initiatives. We are channeling our support into a range of activities.

Together with the federal government and other provinces, we continue to support the Canadian Waste Materials Exchange. Last April, my ministry also joined with the Ontario Waste Management Corporation to provide funding for the activities of the Ontario Waste Exchange.

I believe the increased support has allowed the Ontario Waste Exchange to take a more pro-active role in linking companies that have complementary raw material and waste disposal needs. I predict additional growth for the exchange this coming year.

We are also putting dollars into helping industry help itself. As you heard earlier, since June of last year, my ministry has been working with individual companies to find ways to reduce, reuse, recycle, and recover a greater portion of their waste stream.

We are prepared to pay up to half of the cost of capital and commissioning expenditures, and we are prepared to offer full funding to high-potential research or development projects. In return for our support, companies must agree to certain reporting requirements on the progress and results of the projects. Results will be published for the use of other interested businesses.

Since we introduced the Comprehensive Funding Program eleven months ago, we have funded, or are in the process of funding, 35 industrial 4R projects. We are supporting initiatives that will help tame waste generation in a variety of industries, including newsprint, wood, food processing, electroplating, cardboard and steel.

Let me give you some examples.

One of the first projects we funded is now showing publishable results. About a year ago, a company involved in waste cardboard bailing came to us with a proposal to upgrade its equipment. Because this company was the only one of its kind in the area and because waste cardboard is a high-demand product in Ontario, we agreed to fund one third of the costs.

As a result of the project, the company has increased its output by 40 per cent. That translates into 8,000 tonnes of cardboard per year diverted from the municipal waste stream.

We are also funding research into the development of a new type of furnace for use in steel-making industries. Currently, the iron-oxide dust from electric arc furnaces used in steel-processing is unusable because it is contaminated with other heavy metals. This new technology furnace seeks to segregate iron from the other substances in such a way that it can be reused in steel making.

With widespread acceptance by Ontario's steel industry, this process could divert tens of thousands of tonnes of dust per year away from landfill sites. Ministry funding for this research totals 104,000 dollars over two years.

Two other ministry-supported projects, which involve a solvent recycler and a high-tech industry, will help Ontario deal with the difficult problem posed by some of our chlorofluorocarbon solvent wastes. To protect the ozone layer from damage by these substances, waste CFC material can only be disposed of through incineration.

Technology being developed in these two projects aims at high-quality recycling of CFC solvents so they can be reused in Ontario's high-tech industries. We have committed 30,000 dollars to these two initiatives.

Industries are also finding that 4R techniques can help them comply with some of Ontario's other environmental regulations. I know this is true of the electroplating industry and the requirements it will have to meet as a result of MISA, Ontario's Municipal-Industrial Strategy for Abatement program.

Under MISA, we are requiring industries and municipalities who discharge into our and waterways to abide by tough new controls aimed at cutting pollution at the source. To help municipalities comply with the loading limits that will be set under this program, we will be requiring pre-treatment from thousands of Ontario industries that discharge into municipal sewer systems.

Through our industrial 4R funding, new technologies are being developed to help electroplaters not only treat their waste, but recover heavy metals from it for reuse. The technologies being supported in seven separate projects will be useful to electroplating companies of all sizes. It will help them meet their pollution abatement responsibilities and produce a marketable byproduct at the same time. As I said earlier, 4R initiatives make environmental sense as well as good business sense.

With each of the projects I have outlined, our goal is to nurture the development of new industrial waste management techniques. Good ideas should not gather dust on a shelf because a company cannot manage the cost and risk of pursuing them. Our intent in supporting these projects is to share the risks and spread the rewards of industrial 4Rs research and development.

These then are the strategies we are developing to take Ontario into a new age of waste management and treatment. We are committed to supporting industrial and municipal 4R waste management options. We are directly involved with both the Canadian and Ontario waste exchanges. We offer financial assistance to industries that need help to research, develop or implement 4R initiatives in their companies.

I believe there is a new vitality in the waste management industry today. It comes from an understanding that things are changing, growing and moving forward.

Without a doubt, great opportunities are being created. I invite you, as waste management professionals, to take advantage of these opportunities. Help us make the transition into the age of smarter and safer waste management.

Thank you.

EPA'S WASTE MINIMIZATION PROGRAM

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Introduction

During the 1970s, the nation's attention began to focus on the serious problems associated with the indiscriminate or improper management of hazardous waste. The U.S. Environmental Protection Agency (EPA) documented incidents of damage to health and the environment throughout the country. Highly publicized cases such as "Love Canal" and "Valley of the Drums" heightened the public's concern. In a Report to Congress in 1973, EPA recommended passage of a Federal law to regulate the management of hazardous waste.

Congress responded to EPA's recommendation by passing the Resource Conservation and Recovery Act (RCRA) in 1976, which amended the 1965 Solid Waste Disposal Act. RCRA established a national program to protect human health and the environment from improper management of solid waste, to encourage source reduction and recycling as the preferred strategy for managing solid waste, and to conserve energy and natural resources. In 1984, Congress amended RCRA with the Hazardous and Solid Waste Amendments (HSWA), which required that additional steps be taken to minimize the amount of waste that is generated and ultimately disposed of. In response to HSWA, EPA is developing a number of policies and programs to minimize the quantity and toxicity of waste generated. Waste minimization is more environmentally effective and can be more economically feasible than "end-of-pipe" management and is recognized as a long-term solution to waste management problems.

The Hazardous and Solid Waste Amendments of 1984

HSWA focused new attention on the concept of waste minimization and established a national waste minimization policy:

> The Congress hereby declares it to be a national policy of the U.S. that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment.

The amendments refocused attention on the Congressional intent of RCRA by reemphasizing the preeminence of source reduction and recycling as preferred methods for waste management. HSWA also prohibited land disposal of hazardous waste unless the waste first is treated using the "Best Demonstrated Available Technology."

Waste Minimization Requirements Under HSWA

Section 224(a) of HSWA requires hazardous waste generators to certify on the manifest accompanying every waste shipment that:

- They have a program in place to reduce the quantity and toxicity of their waste to the extent economically feasible.
- The chosen method of treatment, storage, and/or disposal of wastes minimizes the threat to human health and the environment.

This Section also states that the certification must be included in the permit applications of all treatment, storage, and disposal facilities (the certification requirement became effective on September 1, 1985).

In addition, all generators covered by EPA's hazardous waste regulatory program must submit reports to EPA (or their State agency) at least every 2 years describing the efforts they have undertaken to reduce the volume and toxicity of waste they have generated. Over 40,000 generators and treatment, storage, and disposal facilities must submit this information in their biennial reports. EPA's analysis of the 1985 biennial reports will be completed in late 1988. Generators are currently completing their biennial reports for 1987, and the responses are due to EPA by July of 1988.

Another provision of HSWA required EPA to submit a Report to Congress on waste minimization by October 1986. Congress required EPA to report on the feasibility and desirability of establishing standards of performance or of taking any other actions to assure implementation of the national policy to reduce waste generation.

The EPA Report to Congress found that strong incentives exist for waste minimization, including the rising costs of proper hazardous waste management (both on-site management and offsite treatment, storage, or disposal); difficulties in siting new treatment, storage, and disposal facilities; financial liability; increasing costs of pollution liability insurance; and strong public approval of the concept of waste minimization. The Report to Congress also found that the potential for future waste reductions by industry is enormous — an estimated reduction of 15 to 30 percent is achievable. In support of this, the report pointed out that only 4 percent of the wastes generated in 1981 were recycled. It was determined, however, that several disincentives to waste minimization exist, including lack of capital to make process changes or other modifications to manufacturing operations; negative attitudes on the part of management; lack of information on how to minimize wastes; concerns with product quality; and regulatory burdens.

EPA made several key recommendations in its Report to Congress. First, the Agency should gather additional data to assess more accurately the status of waste minimization. Second, EPA should expand its program that provides guidance and technical assistance to generators and States on waste minimization. Third, EPA should continue to assess whether the national waste minimization goals should be accomplished through stronger regulatory actions, including modification of existing generator requirements. The report suggested that a strong regulatory program was inappropriate at this time because of the lack of information regarding opportunities for waste minimization within the regulated community. EPA will report back to Congress in 1990 on whether existing incentives have been sufficient to promote waste minimization or whether a mandatory program is necessary to implement the national waste minimization policy.

EPA's Waste Minimization Staff

EPA's Waste Minimization Staff within the Office of Solid Waste is now implementing a multifaceted program to follow through on the mandates of HSWA and the recommendations in EPA's Report to Congress. Three major components of the program already are underway:

- A massive data collection effort to monitor national progress toward waste minimization.
- A program to develop and disseminate information and technical assistance on waste minimization.
- A program to distribute grants to assist States in developing long-term waste minimization plans and programs.

Monitoring National Progress

EPA's Waste Minimization Staff currently is developing a computerized database that will enable the Agency to monitor national progress toward waste minimization within particular industrial sectors. The database will include information submitted by waste generators as part of their biennial reports. As one component of this submission, each generator must respond to a waste minimization questionnaire. Among the questions asked are:

- Do you have a waste minimization (source reduction and recycling) program?
- Do you have an employee training program or provide incentives to identify and implement source reduction and recycling opportunities?
- Have you conducted a waste minimization audit?
- What specific production or process was associated with generation of the waste?
- How much money was spent by your company on source reduction and recycling activities (including both capital expenditures and operating costs)?
- What waste quantities were reduced?
- What factors have delayed or prevented implementation of source reduction or recycling opportunities at your facility (for example, insufficient capital to install new equipment or lack of technical information on source reduction techniques)?

The responses to the questionnaire will identify waste minimization trends and help the Agency to determine the extent of voluntary waste minimization activity.

EPA also will monitor waste minimization activity through a separate generator survey, which solicits general information on waste characteristics, recovery processes (including metals recovery), reuse of waste as fuel, and fuel blending. In response to its initial survey, EPA has received information from 10,000 large-volume generators. The Agency expects to complete its preliminary data analysis by the end of 1988.

Disseminating Information

In addition to conducting the massive data collection activities described above, EPA's Waste Minimization Staff is coordinating an extensive public information and technical assistance program for States and the regulated community. The information and technical assistance program will include the development of waste minimization videotapes, brochures, technical documents, and workshops. As part of this program, EPA is designing and developing waste minimization posters for 18 specific industries.

EPA currently is developing a series of waste minimization brochures, which will provide specific information on waste minimization topics, including waste exchange, better operating practices, metal parts cleaning, paint application processes, and the economic benefits of waste minimization. This information program was launched with the publication of a general brochure, Waste Minimization: Environmental Quality With Economic Benefits, published in the fall of 1987. In progress is a brochure on waste exchanges that will describe the exchange process and cover such topics as funding, quantities of waste exchanged, the current status of exchanges, and the future of waste exchange. This brochure also will examine funding issues and will provide examples of waste exchange "success stories."

To distribute information on waste minimization, EPA has established a clearinghouse. This clearinghouse operates an electronic bulletin board listing information on upcoming waste minimization meetings and the status of waste minimization activities. In addition, the Staff is initiating a waste minimization newsletter, with the first issue scheduled for publication in the summer of 1988. EPA's RCRA/Superfund Hotline also is available to provide information and answer questions concerning waste minimization.

Grants to States

To foster the development of State waste minimization programs, EPA will award $6 million for training and demonstration projects. EPA will distribute the $6 million to the States through RCRA Integrated Training and Technical Assistance (RITTA) grants and incentive grants. The RITTA grants total $3 million and may be used to plan and implement waste minimization training and technical assistance under State RCRA programs.

The incentive grants, which Congress authorized in January 1988, also total $3 million. These grants are specifically intended to assist States in establishing or expanding waste reduction technical assistance programs. EPA will award approximately 10 to 15 State grants of $250,000 to $300,000 each. These funds may be used to:

- Provide technical assistance to generators (for example, on-site waste minimization assessments).
- Conduct demonstration projects (for example, identifying waste reduction techniques or conducting in-plant or pilot scale studies of waste reduction technologies).
- Develop and deliver staff training programs to assist generators in identifying and implementing waste minimization opportunities.
- Develop or expand information clearinghouses or waste exchange programs.
- Develop or distribute industry- or process-specific technical manuals or brochures.

EPA believes that these grants will help to establish strong State waste minimization programs. The grant programs, in conjunction with EPA's ongoing efforts to provide technical assistance and informational materials, will stimulate waste minimization activity throughout the country. All of the programs described above demonstrate the Agency's commitment to the national goal of significantly reducing the generation of hazardous waste, and of assuring that wastes that are nevertheless generated are managed in ways that minimize risks to health and the environment.

2038H

THE FEDERAL GOVERNMENT AND WASTE EXCHANGES IN CANADA

Dave Campbell
Environment Canada, Ottawa

The Canadian Waste Material Exchange

Among its many responsibilities relating to the management of hazardous wastes in Canada, the federal government has the responsibility to provide a strong leadership role in the development of a comprehensive and workable approach to waste management on a national scale. This leadership role includes the responsibility to promote and support specific projects and programs related to waste minimization.

Consistent with this role, in 1976, Environment Canada commissioned the Ontario Research Foundation to investigate and report on the feasibility of operating a waste material exchange in Canada. The subsequent report recommended that a "Passive Exchange " be set up in Canada on a national basis.

In 1977 Environment Canada (EC) contracted with the Ontario Research Foundation (ORF) to set up and operate the Canadian Waste Materials Exchange (CWME). Full funding (approximately $50,000/yr) was provided by Environment Canada for the first 3 years of operation -'78,'79,'80. Subsequently, funding has been split between EC, several provinces, and by the private sector, the latter through the purchase of subscriptions to the CWME bi-monthly publication and through the payment of listing fees for advertisers.

The funding history of the Canadian Waste Materials Exchange is outlined in Table 1.

FUNDING HISTORY OF THE CANADIAN WASTE MATERIALS EXCHANGE

Source of funds	Fiscal Year									
	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87
1. Environment Canada	46K	50K	44K	10K	10K	15K	15K	10K	10K	10K
2. Provinces				24K	21K	22.3K	35K	28K	27.7K	31K
3. Subscribers				16K	13K	11.7K	14K	15K	16K	14K
TOTAL	46K	50K	44K	50K	44K	49K	64K	53K	53.7K	55K

Table 1

As the chart indicates the federal government's contribution is currently running at 10k per year with the provinces, collectively, being the largest contributor.

Although major campaigns have been undertaken to increase subscription and advertising sales and in other methods of soliciting funds from the private sector, funding from this source appears to have leveled off at about $15,000 per year.

The Canadian Waste Material Exchange has had 10 years of successful operation and is providing a leadership role in waste exchange activities in Canada as well as internationally.

Current Waste Exchange Developments in Canada

Although the Canadian Waste Material Exchange had been operating successfully as a single national exchange it became evident after a few years of operation that activity was mainly centralized in Ontario and Quebec. To better serve the regions, a program was begun in 1984 to establish regional exchanges which would serve as regional contact points for the CWME as well as for arranging local transfers. Recent developments in the formation of waste exchanges in Canada are outlined as follows:

1984 - Ontario Waste Exchange started
1984 - An ORF study indicated that satellite exchanges should be started in other provinces
1984 - Manitoba Waste Exchange started
1985 - Alberta Waste Exchange started
1987 - Experimental exchange started in B.C.

Currently the provinces of Saskatchewan and Quebec are also considering the establishment of waste exchanges. In addition, at the municipal level in Ontario, waste exchanges are actively running in the Regions of Peel and Kitchener/Waterloo.

From the above, it is apparent that waste exchanges are currently proliferating at a very good rate in Canada.

The success of the Canadian Waste Material Exchange has been well established with 10 years of well documented operation behind it -- records indicate that the exchange has been operating successfully in terms of quantity and value of waste exchanged as well as in the related reduction in impact in the environment due to the decrease in landfilling and incineration requirements.

The other exchanges in Canada have not been in operation sufficiently long to document a history of success, however, they are all off to a good start and expected to prove equally successful.

As a matter of interest, the levels of staffing for the first four exchanges established in Canada are as follows:

	Part-Time	Full-Time
Canadian Waste Materials Exchange	2	-
Ontario Waste Materials Exchange	4	1
Manitoba Waste Exchange	1	-
Alberta Waste Materials Exchange	2	-

In spite of the success of the CWME and the anticipated success of the other exchanges in the basic terms mentioned above, there remain two nagging concerns about the future of exchanges:

1) They are not making a large enough impact on total quantities of hazardous waste going to disposal.

2) Government are funding most of the cost of running these exchanges. Indications by most governments are that this arrangement cannot continue on a long term basis.

These concerns have come to the attention of the Waste Committee of the Canadian Council of Resource and Environment Ministers. Membership to this committee consists of representatives from each of the provinces as well the federal Department of the Environment and a study has been initiated addressing these concerns.

Preliminary Study Results

This study has identified the following key requirements for optimizing the effectiveness of a successful waste exchange:

- a pro-active approach to the exchange of wastes
- non-profit status
- development of a business plan in which the objectives and plan of operations for the exchange are outlined
- regular review of the effectiveness of the exchange based on the business plan
- follow-up of waste exchange transactions and de-listings
- geographical coverage that reflects an industrial base adequate to support the activities of the waste exchange
- a marketing strategy focussed on potential clients of the exchange, including generators and users of waste materials
- a long-term commitment of a base level of funding
- a supportive policy/regulative/legislative atmosphere
- an adequate level of staffing (ideally 2.5 full-time staff possessing both technical and administrative skills)
- access to outside technical expertise
- bimonthly publications of a listings bulletin
- inclusion of hazardous as well as non-hazardous waste listings

- maintenance of an arms length approach and confidentiality of listings
- an on-line connection to a North America-wide computerized database

The study has also identified three potential scenarios for the future funding of waste exchange programs in Canada.

1) The first scenario would involve a continuation of the status quo in which most exchanges are chronically underfunded and must expend a great deal of effort in order to maintain minimal levels of financial support.

2) The second scenario would involve a long term commitment by government to provide a base level of funding which in turn, would allow the exchanges to pursue a more effective, pro-active mode of operation in accordance with the above list of requirements.

3) The third, would involve a high initial level of government support, diminishing over a period of five years. In this scenario, the level of funding from industry would be expected to increase to compensate for the loss of government support until, by the end of the interim period, it had assumed complete financial responsibility for the operation of the exchanges.

Conclusions

It is clear that waste exchange operations here in Canada must be enhanced to maximize their effectiveness in the reduction of wastes.

It is also clear that to achieve this higher level of effectiveness, increased funding on a long term basis is necessary.

The problem facing waste exchanges is that the source of these additional funding requirements is still not resolved. Money from government coffers for programs of this type are becoming increasingly hard to obtain. The demands from other government programs such as, welfare, unemployment benefits, industrial development, employment projects, third world aid, all have high priorities.

Governments are becoming increasingly reluctant to make commitments on a long term basis for programs of this type, particularly where the private sector is the greatest benefactor. It appears that waste exchanges will be required to become increasingly financially self-supporting.

As mentioned previously the Canadian Council of Resource and Environment Ministers is currently addressing the subject of waste exchanges in Canada and should soon be coming forward with appropriate conclusions and recommendations relative to their future.

ONTARIO INITIATIVES TO ENCOURAGE WASTE REDUCTION

George Rocoski
Ontario Ministry of the Environment

INTRODUCTION

This paper presents the Ministry of the Environment's (MOE) efforts to encourage the 4Rs (waste reduction, reuse, recycling, recovery) as it applies to industry in Ontario. The major topics to be discussed include the structure of the MOE, the Comprehensive Funding Program for Waste Management, the results of this program to date, an analysis of these results and some possible future directions that are being considered.

STRUCTURE OF THE MINISTRY OF THE ENVIRONMENT

The MOE is a provincially based ministry responsible for environmental issues in Ontario and employs approximately 2700 staff. It is split into several major divisions: Corporate Resources, Intergovernmental Relations & Strategic Planning, Operations and Environmental Services. The two of most relevance to this discussion are the Operations and Environmental Services Divisions. The Operations Division is responsible for the day-to-day functioning of the MOE. This Division includes the Approvals Branch, Investigations and Enforcement Branch and all of the MOE's Regional and District offices. The Approvals Branch deals with issuing Certificates of Approval (permits) for discharges to air, water and land. The Investigations and Enforcement Branch, as its name implies, carries out most of the investigations and court actions initiated by the MOE. The MOE's Regional and District offices cover the province geographically. In total, there are 23 such offices across Ontario, from Cornwall to Kenora, and these staff are generally the MOE's first contact with industries and municipalities. MOE regional staff deal with a variety of issues including inspections, response to complaints and spills as well as other general pollution abatement matters. These staff are also responsible for the daily operation and maintenance of a number of water treatment and sewage treatment plants across the province. Any non-standard or new situations that arise in the field are generally referred to the Environmental Services Division.

The Environmental Services Division is responsible for the development of new programs, policies and regulations, as well as to assist staff of the Operations Division. This Division

includes the Air Resources, Water Resources, Waste Management and Laboratory Services Branches of the MOE.

Although separate from the MOE, the Ontario Waste Management Corporation (OWMC) is a crown corporation responsible to the Ontario Minister of the Environment. OWMC was formed in 1981 with the mandate to establish and operate a hazardous waste management facility that would be able to handle all hazardous wastes generated in Ontario. OWMC also promotes waste reduction through some services provided to waste generators.

BACKGROUND

In 1983, after being in the business of waste management for over a decade, the MOE prepared the Blueprint for Waste Management in Ontario. This document summarized what the MOE had done, the current regulatory status in Ontario and identified options for future directions for all areas of waste management, both industrial and municipal. A significant portion of the Blueprint was devoted to proposed amendments to the province's hazardous waste legislation. Most of these proposed changes were incorporated in Regulation 309, the waste management regulation, in 1985. Also identified in the Blueprint, was the need to continue to work cooperatively, where possible, with industry in the development of more progressive ways to address the problems of waste management.

Through discussions with all sectors concerned with the future of waste management, both during and subsequent to the Blueprint process, it became clear that industrial waste, hazardous and non-hazardous, offered similar potential for diversion of waste requiring disposal. Stringent legislation had been introduced to correct practices that had been found to be environmentally unacceptable and new legislation is being proposed to further restrict these practices. The MOE, prior to the Blueprint exercise, had also identified a need to establish some type of program to encourage the industrial sector to initiate 4R projects. With the establishment of more stringent regulations and the resultant increase in disposal costs, the time appeared to be right for the MOE to become more pro-active in the encouragement of industrial 4Rs practices.

In June 1986, the Waste Management Branch of the MOE was restructured to provide a section devoted to encourage 4Rs initiatives. The Waste Reduction Section includes a Municipal Program Unit, an Industrial Program Unit and a Market Development and Promotion Unit as support to the other two units. The Waste Reduction Section has developed the 4R components of the Comprehensive Funding Program and administers the industrial and municipal support programs available.

The Municipal Program Unit has existed for a number of years, under different names, and was established to promote 4R initiatives to municipalities through technical as well as financial support. The Industrial Program Unit was established to promote these same concepts but with industry as the client group. Recognising that many similar materials can be generated from both municipal and industrial sources, the Market Development and Promotion Unit was created to assist in the development of markets for these recovered materials.

The Industrial Program Unit was formed to assist industry to develop the full potential of the 4Rs for industrial wastes. The focus of the unit's activities is to make industry more aware of the 4R opportunities that are available as well as to provide financial and technical assistance to ensure the timely implementation of 4R approaches. The unit is also responsible for the program's future development as well as administering funding projects and is operated by 3 full-time technical staff.

COMPREHENSIVE FUNDING PROGRAM FOR WASTE MANAGEMENT

Municipal waste diversion from disposal in the early 1980's was limited to a few recycling projects operated by non-profit groups and a few municipalities. Diversion of municipal waste from disposal was less than one percent of the residential waste stream. Industrial recycling was well established through secondary material dealers and brokers for certain materials such as ferrous and non-ferrous scrap metals and some secondary fibers. Most of these materials were available from selected sources but there remained large volumes of materials in the industrial waste stream that had not been tapped and that continued to be disposed. In Ontario, it is estimated that approximately one-half of the wastes disposed in landfills originates from industrial or commercial sources.

In 1981, the MOE implemented a Source Separation Program to financially support municipal recycling efforts. Other programs directed at municipalities were the Waste Management Improvement Program (WMIP) and the Waste Management Master Plan Program (WMMP). In 1987, all of these existing programs, as well as new funding programs were combined into one program called the Comprehensive Funding Program for Waste Management.

The Comprehensive Funding Program (CFP) was announced in April 1987 and details about the program were given that June. This funding program has two major components: 4Rs and treatment/disposal. The treatment/disposal component of the CFP included enhanced funding for WMIP and WMMP as well as a new Financial Assistance Program (FAP) directed at assisting

municipalities to get from the planning stage to the operational stage of disposal facilities that they own and operate. The 4Rs component of the CFP is directed at both industries and municipalities to encourage diversion of waste from disposal options.

The Municipal Recycling Support Program, which replaced the Source Separation Program, is designed to assist municipalities in their attempts to recover as much material as possible from the waste stream through recycling. This program is aimed at getting the homeowner to separate recyclable materials, such as newspapers, glass and cans, from the regular trash. A new Municipal Recovery Program is available to assist municipalities in establishing facilities for recovering materials from mixed solid waste, or for processing these wastes into useful products, such as fuel or compost. A new Reduce/Reuse program was also introduced to assist municipalities, the private sector or others to implement projects aimed at altering consumer waste generation behaviour, or to help consumers reduce the amount of waste requiring disposal.

All of the above programs are primarily directed at municipalities. Another new program, the Industrial 4Rs Program, is directed specifically at the private sector. This program includes assistance available to industry in the form of technical advice and financial support. MOE financial assistance will help to reduce the costs and risks that industry faces in shifting to more environmentally sound waste management practices required by existing as well as future legislation that will more tightly control industrial discharges.

Proponents eligible for assistance include all industrial and commercial sectors. Projects eligible for assistance include feasibility studies, the implementation of new or expanded projects for the reduction, reuse, recycling and recovery of wastes, process or equipment modification or evaluation or both, demonstration of technology either new to Ontario or novel to industry in general, upgrading operations beyond current industry state-of-the-art, and research. The focus of the program is to support industry in projects that break new ground or reduce risks in the implementation of the 4Rs.

In developing the program initially, it was felt that a wide range of activities would need to be supported. As a result, eligible project costs can range from research/feasibility studies through demonstration/development right up to capital equipment purchases and subsequent start-up or commissioning costs for a defined time period. In structuring the grant program, it was recognised that the research/feasibility component of the program would present the most risk to industry. Further, if industry were to purchase capital equipment, it was felt that they should maintain a reasonable

financial stake to ensure that the equipment worked properly. The intent of the program is to share the risk, not assume the risk, with industry, in developing new ideas to maximize waste diversion. It was therefore determined that for research, development or demonstration projects, the program could cover up to 100% of the eligible costs. For capital, start-up or commissioning projects, the program would match the proponent's equity in the project to a maximum of 50% of eligible costs.

Budget projections for the 5 year period commencing in the 1987/88 budget year are $9.3 million. The budget for 1987/88 was $1.0 million and for 1988/89 is $1.2 million. The actual amount of expenditures for 1987/88 was approximately $0.4 million. This amount represents projects actually established and monies actually moved by March 31, 1988 since the June 1987 start date of the program. Currently, we have commitments for a further $0.8 million. All of the dollar values mentioned are Canadian dollars (current exchange rate of approximately $1.25 Canadian to $1.00 U.S.).

Proposals are currently evaluated on a first come first served basis. The criteria used to evaluate proposals include the extent of reduction or elimination of contaminants of environmental concern, the quantity impact on the waste stream, the scope of the proposal with respect to the potential for further application in Ontario, a cost/benefit analysis, the capability of the proponent to undertake the project (both from a technical and business perspective) and the export potential for Ontario industry of new technology.

Part of the administrative details associated with every project is the requirement for the proponent to sign an agreement with the MOE. This agreement outlines the contractual aspects of the project and identifies the items for which financial assistance will be provided. One of the standard requirements included in every agreement is the necessity for the proponent to report actual rates of material diversion over a specified period, typically one year.

RESULTS OF THE PROGRAM TO DATE

Prior to discussing the results of the program, several points must be clarified. First, the definition of "hazardous waste" in Ontario is very similar to the definition used by the United States Environmental Protection Agency. The second point is that MOE has regulated "liquid industrial waste" for many years in a similar fashion to hazardous waste. For example, a solution of spent sulfuric acid with a pH of 4.0, if transported off-site from the generator, would be subject to the same requirements as hazardous waste being transported in a similar manner. This includes generator registration, manifesting, placarding if required, transport by certified

carrier and delivery to a certified receiver. For the purposes of this paper, "liquid industrial wastes" will be discussed in the same light as hazardous wastes due to the similar requirements imposed on the management of these materials in Ontario. The intent of the program is to maximize the quantities of industrial wastes diverted from disposal. This includes both hazardous and non-hazardous wastes destined for disposal to landfill, incinerator or sewer systems.

Since the program began operation almost one year ago, the following are some statistics we have been able to compile on its success to date. We have received approximately 90 formal proposals for funding with reasonable assurance that at least 10 more are forthcoming in the immediate future. We have committed to fund or are in the process of funding 35 projects, of which 21 are capital projects and 12 are demonstration/development type projects. Also, two waste exchanges, namely the Canadian Waste Materials Exchange and the Ontario Waste Exchange, are partially supported by this program.

Also important to note are the projects that do not obtain funding from this program. About 10 formally submitted projects, of the 90, as well as possibly 30 or more potential projects, have not received funding from the program. These projects typically deal with waste treatment or disposal as opposed to demonstrating a 4R component. An example would be a metal finishing operation installing an effluent treatment system that simply produced a heavy metal sludge that would require disposal.

Consider first the demonstration/development projects. Of these 12 projects, 6 are dealing with hazardous wastes and 6 are dealing with non-hazardous wastes. The commitments made to date for these projects are $0.3 million. This dollar amount represents an average MOE contribution of 75%, ranging between 60% and 100%, of eligible project costs. Projects include research of a process to recycle waste iron oxide from steelmaking operations, demonstration of a recycling venture for paper, cans and cardboard at a hospital, demonstration of a cardboard recycling project at shopping malls, investigation of the use of certain food wastes in the development of both animal feeds as well as high protein supplements for human consumption, the development of a number of industrial 4R case studies and investigation of a "zero-discharge" hide tanning operation. Although identifying actual or projected diversion rates for these projects at this time is difficult, it is expected that these rates will be significant, if these projects proceed to the establishment of facilities to divert these materials from disposal.

With regards to the funding of the 21 capital projects, 15 are for hazardous wastes and 6 are for non-hazardous wastes. The

commitments made to date for these projects are $0.8 million, of which $0.6 million is for hazardous projects and $0.2 million is for non-hazardous projects. These dollar amounts represent an average MOE contribution of 30%, ranging between 10% and 50%, of eligible costs for hazardous projects and an average MOE contribution of 25%, ranging between 15% and 50%, of eligible costs for non-hazardous projects. Some examples of the projects dealing with hazardous wastes include a number of projects in the metal finishing industry in which companies are installing equipment to recover metals rather than simply treat and dispose of metal bearing sludges, assistance for the development of mobile facilities that will recycle oils, both hydraulic and emulsified, on waste generators sites, assistance for the development of a system to collect spent solvents from small quantity generators and assistance for the development of on and off site facilities to recycle spent chlorofluorocarbons (CFCs). Some examples of the projects dealing with non-hazardous wastes include the upgrading of a corrugated cardboard recycling facility to increase its throughput, use of certain types of foundry sand in asphalt production and assistance in the establishment of a network to collect recyclable wastes from industry. To date, based on the 15 hazardous waste projects funded, we expect approximately 940 tons plus a further 2 million litres of these wastes to be diverted annually. Based on the 6 non--hazardous waste projects funded, another 42,750 tons are expected to be diverted annually through the efforts of the MOE's Industrial 4Rs Program.

The partial funding of the two waste exchanges is seen to be an important part of the MOE's strategy to maximize waste diversion. With the effective performance of these two waste exchanges, materials can be diverted from disposal and be made directly available to other industries. We anticipate that these waste exchanges can account for significant quantities of waste being diverted from disposal.

In addition to those projects currently underway, there are a further 55 projects being considered for funding, with this number increasing weekly. Of these 55 projects under review, 30 are for capital equipment purchases and 20 are dealing with hazardous wastes.

ANALYSIS OF PROGRAM RESULTS TO DATE

Although the projected diversion quantities identified above are significant in their own right, this is just the beginning. The intent of the program is that information developed be disseminated to similar industries with similar waste management problems in Ontario. This has not begun to a large extent as yet because most of these projects are only getting started and actual diversion data is just beginning to be submitted. Preliminary results from several projects have

indicated that the projected diversion rates have been met or exceeded.

As the program matures, more and more information will be obtained which will then be made available to industry. Once this information makes its way to the appropriate parties, the above numbers could pale to the actual quantities of waste diverted due to this program. Actual quantities will be, understandably, difficult to track at that point.

Subsidiary benefits of the program are the savings of virgin materials and, in almost all cases, water. In the case of virgin materials, estimates are usually provided by the proponent for material savings as well as cost savings. Savings in water consumption are sometimes provided by the proponent. In both instances, these savings are not reported in the values of waste diversion given above. Although important, the program does not generally consider funding projects where only water is conserved.

One of the fears when this program began was how industry would respond to it, being it is administered by the same agency that is responsible for enforcement actions. The response simply by the numbers of enquiries as well as the numbers of proposals received, has alleviated most of those concerns. We recognise, however, that some enquiries may never become submissions to the program because of this issue. We also recognise the need for confidentiality with industries applying to the program with respect to company name, process technology, waste management problems and so on.

We have also had discussions with a number of industries who are involved with regulatory actions (Control Orders, investigations, prosecutions) being carried out against them by the MOE. These discussions have consisted of the ways in which the program can help their particular situation, from both a financial and technical perspective.

Our efforts to date indicate that even in a strict regulatory climate where enforcement actions are occurring with more and more frequency, room exists for a cooperative industry/government approach to tackle the waste management problems of today.

If anything is to be learned from our experiences with this program, it is clear to us that industry responds to financial incentives, even if these incentives originate from an enforcement body. One very important point must be remembered; our relationship with industry did not begin overnight and neither was our program developed overnight. This program was created with a tremendous amount of thought, extensive consultation and a long history with the regulated community.

POSSIBLE FUTURE DIRECTIONS

After almost one year of operation, it is now time to evaluate and fine tune the program. We will be looking at what we have accomplished with this funding program over the past year and revising where necessary.

Certainly, the usefulness of the program to industry lies in the dissemination of the information collected by the funding of the various projects listed above. Recognising this fact, we are currently working with the Ministry's Communications Branch to determine the most effective way of distributing the valuable information developed by the program. No one means will be employed due to the different types of industries involved as well as the vastly different wastes involved. The ultimate success of this program will hinge on how well we can get this information out to those companies that can make most use of it.

As I have previously indicated, a number of similar projects have been funded within some industry sectors. Efforts are now underway to see if there is a need to proportion the yearly budget into components designated for certain industry sectors and/or wastes. Currently, as previously mentioned, we are operating on a first come first served basis, which at the present rate of proposal submission, may require the establishment of a priority ranking system in the near future.

In discussions with industry, they have indicated to us that in many cases for a project to become reality, a loan as opposed to a grant, would be sufficient. We have begun exploring this avenue and in the future, we may be able to provide a grant as well as a loan to a qualified applicant. Many details on this loan function must still be worked out prior to this becoming part of the program.

CONCLUSION

If the numbers of enquiries we receive on a daily basis are any indication, this program has identified a need that exists in industry. We have been operating this program for only one year and already we can anticipate significant diversions of waste from disposal. Looking to the future, if the message can get out to industry, and it appears to be happening, the quantities of industrial waste being diverted from disposal may fulfill our projections that 30% to 50% of Ontario's waste stream, from both industrial and municipal sources, can be diverted from disposal through the effective use of the 4Rs of waste management.

May 1988

THE NEED FOR FLEXIBLE REGULATIONS TO PROMOTE WASTE MINIMIZATION

Bill Stough
Great Lakes Waste Exchange

As a manager of a waste exchange service, I am too often frustrated to hear that a potential waste material transfer was aborted because environmental regulations would not accommodate the unique circumstances required for an exchange to occur. Waste management regulations have evolved over a relatively short time-span in North America with a primary focus on preventing future contamination sites requiring clean-up. In doing so, many regulations have inadvertantly restrained potential opportunities to reuse industrial by-products in a productive manner. With waste reduction and minimization technologies emerging as a major force in waste management policy, a critical assessment and modification of regulatory obstructions that block productive exchanges should be undertaken to make them flexible enough to protect the environment and still encourage reutlization. This effort is especially important in the United States at the present time, as Congress will begin debating the reauthorization of the Resource Conservation and Recovery Act later this summer.

SUCCESSFUL EXCHANGES DEPEND ON A DELICATE BALANCE

Before two parties are able to agree on an exchange, much has to occur that will require a delicate balance of skill and luck. In many instances, an environmental manager decides to try a waste exchange service because all other alternatives have been exhausted. This is a major feature of an informational waste exchange service; to find a market, in the form of a user, for a material that will otherwise have to be disposed of at great cost.

The waste exchange will take the description of the material and place it before a wide cross-section of potential users including manufacturers, brokers, recyclers and treatment facilities through their listings catalogue. Depending on the timing, market conditions, and other external factors, inquiries will funnel into the waste exchange seeking more specific information on the material. The waste exchange will act as a facilitator by placing the lister and inquirer in contact with each other. At this point, the waste exchange will normally exit the process and leave the two parties to negotiate the best arrangement possible.

The two parties must know a great deal more about the waste material than is normally available in the waste exchange's written description. Efforts must be made to determine the chemical properties of the material to find out if it is compatible with the intended use. The physical characteristics of the material will determine the best packaging and potential modes of transportation. The volume generated will indicate the frequency of delivery and help determine economics. Transportation options will be reviewed and an agreement reached. Other features might include issues like: will the transfer require

import/export considerations? What are the regulatory issues affecting the project? And finally, what kind of financial arrangements are acceptable? Each of these, and many more related sub-issues require intensive negotiation before a final decision to go ahead with the exchange can be agreed upon.

At any point in the process the delicate balance required to overcome the many barriers could break down because of technical, financial, or administrative problems. This is to be expected as in all other business matters - there are times when a worthy project is just not workable. In too many instances however, the transfer ultimately fails because of regulatory issues which destroy the project's economics. In this instance, waste material is destined for disposal facilities in direct contradiction to stated national goals of reusing, recovering and recycling as much waste material as possible.

REGULATION AS A WASTE MINIMIZATION BARRIER

If all regulatory issues obstructing productive exchange of waste materials could be grouped into one area, most generators would agree that "liability" would be the most comprehensive area of concern. In the United States, the way that the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund), is written and enforced, places ultimate responsibility for improper management on the generator of the hazardous waste. The concept of a hazardous waste generator's liability from the "cradle to the grave" started in 1976 when RCRA was passed into law. It gained momentum in 1980 with EPA's publication of RCRA's hazardous waste regulations and the passage of CERCLA. In 1984 RCRA was reauthorized and aggressively attacked the casual disposal of hazardous waste in landfills. In 1986, CERCLA was reauthorized and institutionalized retroactive liability for mismanagement of hazardous waste. Generators caught in Congress' regulatory attempt to quickly remedy decades of hazardous waste mismanagement are now uneasy with any program that increases the possibility of exposing them to greater liability.

Waste exchange operations are one form of waste minimization technology that realize less than their full potential because a growing number of generators view use of such options as increasing their risk of liability. Regulations that do not accommodate the "gray areas" involved in transferring a waste between two parties contribute to this problem. When a generator is faced with the choice between recycling and disposing, many choose disposal because they understand how to manage the risk associated with a landfill.

The implication of industry's fear of increased liability is manifested in many individual regulations that hinder potentially productive uses of one industry's waste by another. For instance, a common barrier under RCRA is the 90-day storage limit after which a permit to store waste is required. For many generators 90 days is not enough time to accumulate quantities of a specific material to make transportation economical. On the other hand, it is not economically justifiable for most firms to go through the costly, and time-consuming process to obtain a storage permit, or to want to face the added regulatory requirements a permitted facility must meet. Usually the generator opts for disposal effectively eliminating any potentially productive uses for that waste stream.

In the rare instance when a waste generator can find someone that can utilize their waste stream in its exact state without any intermediate treatment or reprocessing, the waste becomes, from a regulatory perspective, a raw material which offers the opportunity to substantially reduce the generator's liability. For instance, in the case of a generator of a waste acid that has found a potential user, but the user needs to add additional amounts of virgin acid to bring the waste stream up to required strength, the waste and the reuse would be covered as a hazardous waste under RCRA. The regulations interpret the act of adding virgin acid as "treating" the waste, thus both parties are subject to additional liability for reuse. In many instances this regulatory interpretation of treatment adds enough risk to detour the waste stream to a disposal facility.

FLEXIBLE APPLICATION OF REGULATIONS TO REDUCE LIABILITY

In the United States both the National Research Council (NRC), and the U.S. Office of Technology Assessment (OTA) call for flexibility in defining and regulating waste to encourage generators to use recycling, reuse and treatment options over other management options (NRC, 1985; OTA 1986). In its recent report to Congress "Serious Reduction of Hazardous Waste", OTA suggested that Congress could "reward and facilitate waste reduction by offering industry concessions from existing pollution control regulatory requirements." I believe that this concept could be expanded to include waste minimization efforts as well. A special variance or permit process should be established that would allow flexibility in such areas as additional accumulation time, or higher levels of reclamation at a lower degree of regulation.

One of the most troublesome barriers to increased reuse and recovery is when a waste stream from one company requires additional reclamation prior to reuse. If a company could receive regulatory relief when this type of reclamation occured prior to in-plant reuse much more intra-company recycling would occur. Individuals that could demonstrate that the proposed reclamation activity would not violate public health and environmental standards would then have an incentive to seek innovative methods to reduce disposal of potentially reuseable industrial by-products.

This session is devoted to identifying the "gray areas" in existing environmental regulations that act as barriers to productive reuse of industrial waste streams. Three perspectives will be presented: the legal, the industrial generator's, and the public agency's. While there are many additional perspectives to this issue, those presented at this session encompass a very broad view, and it is hoped their comments will be the start of a seriously needed international dialogue dedicated to identifying and suggesting options that will increase the reuse, reclamation, and recovery of materials that are currently sent to disposal facilities.

THE POSITION OF WASTE EXCHANGES IN CORPORATE WASTE MANAGEMENT PLANS

Faith Gavin Kuhn
Harris, Beach, Wilcox, Rubin and Levey
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When the **Resource Conservation** and Recovery Act, RCRA, was enacted in 1976, **Congress agreed** that one of the objectives of the Act was to minimize the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitution; material recovery, properly conducted recycling, reuse, and treatment.

Eight years later, in 1984, when RCRA was reauthorized by Congress, the legislators reconfirmed their commitment to encourage the reduction of hazardous waste generation via waste minimization technologies and regulations.

However, as we all know, good intentions such as hazardous waste minimization often get lost in the bureaucratic shuffle, especially when the bureaucracies involved -- Congress, EPA and Congress' research organization the Office of Technology Assessment, cannot agree on how what waste minimization is.

Amid the confusion on waste minimization are corporations with waste management plans and various regional and state waste exchanges. While the concept of a waste exchange program certainly should qualify as a form of waste minimization, the reality of the waste exchange's situation is that waste exchanges are usually a third of fourth choice for corporations as an option to implement a waste minimization program in their overall corporate hazardous waste management program.

Although several state and regional waste exchanges have been in existence since the early 80's their Rodney Dangerfield profile of "no respect" is a direct reflection our national waste minimization policy.

Further shadowing the waste exchange's image is the environmental insurance issue of joint and several liability, and the economics of using a waste exchange versus disposal costs when implementing a corporate waste management plan.

To the definition of waste minimization. While Congress has yet to specifically define the term, its research agency--the Office of Technology Assessment, which provides Congress with volumes of statistics and information on which legislation is usually based -- does define waste reduction, not waste minimization.

According to OTA, waste reduction is an in-plant practice that reduces, avoids, or eliminates the generation of hazardous waste so to reduce risks to health and the environment. I spoke with Joel Hirschhorn who is a senior associate for Congress' OTA and who has worked exclusively on the issues of waste reduction and waste minimization for several years. When I

asked Mr. Hirschhorn specifically where waste exchanges fit into the definition of OTA's waste reduction, he said that OTA does not consider waste exchanges as a form of waste reduction because waste exchanges do not actually reduce the amount of hazardous waste generated.

In fact, Hirschhorn would categorize waste exchanges as a waste treatment or disposal practice, just another waste management option because waste exchanges require handling, transporting and/or storing of hazardous wastes.

This contention that waste exchanges should be considered a waste management option rather than a form of waste minimization is probably based on the following passage from the 1984 RCRA Amendments.

"The Congress hereby declares it to be the national policy of the United States that wherever feasible, the generation of hazardous waste is to be reduced, eliminated as expeditiously as possible. Waste, nevertheless generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment."

But as it stands today, OTA would not identify waste exchanges as a form of waste reduction.

EPA has defined the term waste minimization. As defined by the EPA, waste minimization means the reduction, to the extent possible, of hazardous waste that is generated or subsequently treated, stored or disposed of. This definition does seem to offer waste exchanges a home.

Clearly, though the recent reality of the EPA's attitude toward waste exchanges and waste minimization programs is exemplified by a 1987 conversation between EPA Assistant Administrator for Solid Waste and Emergency Response J. Winston Porter and Congressman Edward Boland, Chairman of the House of Appropriations Subcommittee on HUD-Independent Agencies. During Congressional hearings before the Boland subcommittee in September 1987, the Congressman questioned EPA's request for $398,000 for the fiscal year 1988 for the EPA's waste minimization program. This $398,000 is about .03 percent of EPA's total budget of $1.5 billion. Congressman Boland noted, "the resources allocated for this program by EPA are minimal, almost non-existence... Doesn't this area deserve more money?"

Mr. Porter responded "It perhaps does. I have considered that question. It may be that we do need to have more money and more resources, but frankly, we are seeing a lot of waste minimization going on already."

Unfortunately for Mr. Porter, he did not have the opportunity to read the October 1987 report from EPA's Science Advisory Board's Environmental Engineering Committee. In this report the Science Advisory Board reviewed the EPA's Office of Research and Development's Waste Minimization Strategy.

The Science Advisory Board concluded that although a few companies and a few states have aggressively pursued waste minimization, many have not. Of note is 1987 OTA statistic that only 50 of 2,000 reports filed by waste generators in New York indicated any waste reduction efforts. The Science Advisory Board report recommends that waste minimization includes a variety of on and off-site, in-process and post generation waste management options that reduce the hazard of a waste, including waste treatment.

The report goes on to say that waste prevention, waste reduction, and source reduction all appear to be synonyms for a subset of waste minimization practices that focus on in-process practices that prevent or reduce waste generation per se. EPA, the Science Advisory Board believes, should clarify the terminology used for waste minimization.

One final note with regards to EPA's budget for its waste minimization program. Four states -- California, Illinois, North Carolina and New York have budgets for waste reduction or minimization programs greater than EPA's.

Currently and since the 1984 RCRA amendments, the EPA imposes waste minimization requirements of hazardous waste generators. But these standards only involve verifying in writing in the generator's biennial report, on their Uniform Hazardous Waste Manifest, and as part of generator's TSD permit records, that the generator has undertaken efforts to reduce the volume or quantity and toxicity of waste generated. Of note is the fact that these waste minimization reporting rules do not apply to TSD facility and are really designed to discourage landfilling of waste, a primary objective of the 1984 RCRA amendments, rather than encourage waste minimization.

These waste minimization verification rules are lite and less filling in comparison with the other heavy weight regulations covering the management of hazardous waste. From 1985 to 1986, there was a 20 percent increase in the number of federal environmental regulations, actually a total of 8,500 pages. This was the largest annual increase in history. Complying with such a thicket of regulations leaves little time, incentive and money for companies, especially smaller businesses, to develop a waste minimization program.

Also of note is the fact that the RCRA waste minimization rules do not specify or provide guidelines on how to minimize hazardous waste. Generators are only required to participate in waste reduction activities that are economically practical, which is left for each generator to determine. Such a subjective criteria may focus the generator's attention toward the direction of waste minimization but by no means offers any road map. The careless substitution of terms such as waste minimization and waste reduction in EPA's RCRA regulations are left to individual interpretation. Does waste minimization mean reduction of the generator of waste or reducing the waste that has been generated?

There are also underlying liability and financial strings attached to waste exchanges.

Briefly, as you all know, since the enactment of RCRA and Superfund, liability costs associated with waste management is a significant financial concern for any corporation. Corporations manufacturing, treating or storing any type of hazardous chemicals are accountable for their handling methods. Most corporations dealing with hazardous chemicals budget in cleanup costs and regulatory compliance costs. Waste minimization and alternative technologies such as waste exchange are not a priority compared to the money necessary to cover cleanup or regulatory compliance costs.

In addition, use of a waste exchange does not free the original generator or sell of the waste from legal liability should the waste show up as a contaminant at a disposal site. Although I could not find any case law on the issue of waste exchanges and Superfund joint and several liability, that does not mean that the potential for such liability does not exist. It is there, and as long as joint and several liability is the apportionment scheme assigned to waste mismanagement, every corporation in the waste management industry must do its best to mitigate the possibility of becoming a potentially responsible party under either the federal or their state Superfund laws.

And finally, as we all realize, the primary motivation for any corporate decision is economically based. In a financial setting where the Congressional Budget Office estimates that the annual cost to industry to manage hazardous waste will increase from $5.3 billion in 1983 to $11.2 billion in 1990 it would seem that there would be more enthusiasm for waste reduction, waste minimization - i.e. waste exchanges as a means of waste management costs. But almost all corporate waste management expenses are earmarked either for regulatory compliance for applicable treatment and/or disposal practices or Superfund cleanup costs. Astronomical costs are exactly the reason most mid-and smaller corporations that generate, treat, store or dispose of hazardous wastes cannot

afford to include waste minimization alternatives in their waste management programs. Compliance with RCRA and Superfund can be financially overwhelming, offering little if and corporate funding to explore waste minimization alternatives.

From my work with the National Association of Solvent Recyclers, I had the opportunity to view the economics of the waste recycling industry. NASR represents almost all of the solvent recyclers in the U.S. -- a total of about 60. It isn't that solvent recycling is not profitable that there are not more solvent recyclers. The solvent recycler's economic lifeline is dependent up the market of recyclable materials. Most solvent recovery facilities are within the vicinity of a highly industrialized area where recyclable material is readily available.

Waste exchanges are in an analogous situation to the solvent recycler. Both have stood up to be recognized as a form of waste minimization, both are economically tied to the market volume of wastes available and both are usually corporate financial considerations after RCRA and or Superfund expenses.

But the most important comparison is that both the solvent recyclers and the waste exchanges have been overlooked as the cornerstones to the future of the waste management industry. In a waste management industry becoming by law less dependent on disposal, the logical alternative is waste minimization.

In conclusion, and I don't mean to exclude the Canadians in the audience, I would encourage the waste exchanges as a group to seek EPA and Congressional clarification of waste minimization. Not only is RCRA again up for reauthorization, but there are two pieces of legislation -- Senate Bill 1429 and House Bill 2800 that were introduced last year to promote waste reduction. Both bills would establish a federal Office of Waste Reduction as a means of providing information and technical assistance about waste reduction. And remember, this is an election year. The entire House of Representatives, one-third of the Senate and a new Vice President and President will be elected. Elections always present opportunities, for the candidates and especially the voters. Isn't it time your elected officials heard about the waste minimization qualities of waste exchanges from you rather than Congress' own Office of Technology Assessment, who don't consider waste exchanges as a form of waste minimization?

REGULATORY BARRIERS TO WASTE EXCHANGE: A MANUFACTURING PERSPECTIVE

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ABSTRACT

The various waste streams produced in both manufacturing and the electric utility industry will be discussed in terms of their potential for reuse. These would include oils, solvents, acids/alkalis, metal sludges, plastics, dusts and paper and wood products. Primary emphasis will be on the regulatory barriers to exchange and reuse. Although RCRA and CERCLA regulations present the greatest regulatory barriers, OSHA and DOT regulations also present problems. Liability issues remain as the largest deterrent to most manufacturers.

INTRODUCTION

The title of this presentation is "Regulatory Barriers to Waste Exchange: A Manufacturer's Perspective". As the author I will take license to expand the presentation beyond the confines of its title in two directions with which I have both expertise and concern. First of all, the manufacturing perspective will include that of an electric utility. The second expansion is to focus on environmental and health related regulatory barriers to reuse whether on site, off site, or through a waste exchange. I will not discuss regulatory barriers associated with non-environmental aspects of commerce. To provide the perspective it will be necessary to provide a background, and discuss both the regulations and various reuse options available with the regulatory barriers.

The issue of reuse of waste material in the manufacturing process is not new to manufacturers, but the development of regulatory barriers is reasonably new. Manufacturers have long looked at off specification products or waste products as raw materials which, if they could be used in final product without affecting its quality, was highly desirable. Even if the waste material could not be used in their product, ready sources were found for waste reutilization e.g. either sale or donation of waste oil to municipalities for road oiling, or sale of used utility pole crossarms as landscape timbers.

With the advent of laws and regulations associated with the environmental movement of the seventies, the disposition of these wastes was more tightly controlled. Concurrently, the period was also associated with an expansive economy so the cost of virgin

materials were not substantially different than reusable wastes when transportation cost etc. were taken into account. The economics were such that the wastes could be sent to landfills reasonably inexpensively. Initially, the environmental regulations encouraged this as every waste stream had a place to go as long as the various agencies were informed either by manifest or permit. The initial cut and zeal of regulations were entirely focussed on setting regulatory barriers to improper disposal or use of wastes. It has become apparent, however that the disposal options are not infinite nor is a waste's presence in a landfill an advantage since the landfill may be poorly designed, or leaking, or endangering the public as a superfund site. We have therefore recently realized that reuse may be acceptable as long as it is not "sham recycling".

REGULATIONS OF CONCERN

It is appropriate to briefly describe some of the environmental and health regulations of concern which impact reuse. Table I summarizes the major regulatory initiatives and respective agencies which affect waste reuse in North America. The most obvious regulations affecting waste reuse are the Resource Conservation and Recovery Act (RCRA) in the United States (U. S.) and Regulation 309 in Ontario which have waste management as their agenda. Both require permits for certain activities and manifesting of hazardous wastes. The other regulations addressed in Table I also affect decisions regarding waste reuse options including waste exchange. These include the Hazardous Materials Transportation Act (HMTA) (U.S.), and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (U.S.) which regulate transportation of hazardous substances or wastes and set strict joint and several liability for superfund sites respectively. The last two initiatives do not have as obvious an impact on reuse. The Occupational Safety and Health Act (OSHA) (U. S.) sets the requirements for Material Safety Data Sheets (MSDS) that have been the basis of the "Right-to-Know movement. The Safe Drinking Water and Toxic Endorsement Act (Prop 65) (California) is a state statute that requires consumer and worker warning to potential toxic chemicals at low levels.

MANUFACTURING WASTE MANAGEMENT OPTIONS

Manufacturers are presented the same basic waste management options that are available to most operations. The on site options include chemical replacement in the process, process changes to minimize waste generation, waste reduction through improved waste treatment, reuse of the waste material in product, incineration for heat recovery, and in some cases disposal through incineration or landfilling.

TABLE II shows examples of various wastes and associated reuse options, both on site and off site. Although many options are available the criteria for which option is pursued are variable. The usual first criterion is the economic concern. Many manufacturers require a two year pay back on any internal process change or

piece of equipment. The economic concerns are adjusted by environmental regulations and the desire to minimize handling and storage of wastes. The greatest desire is to find an option which is cost effective and minimizes hassle. For example, waste acids (Table II) have many reuse options. If the manufacturer uses large quantities of acid it may be economic to purchase on site regeneration equipment. In some instances the waste acid (K062 waste) can be used in waste water treatment for phosphate removal or by a waste treatment facility to treat other waste streams. If the waste acid has unique properties, can be stored easily or another manufacturer or processor can readily use it a waste exchange is attractive. Present economic conditions are such that new acids are inexpensive making disposal an attractive option. Waste oil suffers the same economic cycles. The bottom line is that no one option is the permanent solution as economic and regulatory conditions are constantly changing.

REGULATORY BARRIERS

The major regulatory barriers to reuse or waste exchange specifically are those involving hazardous or toxic wastes. The primary barrier in this regard is RCRA or REG 309 which requires one to obtain licenses or permits if they wish to treat or store wastes and manifest all hazardous wastes which are sent off the plant premises. The most onerous aspect is the requirement to obtain permits to store hazardous wastes beyond 90 days generally, or to treat hazardous wastes. Permits cost a great deal of money in terms of engineering and legal input as well as lost production time. In addition, they open the operation to excessive outside scrutiny as many times public hearings are involved. If the permitting process were streamlined, or if more benign hazardous wastes (recognizably a paradoxical concept) were handled as a less regulated waste, most manufacturers would handle their own wastes on site. By eliminating benign hazardous wastes I mean wastes like acid or ignitable solids which clearly present less risk than asbestos or chlorinated solvents. The other option available for multifacility corporations with these benign wastes would be intracompany shipments of small quantity wastes to a central or larger facility for reuse. An example, would be acid waste streams to be regenerated where one facility, presumably the largest user of acid, would accept and regenerate other intra-company waste acids. Illegal disposal concerns would be reduced because the parent company would presumably be responsible for the individual action of its subsidiary facilities.

The "low risk" hazardous waste opportunity does presently exist to some degree for both generators and recyclers. In Ontario it exists for recyclable material and waste derived fuel (Sec. 53 and 63 of Reg 309). In the U. S. some states allow less restrictions on some reuse than others. The EPA however has proposed regulations (52 Federal Register 16982) which would severely restrict the burning of benign hazardous waste as fuel or for metal recovery.

TABLE I

REGULATORY INITIATIVES AFFECTING WASTE REUSE

Regulatory Initiative	Common Name	Activity Governed	Responsible Agency
Hazardous and Solid Waste Amendments of 1984 to the Resource Conservation and Recovery Act of 1970	HSWA or RCRA	Management of Solid and Hazardous Wastes in the United States	Environmental Protection Agency (USEPA) or Respective State Agency
Superfund Amendments and Reauthorization Act of 1986 to the Comprehensive Environmental Act of 1980	SARA or CERCLA or Superfund	Cleanup of hazardous waste sites in the United States and generator liability	Environmental Protection Agency (USEPA) or Respective State Agency
Occupational Safety and Health Act of 1971	OSHA	Workplace protection in the United States	Occupational Safety and Health Administration (OSHA) or Respective State Agency
Hazardous Materials Transportation Act of 1973	HMTA	Transportation of hazardous materials in the United States	Department of Transportation (DOT)
Regulation 309 General Waste of Environmental Protection Act of 1980	REG 309	Waste management in Ontario	Ontario Ministry of the Environment
Safe Drinking Water and Toxic Enforcement Act of 1986	PROP 65	Toxic chemical exposure in California	California Health and Welfare Agency

TABLE II
EXAMPLES OF WASTE MANAGEMENT REUSE OPTIONS

Type of Waste (examples)	On site	Off site*
Oils - Lubricating	Use as fuel	Distill for reuse
- Transformer		——**
Solvent - Halogenated	Distill for reuse	——
Non-halogenated	Use as fuel	
Acids/Alkali	Use in waste water treatment	Use in treating waste streams
Sludge - Process	Plating metal recovery	Smelt for metal recovery
- Waste Water	None	——
Dusts - Fly Ash	None	Aggregate
- Wood Dust	Use as fuel	——
Plastics/Rubber	Regrind	Incineration
Wood and Paper	None	Salvage
Off spec chem/mixtures	None	Waste Exchange
Off spec product	Repair, if possible	Waste Exchange

*All off site wastes are candidates for waste exchange.

**Solid line indicates comparable option for on site or off site.

The liability concern, while not usually as immediate a concern as costs to the plant manager, can be the biggest issue to the corporate staffs. Since CERCLA allows strict, joint and several liability for superfund sites, the idea that any company is relying on an outsider for the ultimate disposition of a hazardous waste sends tremors through the corporate headquarters. The difficulty in obtaining permits thus obviating the overwhelming desire to treat or eliminate the waste at the plant site many times makes the need to go outside the most practicable solution. Much greater emphasis is assigned the choice of whom is going to receive the waste. Generator initiated audits of hazardous waste haulers, treaters, storers, or disposers (TSDF's) have become a common place activity. The manufacturer will look for reassurance that the waste will not be mishandled especially since with manifesting he will still be liable for the waste's final disposition. These problems are especially significant when off site disposal is the only option.

Although the concerns with RCRA and CERCLA are dimished with off site reuse either from salvage sale, contracted treatment, or waste exchange, other regulatory initiatives enter. If the waste is sold or exchanged, a MSDS may have to be prepared to inform other workplaces that this waste/product is hazardous. Under OSHA regulations regarding formaldehyde exposure, for example, warning labels are required for materials containing a small fraction of formaldehyde. Such a material could be particleboard since formaldehyde is used in the adhesive. The scenario could therefore be that scrap particleboard that goes to another employer (a waste exchange, for example) must be accompanied by a specific warning. Fortunately, the Office of Management and Budget (OMB) has withdrawn those regulations for further review. Another grizzly example is that of wood dust. Since it is now listed on the OSHA Z-1 list, an MSDS may be required. Thus, its reuse as animal bedding etc. might be restricted. Once the MSDS is prepared and submitted to the purchaser, the generator may need some assurance the receiving facility is complying with the Hazard Communication provisions of OSHA and the Community Right-to-Know provisions of CERCLA. Since the MSDS is used in both regulatory schemes, it has greater significance in terms of its accuracy and thoroughness. The cost of preparing an MSDS on a changing waste stream may eliminate any cost advantage of reuse.

If the waste material can end up in the hands of a consumer the OSHA provisions do not apply but regulations such as California's Proposition 65 do apply. It requires that a warning be associated with any exposure to chemicals which can cause cancer, reproductive toxicity or birth defects. For consumers, this involves any foreseeable use of the material. If the waste contains such a chemical, very specific warnings may be necessary. This particular statute also allows citizen law suits if the local authorities don't take action. Therefore, a local electric utility that sells used utility pole crossarms as landscape timbers may have to review this practice since the crossarms are probably treated with a preservative, most likely a toxic one. Even though a warning may be placed

on a bundle of crossarms, if one neighbor gets a few from the purchaser how can the utility insure the neighbor was warned? A potential law suit exists either under a toxic tort or the provisions of Proposition 65.

CONCLUSION

A manufacturer is presented a web of contradictory regulatory initiatives all with good intent. The options to keep his wastes on site are confounded with the economic constraints of major treatment equipment and the difficulty in obtaining permits under waste management regulations. The options to send the waste offsite while relieving his immediate site concerns increase his concerns with how the waste is transported and to the economic and compliance status of the receiver. If the offsite option is for reuse through salvage sale or waste exchange, the manufacturer must investigate the MSDS and warning label implications. In addition, the manufacturer or generator should verify the receiver of hazardous waste is properly permitted and also should consider the liability of shipping and manifesting hazardous waste to an unlicensed TSDF. Since the basis of regulations appears to be focussed on casting a large enough net to catch all potential inappropriate activity, the regulations are sure to change over time. At one time onsite handling looks the most attractive while other times off site disposal is good. The ideal for the present would seem to be to minimize waste production and encourage proper reuse. A waste exchange presents advantages on finding reuse for potentially disposed material. If the waste exchange also acts as a notification clearing house to satisfy both the generator and receiver regarding the possible warning requirements and potential liability associated with improper handling, it can be an optimal solution. As I recently read in a trade journal one persons opinion is "The primary goal of business is not to make money - it is to satisfy the actual or perceived needs of customers. A profit is proof that you are successful in satisfying a need". This applies to both a manufacturer and waste exchange.

WASTE EXCHANGE: BREAKING THE BARRIERS

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Over the past 20 years, our industry, government and indeed our entire society have come to recognize that safe disposal of industrial wastes is of paramount importance to environmental protection and public health. For years, the common and accepted practice of industrial waste disposal was little more than open burning, flushing down the drain, or simply dumping raw, untreated, liquid waste into holes in the ground. Nowadays, much of this practice is not only unacceptable, it is downright illegal.

The need to properly manage our industrial wastes has led to the establishment of new governmental initiatives such as the Municipal Industrial Strategy for Abatement (MISA), and new government legislation such as Regulation 309 requiring all manufacturers in Ontario to register certain wastes with the Ministry of the Environment.

Faced with a tighter regulatory regime and ever-increasing costs for waste treatment and disposal, companies are naturally looking for waste management alternatives. If the opportunities for waste reduction were essentially ignored in previous years, many businesses, both large and small, are now taking a closer look at their manufacturing processes to determine how their wastes might be reduced, reused, recycled, or recovered.

The concept of waste exchange has also begun to attract more and more interest. Based on the old adage that "one man's waste may be another man's product", the opportunities for waste exchange are increasing rapidly as companies foresee potential economic and environmental benefits in making productive use of a waste material.

Waste exchange is clearly a very suitable form of modern industrial waste management. The waste generator cuts down on disposal problems and may even add a new source of revenue to his balance sheet, and the waste purchaser gets a usable product at a bargain price. It is not surprising then that we are beginning to see the opportunities for waste exchange rapidly expand:

- Some caustic wastes from the chemical industry are being used by the steel industry to assist in the recovery of ammonia;

- Sawdust is being formed into blocks to be used as fuel (replacing coal) for institutions such as schools, municipal offices and factories. This reduces emissions of sulfur dioxide.

- Residual chlorine is being recovered from empty gas cylinders and converted into industrial bleach to be sold to various industries;

- A sodium chlorate manufacturer is selling its waste hydrogen by-product to a neighbouring pulp mill which uses it for fuel. This reduces the mill's consumption of virgin fuel which results in the reduction of waste from the production of that fuel;

- Spent oils from industry are being re-refined and sold back to industry.

- Spent $AlCl_3$ catalyst from a chemical plant is used for phosphate removal in a sewage treatment plant.

These examples clearly demonstrate that many waste materials have significant value as reusable products. There are, however, a number of significant barriers that continue to inhibit the waste exchange potential.

Perhaps the major barrier to waste exchange is simply one of attitude. Most companies prefer to use what they consider to be "pure" or new materials in their manufacturing processes. They fail to recognize that pure materials are very seldom found in nature. In fact, many wastes may well constitute a much higher grade substance than the actual material used in the manufacturing process that generates the product that eventually ends up in these wastes.

Moreover, very few final products consist of one pure material, but are rather a conglomerate of materials. For example, steel consists of iron with a number of other materials added. We also know that plastic, steel or wood can be added to concrete to improve its properties for various uses. The question then becomes: why not add paint sludges, plating sludges, sawdust or other waste materials to help give concrete the specific character desired?

The answer is that most companies continue to view waste materials with a certain disdain, refusing to accept that many of these wastes may be as good or even better than the so-called pure materials they are using. Overcoming the attitude barrier will require further experience and education. When companies learn that they can achieve economic benefits by employing waste materials in their manufacturing process without jeopardizing the quality of the product, we will begin to see waste exchange opportunities pursued with greater vigor.

A second barrier to waste exchange pertains to the way many wastes are handled by the generators. For example, some companies continue to mix their halogenated and non-halogenated wastes together, thereby resulting in an overall waste material that may be too contaminated to be exchanged. By keeping these two waste classes separate, a company may find itself with wastes that are much more conducive to exchange, simply because two raw materials will satisfy a wider variety of uses than will just one.

The incentive to segregate various waste types is directly related to the increasing costs of disposal. As companies come to realize that their waste disposal costs can be reduced through waste segregation, we can expect them to show more interest in the potential for their wastes to be revenue generators rather than economic liabilities.

Many companies also dilute their wastes with water, a practice that probably began for reasons of process equipment cleaning and product washing, but may remain in order to meet sewer by-law regulations. However, diluting wastes significantly increases the volume of the waste and results in higher treatment costs and higher transportation costs when off-site disposal is eventually required. In addition, highly diluted wastes do not lend themselves very well to waste exchange simply because the value of a waste can be more easily recovered from a concentrated solution or mixture. The economic incentives along with the effects of MISA should cause many companies to think twice about diluting their wastes. A reduction in the practice of dilution will lead to more waste exchange opportunities.

Another barrier to waste exchange which must be considered involves the confusion and uncertainty created by a complex regulatory regime. For example, let's say Company A wants to neutralize its basic waste with Company B's acidic waste stream. However, this seems to suggest Company A must obtain a waste management license which could conceivably be a lengthy, costly and difficult bureaucratic process. Instead, Company A decides to take the path of least resistance which means using a virgin acid to neutralize its basic waste.

A similar example involves a company producing a bisulfite waste and finding a market for it as a reducing agent. This would appear to be a fairly simple waste exchange opportunity, but the deal could easily fall through because both participants in the exchange may be concerned that a waste management license will be required. If the bisulfite is wholly used (and I assume that means as wholly used as the usual bisulfite raw material) in the production process it becomes exempt as a recyclable material. If it is used in a plating company's waste treatment process to cause the precipitation of chrome for removal, it would seem that the bisulfite cannot be called a recyclable material. Perhaps it should be marketed simply as a product reducing agent (that only becomes a waste if no one buys it--at any price).

The problems here pertain to a basic question: When is a waste not really a waste? If Companies A and B agree that Company B's acid is not an industrial waste, but rather a valuable by-product, it would appear that no waste management license would be required. But to be on the safe side, they decide to inform the Ministry of the Environment of the details of their arrangement with the hope that the Ministry will concur.

In view of the fact that the MOE is a strong advocate and promoter of waste reduction, recycling and exchange, it would appear to be in the Ministry's best interest to have these types of problems suitably resolved. In all likelihood, a permanent resolution would require further amendments to Regulation 309 making it easier for companies to pursue waste exchange opportunities without becoming entangled in a difficult bureaucratic and regulatory process.

While all of the barriers mentioned above are significant factors that may prevent waste exchange from realizing its full potential, there is still every reason to believe that these barriers can be overcome. Waste exchange is still a relatively new concept in the minds of most industrial operators. There is a great deal more information to be learned about the potential uses of many industrial wastes, and the indications are that these uses may be practically limitless.

Increasing the opportunities for waste exchange will ultimately depend upon the net economic benefits that can accrue to industry and the environmental benefits that will naturally result. In other words, waste exchange is an idea in which both government and industry have a vested interest. It will no doubt take the participation and cooperation of both parties to ensure that waste exchange becomes an expanding and enduring component in Ontario's overall waste management system.

OIL RECOVERY

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Retek Resource Recovery Inc. has a provisional certificate of approval from the Ontario Ministry of the Environment for the operation of a oil recovery facility. In addition to the certificate Retek is also recognized as a Waste Water Treatment facility Class IV. Recovery has been defined as the processing of waste to reclaim a material. Retek uses physical and chemical treatment methods to process waste materials that contain oil. Retek recovers the oil from the waste and treats the resulting effluent to meet the criteria for discharge to the sanitary sewer. Any solids that are separated in the process are disposed of in either secure or sanitary landfill. When possible Retek minimizes the processing cost by the use of selected waste streams in the treatment process.

The presentation will discuss the recovery operation at Retek, detailing the benefits and limitations of the different treatment technologies used in the recovery of oil from waste materials. The presentation will highlight how the presence of trace contaminents increase processing costs and reduce the possibility for the recovery of the waste material.

RETEK RESOURCE RECOVERY INC.

John Rocchi

SAFE RECOVERY OF SOLVENTS BY CONDUCTIVITY HEAT TRANSFER

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ABSTRACT

Solvents can be distilled in-house safely and efficiently by manufacturers using a few hundred gallons or only a few gallons per hour.

Such solvents are not just the low-boilers (i.e. degreasing solvents), but also the high-boilers (i.e. ketones, aromatics, alcohols).

Economics remains the major advantage of in-house solvent recovery. Yields and repetitive recovery rate 85-95%. Imagine reprocessing a 55-gallon drum of contaminated solvent and reclaiming 50 gallons into excellent, pure solvent for immediate re-use.

Secondly, the hazardous discharge liability is reduced dramatically with in-house reclaiming.

Proven technology has developed into batch and continuous feed distillation equipment now conventionally available and in use in hundreds of industrial applications.

This technology will be evaluated in its proven form and present in-house solvent distillation cases on a before and after basis.

KEY WORD INDEX

hazardous waste
contaminated solvent
batch distillation
conductivity heat transfer
indirect heat transfer
reclamation
volatiles
residue/bottoms

INTRODUCTION

This paper discusses today's batch distillation process of recycling contaminated solvents as it has evolved from earlier methods. Explanation of the process and equipment as well as case studies are included. This paper illustrates the necessity for in-house recycling of contaminated solvents and the viability of this alternative to hazardous waste disposal.

TEXT

Prices of solvents have increased, and will continue to increase dramatically, since the early 1980's. Legislation by federal and state governments have given "cradle to grave" responsibility to users of industrial solvents thereby causing cost of disposal to sky rocket. Solvents are essential to industrial processes, thus causing higher and higher costs of goods sold.

In order to cope with these ever increasing purchase costs and expense liability of disposal, hundreds of companies have opted to reclaim their contaminated solvents in-house.

True solvent reclamation is achieved by distillation, not by mere filtering. Filtration alone may extend a solvent's life for a limited time. By removing particles such as metal shavings, dirt, etc., it can produce a reusable although not pure solvent. Typically, parts washers come with a built-in filtering system to allow multiple uses of the solvent before a change is necessary. But filtration cannot extend its life indefinitely.

Distillation can return cleaning solvents to their original performance by removing all contamination, both suspended and dissolved. However, fractional distillation systems for breaking down solvents into their original components are expensive and not normally practical or necessary for reclaiming solvent for cleaning purposes.

Simple distillation units can reclaim both single and multiple component solvents. With multiple component solvents, composition may change due to evaporation during use. Normally, this will have little or no effect on utility of the distilled solvent because all properties necessary for cleaning are retained.

This article discusses solvent recovery with simple batch, package units. Equipment of varying capacities is readily available from several manufacturers, allowing the convenience of an in-house operation while substantially reducing both cost and hazardous waste disposal.

Distillation systems have not always been economically feasible for a business generating small quantities of waste solvent. One reason was that it was very expensive to design and manufacture a "safe" unit.

Underwriter's Laboratories states, "The maximum acceptable temperature for external surface of the heater for Class I, Group D shall be 365^{O}F" (Book UL823). This is by far the most important safety design aspect of a small distillation unit. Prior techniques used bayonet-type heaters immersed into a heat transfer fluid that in mis-operation could be disastrous and ultimately result in degradation of the fluid.

With small package batch distillation systems now available, electric heaters are cast into a heavy aluminum disc in the bottom of the distillation pot whose wall is also aluminum. Thus, the vessel is essentially a single-piece of aluminum. The aluminum conducts the heat throughout the very thick bottom and up the walls in the contaminated solvent, transferring heat from almost all directions. The very thick cast bottom of this vessel and the cast-in thermowells with redundant temperature controllers prevent the temperature from exceeding 350°F. Also, it is absolutely necessary that the remainder of the unit be explosion-proof. This means full compliance with Class I, Division 1, Group D of the National Electric Code. This adds some strict, difficult and costly requirements such as rigid conduits, special heavy electrical boxes, potted fittings, etc.

Many common and relatively inexpensive solvents such as mineral spirits boil at temperatures in excess of 365°F. Thus, they cannot be reclaimed "safely" (in compliance with UL) with a conventional unit of this type. To satisfy this need, a vacuum system attachment can be provided to allow distillation to occur at less than 365°F.

A secondary characteristic of this type system is the ability to solidify distillation residue/bottoms. By evaporating and recovering all volatiles, a solid or semi-solid residue is left that can meet RCRA landfill criteria. The process can recover volatiles from clean up and mask-wash solvents, paint (including off-specification paint), spray booth sludges, and similar organic types of waste. It can also be used to purify vapor degreasing solvent.

Small-scale solvent recovery systems have evolved from conventional batch stills which required considerable effort in removing sludge and still bottoms. The evolution to a plastic disposable liner bag system was a clear step forward. In this process, a bag of high-temperature stabilized nylon film is inserted into the still to contain all solvent and residue. Solid, paste or liquid residues can then be removed simply by lifting out the bag.

An alternative to the liner bag feature is available with the introduction of small-batch solvent recovery units with a Teflon-coated boiling vessel. The residue remains behind in the pan and is easily removed by lifting out the pan.

For small batch distillation (15-55 gallons per shift), the boiling vessel is heated via electric heating coils encapsulated in the cast floor of the all-aluminum vessel. For large batch (or continuous) distillation (30-80 gallons per hour), a steam-heated jacket surrounds the distillation chamber. In either case, vaporized solvent is condensed in a water-cooled heat exchanger and collected in a receiving drum.

In-house solvent recovery by batch distillation is rapidly gaining favor. Not only have prices of solvents increased

dramatically, but disposal costs have accelerated as well. In some states, it is almost impossible to dispose of used solvents due to the lack of hazardous waste disposal sites.

Equipment available for less than $8,500 can recover about 15 gallons per shift. Such operations typically require a half hour of semi-skilled labor per shift and use 7-10¢ of electricity per gallon processed. When solvent cost plus disposal cost is considered, payback can be less than one year, even for single shift operations.

CASE STUDIES:

1. Degreasing Solvents

   Following punching, welding and grinding of sheet and reinforcing steel in the manufacture of custom-built luminaries, a Pennsylvania company employed a degreaser for removal of surface oil.

   Solvent prices were rising, and disposal of dirty solvent as hazardous material cost $90/drum. The once-through system for solvent use was proving too expensive.

   Handcrafted workmanship is of a high order and use of dirty solvents in the degreaser, which leave a residue on the product, cannot be tolerated. They decided to find an alternate to adding new solvent to the degreaser every time a recharge was necessary.

   Opting for in-house reclaiming, they installed a 15-gallon batch still, which separates the volatile solvent from the oil picked up in the degreaser. Distilled solvent is collected in a drum for reuse, and the oil is retained as residue.

   In the first year of operation, this Pennsylvania company experienced a reduction of more than 90% in new solvent purchase and also found reuse for the residual oil. Payback time also was approximately one year.

   A one-shift, 15-gallon batch daily distillation permits emptying the 160-gallon degreaser as often as once every two weeks. With light contamination, this may be extended to once every 30 days.

2. Coating Manufacturers

   Solvent recovery has been a necessary part of operations at a varnish company in Indiana. The plant needs to recover about 500 gallons/day of a mixture of virtually all types of organic solvents:

   - Ketone, methyl ethyl ketone (MEK), methyl isobutyl ketone

(MIBK), and acetone comprise roughly half the total.

- Aliphatic and aromatic solvents such as toluene, xylene, heptane, and naphtha account for about 35% of the solvent mixture.

- Glycol, ethers, and alcohols represent the remaining solvent load.

This mixture of solvents has been calculated to cost approximately $2.16/gallon.

The spent solvent needs to be treated primarily to remove accumulated water, and also to extract small amounts of pigment and other high boiling impurities. They had employed an extraction/recovery still that could process up to 30 gallons/hour; however, it required too high an operator skill level for the still to be economical.

Since the solvent was both too costly and too hazardous to discard, the plant contracted to have the spent solvent treated and returned. Along with the high cost, the purified solvent that was returned was of lower quality because the contractor would mix it with other solvent wastes before treatment. After investigating possible alternatives, a sample of the contaminated solvent was presented to a recovery still manufacturer for a feasibility determination. The results were favorable and warranted installation of an automated 500 gallons/shift solvent distillation and recovery unit.

The solvent recovery equipment employs differential heat transfer technology. This is achieved by indirect heating through a jacket having bands of steam coils. By controlling the fluid level, temperature and viscosity, the solvent is separated by vaporization and is subsequently recondensed for recovery.

Contaminated solvents are collected in drums and unloaded into a holding tank prior to treatment. The solvent distillation unit automatically feeds from the tank. Continuous internal mixing and scraping in the distillation boiler keeps the feed in suspension and prevents residue buildup. The purified solvent is gravity discharged into a collection tank.

The automatic operation was an important deciding factor for the plant. Not only does it circumvent the problem of insufficient operator skill level, but it allows the person responsible for the unit's operation to do other functions; he performs the necessary material handling operations such as collection of contaminated solvent drums.

The recovery still was installed in January 1982 and has been operating with no major difficulties.

The unit is operated during one shift each day, reclaiming about 400-500 gallons of solvent and producing about one drum of still bottoms. According to daily logs, the cost of recovery has been $0.30-0.50/gallon compared to $1.05/gallon charged for contract work. The payback period, based on these figures and including equipment and labor considerations, is estimated to be under two years.

Maintenance and operator requirements have been minimal. When the recorded solvent output level drops, the unit is washed (to clean heat transfer surfaces) and the scrapers are replaced.

The distillation unit has satisfactorily processed the spent solvents to an acceptable purity level. Analytical testing of the recovered solvents by gas chromatography has shown that the water content is less than 1% (no water peak detected).

3. Silk Screen Decorators

Early in 1982, a New England company saw a need to improve their screen cleaning process.

The existing system utilized a totally exhausted booth into which a hose washed down the contaminated silk screens. This not only created a liquid waste, but also vented thousands of dollars a year into the atmosphere. Their first step to improve the process and save money was to install an automatic screen washer. This washer is totally enclosed allowing no vapors to atmosphere during the cleaning process. The equipment saves 200 gallons per day of an extremely volatile MEK while extending its life up to 5 times before it needs changing.

Now having improved the washing process, a short time later a solvent still was purchased to reuse the waste solvent. Fifteen gallons are processed in a batch and the still is operated on a one or two shift basis daily.

The purchase price for new MEK is $2.27 per gallon and the yield for the still is between 13-14 gallons per batch.

The distillation unit paid for itself with 6 months and has been updated to incorporate new Teflon technology outlined earlier.

CONCLUSION

In order to continue using necessary solvents in their processes, manufacturers and their suppliers must reprocess them to reduce costs and eliminate wastes. The preferred method from a quality and cost standpoint is indirect heat transfer solvent distillation.

CLEANING AND SEPARATING TECHNOLOGY FOR MIXED POST-CONSUMER PLASTICS ONTARIO

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Reflex Polymer Mining Inc.

The first part of my career in plastics had to do with the development of structural composites, both rigid and flexible. These were used as membranes and cladding materials for inflatable and tensile structures. At that time, Janet, who is my wife, accused me of wanting to cover the world in plastic. My current passion is the recovery and re-use of post-consumer plastics which would otherwise end up in landfill. Notwithstanding the direction of my current work, Janet still accuses me of wanting to cover the world in plastic. And she's probably right.

The goal of environmental harmony is not inconsistent with growth in the use of plastics, provided we all take a responsible view, and map out strategies which address the consequences of our actions. If plastics were gold there would be none in land-fill. The major resin producers have been conspiring to make this absurdity a reality by practicing alchemy in the marketplace. Bouyant prices, and shortages of supply in some prime and most secondary materials, are setting the stage for viable and even alarmingly profitable recovery scenarios from curbside to garbage dump. I think the time has finally arrived for us garbage pickers.

The route that led me to addressing the problem of post-consumer plastics recovery began about eight years ago when I became a marketer of secondary plastic materials; buying in North America and selling in the off-shore markets, primarily in Eurpoe. In my travels there, I was amazed to find that there were small operators who collected plastics from municipal and industrial garbage, and having washed it, sold it to small manufacturers for a life-sustaining income. Their only tools were a tiny truck, a brush and water hose, but they were very knowledgeable in a non-technical way about their products; having an uncanny ability to identify by type and even processing grade, by the tear-chew-break and burn method. Plastic has this mystical ability to release information when you input energy. It talks to you.

On the other end of the spectrum, I discovered there were serious commercial installations to recover plastics, metals and paper from mixed wastes, and from that point on, I was hooked.

Some of the projects I have worked on since that time include Becker's milk bottles, creating a mouldable polypropylene alloy from PP/PE laminate diaper wrap by fusing it with equally unprocessable wet polypropylene powder; recovery of colour concentrates and processing aids from resin pre-mixes; recovery of ABS of good purity from telephone casings; recovery of PVC wire and cable compounds from metals and other polymer contaminants; and various multi-component recoveries from intermixed polymers.

Early this year, Ron Hayter of SPI asked me if I would be interested in playing with post-consumer plastics collected at curbside in a pilot project from Niagara region. I jumped at the opportunity as I felt it was a particularly challenging one, cognizant of the scale, potential and environmental impact of such a project should it prove to be successful.

The citeria I established were to recover as many polymer streams with compatible processing characteristics as possible, while removing residual contaminants such as food

waste, dirt, paper, foils and foams. The first attempts were unqualified failures using conventional washing and sink-float separators, but at the same time, very instructive in formulating a model for a future system. This information materialised in a bench-scale prototype which I demonstrated at SPI last summer. The initial treatment of the pre-granulated intermixed waste occurs in an abrasive washer-separator in which de-greasers and reagents interact with the contaminated materials, and undesirable adherants to these materials are mechanically removed. The cleaned olefins are floated off, and the "over one" polymer fraction, together with paper, foil and other contaminants are removed from the bottom of the chamber. The liquid media are filtered and re-used in a loop. From the descending fraction, PS and SAN are recovered in a separation vessel, and the remaining sludge with small amounts of PVC and PET is discarded. The olefin group of which hard post-consumer plastics mostly consists is fed into sequential separation vessels where three streams are recovered. These are HDPE, and MDPE and PP. In terms of total proportions, a number of trials have established the following:

Total Recoverable Polymers	90%
Consisting of	52% HDPE
	24% L/MDPE
	21% PP
	3% PS/SAN

Some evaluations were carried out at C-I-L on the recovered olefins. I would like to read the text of the accompanying letter from Dr. Eagles, Manager of Research and Technology and C-I-L's Plastics Technical Centre.

Some further tests have shown that efficient recoveries are possible from lube-oil bottles and flexible packaging materials, primarily carrying sacs and garbage bags from post-consumer and land-fill sources.

I am working actively towards the goal of establishing a commercial facility with a capability of 20,000 tons per annum and a projected start-up cost of five to seven million dollars. To this end, I am engaged in discussions with the Ontario Environment Ministry to obtain development funding for the project and am also exploring private investment opportunities.

Thank you for your time and this opportunity to address you.

SUCCESSFULLY MANAGING USED OIL

Bob Hollins
Heritage Environmental Services, Inc.

In the past two or three years the U.S. EPA has made changes in regulations affecting used oils. The majority of the regulations directly affect the recycler and end user. Indirectly, though, the generator is affected because he is limited in the types of uses to which the oil may go. For example, at one time oil was used as a dust suppressant on unpaved roads. While this was considered a legitimate use at the time, today this is not a legitimate use. These restrictions on the end use make it virtually impossible for the generator to do anything legally except go to a legitimate recycler with his oil. It is with this in mind that I approach the management of used oil through the use of a waste exchange.

In order for the generator to make the best possible use of the waste exchange there are certain things that a generator needs to know. First, he needs to know how to handle the oil within his own facility and how certain practices affect the marketability of his oil. Secondly, he must realize that a used oil company advertising in or getting the generator's name from a waste exchange has not been screened by that waste exchange. It is the responsibility of the generator to be convinced that his oil will be handled properly. In other words, he has to manage the oils off-site as well as on-site. Prior to considering these two areas, though, comes the process of determining that all possible reductions in used oil generation have been made.

The areas of collection, in-house movement, and storage of the used oils need to be considered. It is extremely important that the oils not be contaminated. The mixing of chemicals, solvents, water, or other materials with the oil can become a costly mistake. Keep all containers which are used for collecting or storing used oil covered at all times. Also, make sure they are readily identifiable as used oil containers. This will help prevent accidental contamination. When storing and transporting inside the facility, make sure that all containers are properly secured.

In my opinion, there are two key elements in carrying out a successful used oil management program. First, having a specific, well defined area for handling used oil is imperative. Second, the responsibility for actually handling the oil at the facility should fall to certain selected individuals. These two things will, more than anything, help prevent accidents and product contamination.

The truly successful oil management program doesn't stop here, though. It follows through to the disposal of the oil as well. All of the careful on-site policies have in a sense been wasted if a proper recycler is not selected. Some criteria to be used in selecting an oil recycling facility is the same as for selecting a TSD facility for hazardous waste.

This criteria can be seen in the following outline:

I. General requirements to qualify a service

   A. Permits and insurance

      1. EPA ID number to transport, store or dispose of the waste

      2. General liability vs pollution or environmental insurance

   B. References

      1. From other generators with similar needs, job scopes, etc.

      2. From federal, state, or municipal agencies

   C. Technical support

      1. Compliance with current EPA and state regulation

      2. On-going regulatory awareness

      3. Interpretation and consultation where applicable

      4. Service representation

   D. Visual inspection

      1. General housekeeping

      2. Inspection reports

   E. Develop contract or agreement

      1. Copy of standard pricing

      2. Copy of services provided, as well as those subcontracted

      3. Establish a working time frame

From this outline, I would like to emphasize a few items. First, make sure the company has all the proper permits to do

what he does. Anyone can get an EPA ID number. Also, it is extremely important that the recycler have proper insurance. General liability insurance will not cover an accidental spill. Proper environmental insurance must be purchased by the recycler to cover this type of occurrence. Make sure the limits of this policy are high enough to cover your needs.

Another area that is extremely helpful in selecting an oil recycler is a personal visit to the facility for an inspection. Make sure the oil handling area is kept clean and that the oil is handled properly. Find out the disposal method for the waste products removed from the oil. The two main waste products are sludge and water. Make sure their disposal is handled in a timely and proper manner.

Once the generator has these issues, as well as any other questions he may have answered to his satisfaction, an agreement between the two parties is the next step. Make sure the areas of pricing, services provided, and when the work is to be performed are covered in the agreement.

I believe this information will give a generator the foundation to properly evaluate the ability of an oil company to properly handle his oil. As I stated before, a waste exchange cannot screen a company using their publication. Therefore, we need to remember that it is ultimately the responsibility of the generator to make sure his oil is being handled properly.

Now that we have this foundation, let's look at how to use this information to make better use of the waste exchange. The main way this will help the generator is that it enables him to talk to a recycler on a more informed basis. It allows him to ask the proper questions and determine if he is getting the proper response to these questions. By being informed, any transaction that takes place is more likely to be satisfactory to all concerned.

WASTE EXCHANGE WORKS: SUCCESS STORIES

Mary A. McDaniel
Southeast Waste Exchange

You can put your waste products to work.

Not everyone sends waste products to the dump. Some companies sell their industrial by-products. Other companies want them. More and more businesses are recycling because it makes good economic sense.

Waste Exchanges operate as **information clearinghouses** and as such, provide information, education, and research services to industries that want to develop safe, economical waste management strategies.

If your company generates industrial waste, a Waste Exchange can put you in touch with potential users for your surpluses and by-products. If your company is looking for waste management services, an Exchange will help you find the services best suited to you.

Stringent regulations, liability issues and increasing disposal costs now demand that waste generators look for waste management options. Waste Exchange offers an excellent solution to this challenge. Instead of investing hundreds and thousands of dollars in waste disposal, businesses around the world are economizing by recycling their wastes.

For example, the textile industry produces a number of waste products which can be recycled through waste exchange. To site some specific examples from the textile industry that have occurred through the Southeast Waste Exchange:

- 6,000,000 pounds of polyethylene were sold by a textile company for an annual cost benefit of $240,000
- wooden pallets were sold for $300 for use by another company
- 425 plastic barrels were sold for $1,700
- the ongoing sale of 6,000 pounds of textile remnants earns one company $20,700 a year
- 144,000 gallons of toluene sold for $7,200 a year and saves the generator $21,600 in disposal costs

Each industry has its own waste management challenges and its own markets for recycled materials. Waste Exchanges help industries of all sizes and kinds to manage their wastes safely, efficiently and productively. Isn't it time your wastes started earning their keep?

RECYCLING OF NON-TRADITIONAL WASTE STREAMS
WHAT NEXT?

Allen Fracassi, Philip Environmental Group
Romeo Palombella, P.Eng., Hamilton-Wentworth Region

1. INTRODUCTION

There are a number of relatively new terms that are becoming a more common part of our everyday business language and communications, that require serious deliberation by executives in both the private and public sectors. All administrators responsible for environmental affairs and plant operations are already familiar with, or should quickly become familiar with, the following subjects and their implications:

-Regulation 309
-Spills Bill
-MISA
-Transportation of Dangerous Goods
-Regulation 308
-Special Wastes
-Perpetual Care
-Environmental Protection Act
-Environmental Assessment Act
-Due Diligence
-Environmental Auditing
-Risk Assessment
-Contingency Planning and Emergency Response
-Liability Exposure
-Risk Management and Control
-Insurability
-Workplace Health and Safety
-Right to know Legislation
-Research and Development
-Operational Efficiency
-Profit/Loss Statements
-Corporate Responsibility
-Corporate Image
-Community Relations

The foregoing list is certainly not complete and it touches only superficially upon key issues of special interest; a much more extensive

network of detailed sub-sets can be developed readily from each item for a more detailed representation of these important concerns.
It is understandably essential for managers to be accurately informed of their obligations and options, and to have available to them the best possible advice, and most effective resources available, for the performance of their work. The long-term economic success of companies, and the effective protection of the environment is affected significantly by the daily decisions of middle and senior management.

2. BACKGROUND

Public attitudes are becoming more resistant to archaic and unsafe practices of waste disposal and untidy environmental housekeeping, while regulatory and approvals processes become increasingly stringent and complex. Environmental management practices by industry and government, and the waste disposal industry in particular, have become a focus of unfair, though perhaps not undeserved, criticism. The exposure provided to Love Canal and similar sites in the last decade, and the emerging environmental consciousness of the public and special interest groups have all served to place prominent emphasis on the need to practise effective environmental conduct.

It is evident that past industrialization, population growth, and the proliferation of numerous new household, commercial and industrial goods were subsidized by means of inexpensive waste disposal, at the expense of the environment. It has also become evident that, as the environment suffers, so does the quality of life within that environment. However,it is possible to systematically and progressively eliminate poisonous discharges to our land, waters, and atmosphere, and to stem the irresponsible discard of useful materials in pursuing the short-term convenience and false economy of virgin raw resources.

When considering improved environmental management measures, the matter of costs is questioned immediately. It is a commonly held perspective that it is very costly to apply improved pollution control and waste disposal methods. However, this is not an accurate representation. Improved environmental and waste control does not consist simply of increased contaminants removal and better disposal measures. It is important to refer to the 4R's which the Ministry of the Environment has promoted for several years;

-Waste Reduction
-Reuse
-Recycling
-Reclamation

If it appears that the cost/benefit ledger, or market competitiveness of a firm may be compromised by more effective environmental management, it is necessary to evaluate properly the different technologies and services that can be applied to achieve this objective. A knowledgeable and experienced approach to developing appropriate environmental measures, consistent with the 4R's, can often provide desired results with minimum short-term cost impact, while improving the subsequent long-term financial performance of an operation.

Properly directed research and development can devise means of reducing or

eliminating waste products by modifying front end industrial processes. The waste of materials and energy, and their attendant costs, can also be cut by implementing closed-loop operations wherever feasible, or by taking advantage of materials and processes which can benefit from internal recycling and reuse. In this manner, the capital and operating costs of accessory pollution controls, and the resulting disposal costs of the generated wastes, can be minimized.

3. PAST PRACTICES

The development and operation of environmental management systems was traditionally assigned a relatively low priority in the overall scheme of industrial and municipal programs. Waste disposal sites, often justifiably designated "dumps", were usually situated on the outskirts of a town or city, close enough for convenient haulage, but distant enough to avoid creating an obvious public nuisance. Dumps developed almost at random, with garbage being deposited in areas that were considered useless or non-productive. Such areas included swamps, gravel pits and quarries, and less frequently, stream banks, where refuse would be "washed" away. In this manner, two objectives were met: waste disposal was carried out inexpensively, while non-productive areas could be filled and graded to accommodate industrial or recreational activities.

Often there was little or no regulation to control open dumping, resulting in obvious problems such as increased rodent and insect populations, scattered litter, odours, and fire and smoke. In some cases intentional open burning was practised to extend the useful life of a site of limited size. Fires were also caused by smoldering waste delivered to the site, or by vandals who deliberately ignited exposed garbage. The result of this practice was usually predictable; the burning of damp garbage, often containing tires, created clouds of black smoke that could be seen for miles, with attendant fallout of black particulate matter in the immediate vicinity. Also, there was the constant danger that the fire might spread out of control. The nature of wastes that were permitted for disposal was also generally unregulated. With the exception of local disposal restrictions on flammable and explosive materials, all classes of liquid and industrial waste were deposited at municipal sites, and on many private company lands.

Similarly, waste discharges to sewers and surface waters often proceeded unchecked, unless they resulted in blatantly offensive impacts, such as public health dangers, extreme nuisance and significant environmental deterioration.

Past practices were generally not a result of negligence or intentional irresponsible management; the accepted methods at that time were considered to be adequate. These practices continued due to lack of awareness of potential environmental impacts on the part of regulatory and operating agencies, as well as the general public.

4. A CURRENT AWARENESS

The urban growth,increased industrialization, and affluence of the 1950's and 1960's began to take effect. Per capita waste generation rates escalated, accelerated by increasing populations. Intensive industrial expansion added further to the quantity and diversity of wastes. Many small dumps grew into

large mountains of garbage and the varieties of substances entering sewers increased geometrically. All these factors were further compounded by urban expansion, as new building developments approached, and in some cases surrounded dumpsites that had existed for 30 years or more.

Eventually, the law of mass balance was manifested. Wastes entering disposal sites generated products which mixed with infiltrated surface water. The principal outflows were leachate, the combined result of decomposing waste and surface infiltration, and methane gas, formed by the anaerobic decomposition of putrescible materials. Leachate consists of numerous elements, including the products of decomposition, complex chemical reactions and soluble or liquid wastes draining out of the garbage mass. Traces of persistent toxic materials spread far afield and were being detected in the remote regions of the earth. It is now apparent that many methods traditionally selected for waste disposal were, by present engineering standards, at least partly inappropriate. The high water table in wetlands saturates deposited waste and distributes leachate to surface and groundwaters. The porous beds and fissures characteristic of unlined pits and quarries provide ready paths for leachate flow into the groundwater regime, increasing the potential for contamination of underground water supplies. Methane gas from refuse buried below grade in quarries also travels along horizontal rock strata,and there are documented incidents where explosions have occurred in buildings located near garbage disposal sites. It was apparent that the environment did not have an infinite capacity to assimilate man-made wastes..

5. CONTEMPORARY STANDARDS

One of the most significant turning points on the Ontario Environmental management scene occurred in the late 1960's. Prior to this time, practices in the Province were regulated mainly under the jurisdiction of the Ontario Ministry of Health, with supplementary legislation provided by local municipal by-laws. These controls, however, did not specify operating standards, but were in place to deal with health hazards or reported complaints of nuisance.

The responsibility for environmental management was transferred among a number of Provincial ministries from 1968 to 1972, when it was finally assigned to the Ontario Ministry of the Environment. This latter measure initiated the development of guidelines and regulations for modern environmental practices, which have never been pursued so actively, sincerely and constructively as they are today.

6. TRENDS IN GENERATION AND REGULATION

There are two imminent major regulatory changes which will result in a significant improvement in environmental management, while simultaneously increasing the amount of special or hazardous wastes requiring safe handling, treatment and disposal. In the first change, the implementation of a full-fledged MISA program (Municipal-Industrial Strategy for Abatement) will enact enforceable standards to control the loadings permissible in discharges to water bodies, and will set standards for sewer effluent as a means of eliminating persistent toxic chemicals in our rivers and lakes.
With this activity,the Ministry of the Environment is directing active efforts towards operations which discharge wastes to watercourses and sewer systems.

These parties will be required to effect adequate pre-treatment measures, as required to meet designated discharge standards. In the second change, revisions to Reglation 308 to be phased in over 5 to 10 years, will impose stringent controls on industrial atmospheric emissions. Compliance with this new statute is expected to generate significant quantities of scrubber wastes that must be directed to appropriate treatment or disposal.

Available statistics indicate that the amount of waste generated annually in Ontario under Regulation 309 classifications is in the order of 6.5 million tonnes. Of this amount, approximately 5.3 million tonnes were disposed of within the generators' properties or facilities, while approximately 1.2 million tonnes were directed to off-site disposal, in 1987.

At the present time, between 50 and 60 new Regulation 309 registrations are submitted to the Ministry weekly, rapidly inflating the 25,000 registered streams which are certified already. To further emphasize the urgency for improved waste control, data obtained as a result of Regulation 309 registrations notes that more than 1 million tonnes of regulated wastes were discharged to sewers in 1986.

In the preparation of a partial solution in this regard, the Ontario Waste Management Corporation is steadily moving towards the development of a system that will provide for the safe and effective treatment and final disposal of hazardous wastes. However, the Ontario Waste Management Corporation also stresses that the preferred front-line strategy for hazardous waste control subscribes to the Ministry of Environment 4R philosophy. This objective is already being met in many sectors with the assistance of a broad range of resources which are directed towards this effort, in particular the Ontario Waste Exchange and the Canadian Waste Materials Exchange.

7. STRATEGIES AND SOLUTIONS

The title of this presentation, WHAT NEXT? is a question directed at waste generators, public agencies, and the public at large. In assisting the waste management industry to develop and present the range of capabilities available to address environmental requirements, generators and regulators are asked to present their needs for the application of suitable existing solutions or the development of innovative measures.

A firm such as the Philip Environmental Group is structured to provide a total environmental management service to industry and the public on a regional basis. During the last decade, perspectives related to this type of service have matured from early cynical attitudes to the current recognition of the integral and essential role of adequate waste management for the present and for the future.

It is clear that the various initiatives which have evolved from external and regulatory influences, and from within industry, have resulted in escalating treatment and disposal costs. In response, the status and strategies related to industrial waste management have progressed to a level of high standards demanding the application of complex and well-managed scientific principles and engineering skills.

Initial forays into the new sphere of more challenging environmental requirements encountered increasing expenses, which generated a more attentive focus on the 4R's.

Most major firms have the capability of designing and applying an effective waste management program, supplemented with the 4R's philosophy, by using their internal resources. By reducing waste, these and smaller industries have often realized significant operating and material cost reductions. The net annual financial benefit to firms in Ontario that have actively embraced the 4R concept is in the order of at least hundreds of millions of dollars, and probably in the realm of billions of dollars.

Due to their considerable scale of operations, large industries can usually be almost totally self-sufficient in their requirements for environmental management development and operation, although outside resources are frequently retained for intermittent but regular special services, or for intermediate term support and assistance. The most basic activities of recycling and reuse are readily applied by the larger firms which can assure consistency of supply to their by-product markets, while maintaining acceptable quality control, product price level, and stable market outlets. However, the high capital and development costs associated with the design, installation and operation of waste processing and recycling systems often limit the exclusive availability of such facilities to the larger corporations. But, it is important to note that even the corporate giants require some level of ongoing participation with service firms that can provide a broad range of competent and dependable expertise and assistance.

To meet this need for industry in general, firms such as the Philip Environmental Group have developed a range of services and facilities to accommodate readily any routine waste management requirement, with the additional ability to design, establish and operate custom processes for more specialized or non-routine demands. A specialty waste management firm is in a position to provide effective and economical services to small and medium-sized industries by sharing its centralized resources with its clients on an as-needed basis. In this manner the client pays only for the level of expertise and amount of service required, only as required, rather than being committed to supporting a substantial in-house contingent that may be often under utilized, while being inadequate in other circumstances.

The economic and management advantages of retaining external expertise and services become easily apparent when considering the difficulties attendant in establishing and maintaining state-of-the-art capabilities in some of the following areas:

-technical research and development
-system construction
-system operation
-system maintenance
-process upgrading
-staff training
-health and safety programs
-emergency response and contingency planning
-materials transportation and storage
-consistency of waste or by-product quantity

flow
-by-product quality control
-market development
-financing
-liability protection

Within a regional territory, there are numerous sources that generate individual small quantities of similar classes of wastes that are not totally identical. In order to apply cost-effective reclamation measures, like classes of by-products must be suitably processed before or after they are all combined. Subsequently, some form of upgrading is often applied before the product is suitable for packaging and delivery in accordance with the end-user's specifications. Throughout this activity, from initial waste pick-up to final delivery or disposal, Philip Environmental maintains strict adherence to the applicable standards of the Ministry of the Environment and the Ministry of Labour, while complying with the conditions of the Certificates of Approval pertaining to each operation and its various facets.

In most cases, there is a symbiotic relationship between waste generators and waste reprocessors. The generator produces a waste or by-product that is expensive to dispose of. This is collected by the reprocessor and made into a useful product which is then sold back to the original waste generator, or another industry which can use the material in its own process. In this manner, the cost of disposal to the original generator is reduced as a portion of the resale value of the reprocessed waste, the waste management firm realizes a revenue from its part in the activity, and the end-user achieves a saving by purchasing a suitable reprocessed material at a cost that is less than a similar raw process material.

As a very simple and early example of this type of arrangement, the landfill closure operations of the Hamilton-Wentworth Region are presented. During the interval from 1976 to 1981, the Region closed 10 former disposal sites. Normal closure guidelines specified a compacted top cover of clay and topsoil to be applied, a requirement of approximately 1,000,000 cubic yards of material. The firm of Philip Enterprises and the Region developed a joint strategy, which was approved by the Ministry of the Environment, in which designated and classified local steel industry solid wastes were substituted as acceptable final cover materials. In this manner, the Region achieved satisfactory site closure without having to purchase massive amounts of conventional cover material, a requirement which would also have consumed vast amounts of valuable soil. The saving to the Region, in 1982 dollars, was approximately $2.5 million. As a benefit, local industry was able to divest itself of a large quantity of by-products that otherwise would have occupied valuable landfill space, and to do so at a cost which was significantly less than that which would have resulted from the payment of normal disposal fees. A further added bonus resulted from the local economic and employment benefits garnered by Philip Enterprises in the performance of this project.

In another more recent initiative, the Philip team has developed an organic soil conditioning farm-style operation. This activity takes wastes and by-products, from food processing plants, which are treated to produce a compost-

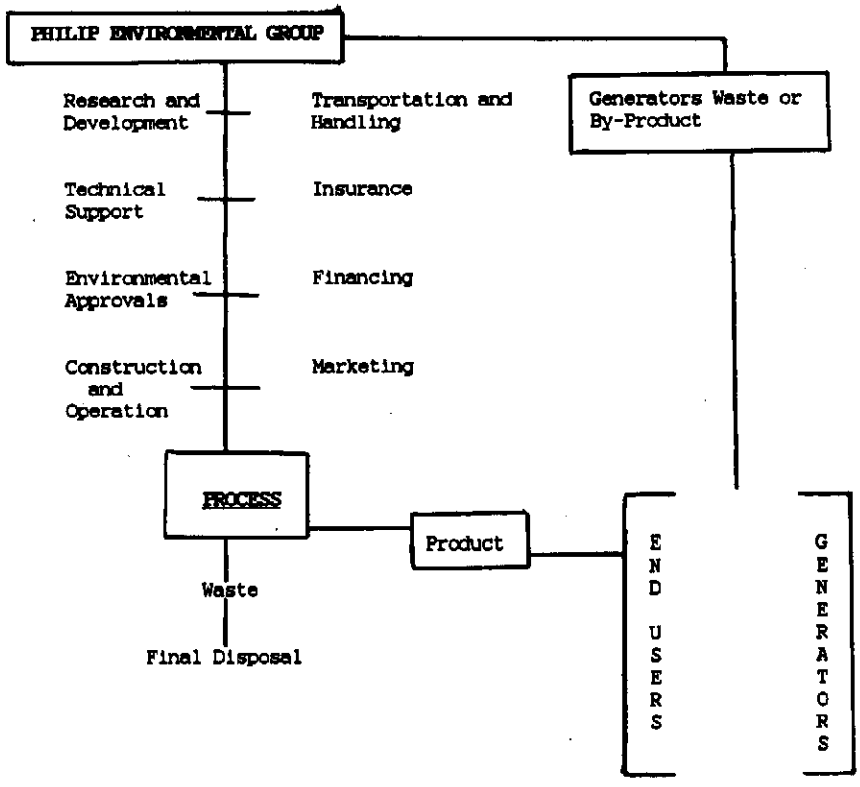
like substance which is being marketed to farms and greenhouses for soil enrichment. As a result, valuable municipal landfill space is conserved, the generator incurs lower disposal costs, and a valuable agricultural soil improvement product is generated.

Of course, many waste management requirements and activities are far more complex and technical in the current climate than in the stated examples. However, these instances serve to illustrate the broad range of benefits that can be realized in even the most simple applications.

It must also be realized that , even with extensive waste reduction and reclamation, some residual materials still require proper treatment and disposal. To accommodate this need, and as part of its full service enterprise, Philip Environmental Group is licensed to use its equipment and transfer stations to accumulate, blend, store and transport designated materials for final disposal at approved sites.

With its broad established network of clients,and in association with a diversified resource team of engineering affiliates, the Philip Environmental Group can respond promptly and effectively to the environmental demands of the private and public sectors.

FIGURE


PHILIP ENVIRONMENTAL GROUP
Research and Development
Technical Support
Environmental Approvals
Construction and Operation
Transportation and Handling
Insurance
Financing
Marketing
PROCESS
Waste
Final Disposal
Product
Generators Waste or By-Product
END USERS
GENERATORS

8. BENEFITS

Beyond the obvious benefits that accrue to the environment as the result of competent and effective environmental management, there is a broad range of direct and indirect returns provided to the responsible waste generator.

As the numbers of landfills decrease, available disposal space and attendant user restrictions become more critical, and disposal fees escalate geometrically, waste generators are compelled to choose feasible alternatives to direct disposal, while continuing to maintain a competitive edge in the marketplace. For a direct example of one issue only, consider that the disposal fee in the Metro Toronto area has doubled this month to approximately $50.00 per ton. It is almost certain that by 1990 disposal fees at sites serving major urban centers will be in the $100.00/ton range.

If a generator disposes of a waste, they continue to retain perpetual liability for any environmental deterioration that may result from the disposed material. In fact, the liability encompasses the entire activity of handling and disposal, commencing with storage at the generator's site, transportation to, and placement at, the disposal site, and continued responsibility after burial. Alternately, if a waste is reclaimed and recycled, the generator retains no further liability or other responsibility.

In economic terms, it can be significantly less costly for a generator to reprocess a waste or low-grade by-product for recovery of residual product value than to pay a costly fee for outright disposal and retain continuing liability for the material.

In commissioning the services of an environmental management firm with a team of dedicated and experienced staff, and sophisticated equipment resources, a client receives the following benefits:

-specialized expertise
-extensive research and development, and problem solving resources and equipment
-minimize or eliminate capital and operating costs for waste management
-improved operational efficiency
-revenue recovery through materials reclamation or resale
-enhanced health and safety environment in-plant
-improved labour/management relations
-enhanced corporate image
-improved community image
-compliance with regulatory standards
-improved environmental protection
-protection of due diligence
-improved risk control
-reduced or eliminated liability exposure
-improved insurability
-avoid prosecution
-avoid surprises

This list of benefits could be more extensive, but the key considerations are presented. On a further point of auxiliary returns, a regionalized network of waste collection, processing and redistribution contributes to an improved economic base by creating employment and more disposable income, and by increasing demand for processing hardware. This elevated economic activity can usually produce measurable direct or indirect returns in the local marketplace for the firms which originally generated the waste products at the beginning of the cycle.

9. RANGE OF SERVICES

The following description of the services provided by the Philip Environmental Group is presented to exemplify the scope of activities, and nature of resources, available through a leading full service environmental management firm.

In the activity of reclamation and reuse alone, Philip Enterprises collects and processes materials from 150 clients which generate 30 different classes of wastes and by-products. The annual quantities received from each individual customer range from 150 tons to 50,000 tons, comprising a total waste stream of 150,000 tons per year received by the Philip Environmental Group.

The reprocessed materials, in turn, are distributed to a group of 50 customers who are involved in diversified industrial activities. Current market boundaries encompass all of Ontario, part of Western New York State, and part of Quebec, with a steady campaign of development and expansion which has permitted an attractive rate of steady growth.

The Philip Environmental Group is qualified to provide a full range of competent and dependable services with guaranteed performance. This is possible through the experience and skills provided by professional dedicated team members, supported by a full range of licencing and insurance certifications. With these resources, environmental management needs can be accommodated in all areas of:

-investigations and reporting
-program review and development
-waste audits
-environmental audits
-research and development
-transportation
-laboratory services
-receiving
-storage
-blending
-upgrading
-transfer
-processing
-treatment
-disposal
-marketing
-spill response
-site remedial works

The needs of industry and the community are extensive, complex and immediate. To meet this need in a responsible and prepared manner, the Philip Environmental Group retains 9 certificates from the Ministry of the Environment which encompass over 300 classifications of materials.

10. CONCLUSION

The bottom line is to maximize profit without environmental impairment. Follow the basic rule of good business: stick to what you do well and have the experts manage your other issues. Let them absorb the high costs of research and development, capital development, and operations management, and spread these costs over their larger service area. Let the experts use their resources and experience to provide you with the most effective solutions and services at the lowest possible cost, by doing it right the first time and every time. Divest yourself of unnecessary responsibilities, expenses, distractions, and liabilities by retaining a competent full service firm.

What Next? Come and ask us to show you.

LARGE SCALE COMPOSTING OF WASTES

Quentin Chapman
Grow-Rich Waste Recycling Systems Inc.

I am particularly pleased to be able to speak to you today on the subject of Large Scale Composting because I am myself a recent convert to recognizing the massive potential of this largely-untapped means for the effective management of bio-wastes.

Until three years ago, like many in the general public, I had only a vague understanding of composting; associating it with a natural rotting process, usually quite odorous and practised on a small scale by farmers and avid gardeners.

From a close association with the composting firm, Grow-Rich, I have now begun to appreciate the almost unlimited capacity of this technique for converting large quantities of potentially troublesome wastes into useful and nutritive organic fertilizer products.

From an engineering standpoint, composting can be viewed as a branch of chemical engineering in which the organic constituents of the raw wastes are broken down, under controlled conditions, into a stable humus-like product. The agents of decomposition are bacteria, which reproduce at predictable rates given certain conditions of temperature, moisture and oxygen concentration.

The primary production objective of large scale composting is to systematically control these variables to ensure the production of a uniform product. Although this reliance on methodology may take some of the romance out of the composting art, it is an essential prerequisite for a sound marketing program, the importance of which will be discussed later.

Large scale composting systems can be divided initially into 2 types depending on the dominant type of microbes. Anaerobic systems, as the name implies, cultivate organisms that flourish in the absence of oxygen (air). By-product gases are primarily methane and hydrogen along with highly odorous reduced sulphur compounds such as hydrogen sulphide and mercaptans. Landfills in fact are examples of (uncontrolled) anaerobic composting.

Aerobic organisms employ oxygen in their conversion processes and create as by-products carbon dioxide gas and water. Normally, anaerobic and aerobic composting processes are mutually exclusive since, under homogeneous conditions, one type of bacteria will eliminate the other. The Grow-Rich system is of the aerobic type.

Aerobic composting can be further categorized into the type of process employed. Windrow, or open system,

composting process use ambient atmospheric surroundings to gradually compost a pile of material arranged in a suitable geometric shape, usually a long row having a triangular cross section measuring perhaps 8 feet at the apex. There are sub-variations depending on certain aspects of particular form of processing employed. These include static pile composting in which the windrows are not turned and forced air windrowing where air is sucked or blown through the pile by the action of fans. The Grow-Rich process in Niagara Falls is a windrow method using scheduled turning of the compost piles.

The second main type of aerobic composting method is the mechanical or closed system, which uses machinery to continuously blend and turn the composting materials inside a vessel to promote uniform conditions.

A good example of this type of plant is afforded by the composting facility formerly operated by the Ministry of the Environment as part of the Experimental Resource Recovery Plant in Metro Toronto. Composting was carried out in a 50 foot diameter vessel. A steel carriage, pivoted in the centre and equipped with drive wheels on its extremeties, is rotated around a track in the circular wall of the vessel. Augers continuously deliver fresh

material from the extremeties to the discharge opening at the centre. Residence time is a number of days and the product, a green compost, must be matured outdoors for a number of months to provide a stable compost product.

At the Grow-Rich operation in Niagara Falls, Ontario, the principal raw material for composting is paper sludge. This is not due to any process restriction, being the result of the commercial convenience of having a large quantity of uniform material on hand for the process. The Grow-Rich system, in fact, is capable of converting a wide range of bio-wastes such as sewage sludge, food wastes and cellulosic-type materials to name a few. Despite the range of raw material, the method is still able to maintain the bio-chemical and physical properties that have become associated with the product.

Having described the basic outline of composting, I would like to give a brief history of the development of the Grow-Rich organization.

The Grow-Rich process was discovered some 23 years ago by the founder of the company, Mr. Pierre Phillippe, who at 76 years of age, is still active in the organization today. His initial operation was in Oldcastle, near Windsor,

Ontario, and produced the original Grow-Rich product from sewage sludge and local food industry waste.

SLIDE 2: This shows the windrow operation at Oldcastle in which the blended materials are piled conically in long rows. The rows were periodically turned by a front-end loader. The Oldcastle operation was carried on as a family business for some 20 years and the product was well-known locally.

SLIDE 3: Here you see a local nursery customer with a variety of retail flowers grown using Grow-Rich.

It has to be said that the Oldcastle operation never grew beyond its 10-15 000 cu. yd. annual capacity principally because land spreading or landfilling of the wastes always presented a cheap alternative available to waste generators.

In 1985, the company moved to its present 65 acre site in Niagara Falls, Ontario, to take economic advantage of the large volumes of paper mill waste which allowed a 5-fold expansion of the business. Even so, tip fees available to Grow-Rich from the mills at the time were still relatively small and only in the past eight months have circumstances

changed. As a generalization, it can be stated that the quantity of compost material marketed has been found to be more or less proportional to local landfill tip fees. The reason for this is that large volumes of compost can only be sold if prices are very competitive with local inexpensive alternatives such as topsoil. It will be appreciated how self-regulating the commercial parameters of large scale composting are, i.e. as local landfill fees rise tip fees payable to the composter also rise allowing him to set more competitive prices thereby selling higher volumes and establishing a reliable recycling service. The composting site rises in capacity as available landfill capacity diminishes -- an automatic safety valve for waste management.

The Grow-Rich process has three main operations:

(1) Blending

Incoming paper mill sludges are blended with a relatively small quantity of another organic material known as the "bio-starter." The "bio-starter" is in turn made by innoculating the organic starter material with the proprietary catalyst which is the heart of the Grow-Rich system. When the raw materials have

been blended in the right proportions, they are arranged in outdoor windrows.

(2) Windrowing

The shape of the windrows is similar to that shown in the earlier slide for Oldcastle (approximately 12' at base, 8' high and 100 ft. long).

At Niagara, the piles presently are turned with a front-end loader but there are plans to mechanize the process using a device similar to that shown in SLIDE 4

Very soon after the windrows are formed the temperature in the piles start to rise. This occurs within a matter of days and is one of the primary indicators that aerobic composting conditions are present.

The temperature rise serves to sterilize any weed seeds, pathogens or other adverse organic species in the pile. Turning the pile allows the relatively cool extremeties to be transferred to the interior and also prevents local anaerobic colonies from developing. At this stage, even on the first turn, the odour is "earthy" and definitely not the unpleasant smell associated with putrescence.

Windrow composting is relatively slow (compared with mechanical composting) and the piles remain in place for, at least, three months. The composting process gradually reduces the particle size and moisture content of the pile until, at maturity, the finished natural organic product is weed- and pathogen-free. It is a free-flowing, ~~and pathogen-free,~~ crumbly material with a total nitrogen content of about ~~0.5%~~ 1 per cent.

(3) Finishing Operations

Mature compost is retrieved from the pile only after the minimum composting period of 3 months. The material is then sent for final conditioning SLIDE 5 in which adjustments may be made to moisture content and bulk density, usually by adding an amendment material such as sawdust. The conditioning step also allows any material that is incompletely composted to finish curing.

The conditioned product is passed through a "shredder" prior to bagging. In fact, the material is actually dressed rather than shredded, i.e. loose agglomates are broken up rather than individual particles being torn apart.

PROCESS CONTROL IN COMPOSTING

There are four aspects to the control of the Grow-Rich process:

- Materials Handling
- Monitoring of Windrows
- Record Keeping
- Scheduling of Deliveries and Inventory Control

The success of composting depends very much on the homogeneity of the starting blend. This means that the large quantities of raw material must be moved efficiently, blended and then transported to the windrowing operation. During windrowing, the piles must be turned in a consistent manner and on a regular schedule. At Grow-Rich, much of the initial stages of processing are presently done with front-end loaders although this will be replaced by a continuous pre-treatment plant comprising of conveyors, a blending facility and storage silos.

At the windrow stage, probes monitor the prevailing temperature, moisture content and degree of compaction in the piles. It will be appreciated that some of the variables are inter-related, for example, moisture and degree of compaction. In extended periods of wet weather,

because the windrows are outdoors, the moisture content may increase. However, the windrows are, to a certain extent, self-sealing and much of the moisture is carried down the extremeties of the pile rather than the centre. Where there are changes in the key control parameters, adjustments are made accordingly.

Record-keeping is important to all phases of the operation from raw material arrivals to finished product deliveries. Weights of materials entering or leaving the plant are recorded, as well as the process variables and site inventory. Each windrow represents a batch and this reference is identified in the final product records. Quality control of the material is maintained in part by the foregoing procedures and also by maintaining information on the raw material quality through regular analysis of samples at external laboratories.

The scheduling of deliveries and recipt of feed materials is part of the overall control. Costumer demand is often seasonal and this fact, coupled with the relatively long composting period, means there must be constant attention to the linking of delivery forecasts, inventory records and production schedules.

MARKETING

The production aspects of composting are important but marketing is no less so. ~~It will be appreciated that~~ a large-scale composting system is inherently a waste management service, whether taking sewage sludge from a municipality or waste from private industries. It follows from this that our compost marketing program has as its main objective the long-term steady and reliable delivery of product so that client waste can always be accepted. In short, if compost sales don't keep up ~~with~~ it means there is no waste service.

Grow-Rich has addressed this need by securing two types of sales contracts.

(1) Large Volume Sales at Low Prices

This part of the sales plan consolidates the waste management aspect of the business. It is characterized by high rates of material flow to customers who are seeking an inexpensive material to re-start vegetation on old quarry sites, slag banks or even as cover for landfills. Progress in these large scale uses has been achieved through both the private and public sectors.

As an illustration, the Region of Niagara has for many years been concerned about the rate at which their agricultural soil is being consumed in residential constructon projects. It is common practice in the Niagara area to purchase farm land, strip it of top-soil, which is sold, and then re-sell the de-graded land. Grow-Rich proposed a comprehensive programa to the Region to offer the compost product competitively with topsoil at any location in the Region. This offer has been taken up.

A low price, high volume market plan necessarily places a geographic limitation on the market range, typically under 100 miles. The Grow-Rich philosophy is to open regional production centres and I will comment on this later as part of the company's future plans.

(2) Low Volume, Higher Unit Price Sales

The material sold in bulk provides the starting point within the Grow-Rich organization for the value added materials sold to nurseries. Depending on the specific application, the material may be blended with other constituents, such as peat and vermiculite, and is

offered in various bag sizes, from 1 L up to 30 L, for retail sale. An example of this type of material is our White Rose product which has enjoyed some considerable success since being introduced in the Metro area this year.

At the present time, the Grow-Rich product is being purchased by customers for use in greenhouses, gardening centres and as a starter medium for raising seedlings and bedding plants. The higher added value of the product allows shipment to markets as far away as NY state and Michigan.

The prospects for expansion in this market are considerable, because of the growing popularity of home gardening and the steady growth of the flower industry. There are also plans to market a product designed specifically for golf course use.

Grow-Rich has established firm credentials with such organizations as the Royal Botanical Gardens and the Niagara Parks Commission who have used the product successfully.

GOVERNMENT APPROVALS

Composting processes which utilize off-site materials are waste management systems and come under the Environment Protection Act of the Province of Ontario.

The Niagara Falls site received its Certificate of Approval in 1985 to handle paper sludge from a single mill. The Grow-Rich process had the distinct environmental advantage of taking the mill wastes out of the food chain since past and current practice in the area is for some of the material to be spread on agricultural land. The land spreading program is carried out under guidelines and is monitored by the M.O.E. but composting is clearly an environmentally superior concept since the waste is processed in such a way that any deleterious organisms are subject to controlled microbial action and the final product is sold almost entirely for horticultural-type applications.

Each new source of raw material, even if it is a very similar waste to one already approved, requires a separate application to the Ministry. The Grow-Rich Niagara Falls operation presently has approvals to treat materials from four separate sources.

Where municipal waste or sewage sludge is to be composted, the operation will in all likelihood require public hearings under the Environmental Assessment Act. The company is presently undergoing the initial stages of this process in the Windsor area as part of an application for a composting site to process sewage sludge and food industry wastes. The public hearing process is not for the faint-hearted nor those in a hurry since, for understandable reasons, the common perception is that composting operations create serious odour problems.

In line with its philosophy of establishing regional production centres to serve local markets, Grow-Rich is in the process of preparing sites at two new locations which, with the present Niagara operation, will make three sites in all.

The application in the Windsor area has already been referred to. This will be a windrow operation as in Niagara Falls but with the additional feature of a drying operation to create a product for a large specific market in that area.

The third location will be the composting facility of the Experimental Resource Recovery plant in Downsview formerly

operated by the Ministry of the Environment. Grow-Rich is presently in discussion with Metro Toronto concerning a proposal to take over the compost plant.

The Downsview plant has a Fairfield Hady mechanical composter described earlier rated at about 40 000 tonnes annually. The Grow-Rich process is readily adapted to the Fairfield system, which actually accelerates the preliminary phase of composting. The plant will undergo certain modifications to allow it to accept food wastes from two major Metro industries. The Downsview production will be a welcome addition to the company's business plan since it will supply the considerable demand for Grow-Rich in the Metro area which presently has to be satisfied from Niagara Falls.

CONCLUSION

There are also plans to licence the Grow-Rich technology in other provinces and countries.

Overseas work in Costa Rica already has shown the process can convert coffee wastes to a first rate compost. Similar studies are in progress for other materials.

Large Scale Composting under properly controlled conditions, is a powerful resource recovery system for the management of bio-wastes. At its Niagara Falls operations, Grow-Rich will process and sell approximately 35 000 tonnes of material in 1989, which still represents only half the operating capacity of the site.

With the addition of the Metro Toronto and Windsor area processing output could rise to as much as 120 000 tonnes by 1990/91. At these throughput levels the company, from its three operations, would divert more material from landfill than is presently being accomplished by the Blue Box source separation program for recycling municipal wastes.

CREATING MARKETS FOR RECYCLED MATERIALS IN THE STATE OF ILLINOIS

James Mergen
Industrial Materials Exchange Service

I am pleased to discuss Illinois' efforts to create markets recycled materials. I am sure that all of us realize that without these markets and without the end use for recycleable material, recycling is a futal exercise. We have all heard of horror stories stories from the east coast and Iowa, and indeed in our own states about people who have gone to elaborate efforts to recycle materials only to find out they are in fact worthless because no market exists for the use of these materials.

Gov. Jim Thompson has a strong interest in both the encouraging of recycling of materials and the use of these recycled materials by the state. On April 17, 1988 Governor Thompson announced the names of eight winners in the first annual Governors Corporate Recycling Award. Included in this award is the recycled product utilization category. The following companies were recognized for their efforts in this area: Precision Twist Drill Company for utilizing 26 tons of old newspaper annually for packaging products rather than using foam packaging and Waste Management of Illinois for using over 8,000,000 sheets of recycled office paper at their corporate headquarters.

Governor Thompson also issued an executive order concerning recycling on April 28, 1988. This executive order calls for all state agencies to purchase paper containing 40% recycled materials as of June 15, 1988. In addition, Agency's are mandated to begin recycling programs and to implement purchase programs for recycled materials. I am proud to say that the Illinois EPA (the Agency for which I work) is already accomplishing all aspects called for in this executive order.

Governor Thompson's own office has also initiated a cooperative program with the FSC Corporation in Alsip, Illinois to recycle newsprint. The mill in Alsip is the states newest paper mill. It is situated in the Chicago suburbs not in the middle of the Forests of southern Illinois as might be expected. This facility to totally dependent upon recycled newsprint to survive. Therefore we can hope that it will continue to generate a market for newsprint throughout its life span.

Under Governor Thompson, state agencies efforts to encourage recycling markets have been diverse and innovative. The Department of Energy and Natural Resources, the science arm of our environmental agencies in the State of Illinois has put together recycling directories and research publications. A directory of Illinois recycling centers has just come out including a Chicago Edition concerning Cook, Lake, McHenry, Kane, DuPage and Will Counties. The DNR has put together a planning guide for residential recycling programs in Illinois, including drop off, curb side, and yard waste composting. DNRs is available and can provide assistance to anyone on recycling in the State of Illinois. They've been involved in attempts to find markets for paper, used tires, wood, and plastics.

The IEPA has been purchasing recycled paper for the past 10 years. We currently operate an inhouse recycling program out of the Land Pollution Control division of the IEPA. This simple pickup service is currently

providing the Agency anywhere from $8,000 to $10,000 in calculated yearly benefits. The Agency provides market development services as well through the industrial materials exchange service. The Exchange is considered by the Agency to be a market development tool. The Agency has put on day long conferences, such as the Innovative Plastics Form to bring together experts in recycling and to talk about business opportunities in reclycling. A used tire symposium is one the drawing boards for this fall.

The Department of Central Management Services, the purchasing arm of the Illinois state government is currently involved in a study of ways it can support recycling within the state agencies. They're also developing a contract to provide for silver recovery from microfiche, x-ray film and photolabs statewide. CMS has no special recycling category for purchasers under the Executive Purchasing Act. However, they welcome recyclers to market materials to the state. Many vendors do not know the process of bidding in the State of Illinoi.

The Department of Commerce and Community Affairs does not have a specific recycling category within its business development activities. It does however place a high priority on recycling industry when it promoted business development in the state. DECCA has supported recycling companies entering the state through grants, research capacity, assistance with regulatory hurdles, as well as general siting information. There are currently five recycling companies negotiating with the Department of Commerce and Community Affairs and we look forward to this area becoming even more important.

JM:jab/1759j/11-12

MARKETING PLASTIC RUBBISH

Thomas Norton
Turtle Plastics, Cleveland, Ohio

Cleveland Reclaim and Turtle Plastic take material that is going to be landfilled because of some processing contaminant or post-consumer contaminant. Contaminants can be:

1. Dirt
2. Plated parts
3. Parts with metal
4. Painted parts
5. Parts with another kind of plastic fastened in some way to them.

We get this material virtually for the cost of hauling it away. After receiving it at our facility at 2366 Woodhill, Cleveland, Ohio, Cleveland Reclaim then:

1. Sorts it
2. Slits or routes it where applicable
3. Grinds it to a 3/8" particle
4. Pelletizes it

Much of the material is then sold in either the regrind form or the pellet form. Most of the material that is sold this way is used by injection molders to make low end parts. Some of the material is also exported.

Because of the reluctance in this country to buy raw materials that are reprocessed, we decided, a number of years ago, for the sake of our potential raw material customers, that products could, indeed, be made and marketed from this material. To that extent, Turtle Plastics then takes some of the raw material and has it molded into parts such as:

1. Fatigue mats for use around industrial plants and commercial applications wherever people stand.

2. Truck bed mats for the pick-up.

3. Urinal screens.

4. Turtle Tracks which are aids in getting started when stuck in the winter.

5. Runner material

Turtle also makes some proprietary items for specific customers. These include things like fender flares and mats.

After manufacturing these products, Turtle then markets them using traditional marketing methods, with the emphasis being on the fact that we are making an excellent product but at a cost considerably less than anyone else's because our feedstock really doesn't cost anything. Some of the ways in which these products are marketed are:

1. Manufacturers Agents. A field force of about 120 sales people call on distributors in:
   a. Janitorial Supply
   b. Automotive Aftermarket
   c. Fire and Safety
   d. Marine
   e. ??????
   f. Air Force
2. Four Color Literature
3. Trade Shows
4. Advertising in Trade Journals
5. Attractive Packaging

By creating market presence with products that are made from rubbish but look like they're made from brand new material, we have been able to gain a growing credibility that says "yes, this material does work for certain kinds of molded parts." As a result, this is slowly beginning to help our pellet business.

In trying to select a product that is going to be made from plastic rubbish, we have developed what we call TURTLE PRINCIPLES:

1. Choose a market that is well established. There are millions of things that can be made for home and industry that already have great demand - no need to re-invent the wheel or build a new widget.

2. Choose a product that is forgiving. It won't work well for medical or food or space age type items.

3. Try to choose something that is dark in color. Reprocessed material is very difficult to keep clean in order to color it.

4. Choose a process that is forgiving. This type of material works best on injection molding or extrusion with heavy embossment.

Look at how these principles apply to some of the products we already make, such as the cushion tile:

1. Mats and matting are a huge 800 million dollar a year market well established.

2. It's a forgiving product. We walk on it.

3. Most matting is dark in color - black or brown.

4. The mat is injection molded.

Or let's look at our famous Oui-Oui screen:

1. Again, a huge market. Millions of them sold.
2. As forgiving a product as you could ever ask for.
3. Neither integrity nor appearance really bothers anyone when choosing a urinal screen.
4. Dark in color - at least ours is. The only black urinal screen on the market that is rapidly gaining acceptance because the dark color doesn't show cigarette burns, etc.
4. It's injection molded.

We've identified over 200 products that can be made from plastic rubbish. There are all kinds of commercial/industrial and household items that you can find every day by walking through your local discount, hardware, aftermarket, lawn and garden stores. They can be made from a variety of materials, including the vinyl we now work with as well as high density polyethylene milk bottles and PET pop bottles. Slowly, as our business grows, we will be grinding out more and more of these items, but always with the intention of using them to help sell the raw material.

They say 30 billion pounds of plastic were landfilled during 1987 and most of it could, in one way or another, be used to make low end items like mats or urinal screens and widgets. It is really more of a marketing problem than anything else because the technical expertise and the processing equipment in many cases are already in place. When the will of the people really decides to do something about it, then plastic recycling will happen in a large and a very successful way. Until then, there must be a few voices in the wilderness crying out "slowly but surely".

DIFFICULTIES ENCOUNTERED WITH MARKETING OF PRODUCTS MANUFACTURED FROM RECYCLED MATERIAL

Mel Tucek
Retico Rubber Inc.

SUMMARY OF REMARKS

(1) Federal and Provincial sales taxes should be eliminated to encourage recycling.

(2) Federal and Provincial governments should specify recycled material content in all of their purchases.

(3) Recycling levy to be imposed on throw-away containers.

(4) "We Recycle" containers should be made out of recycled material.

G7 - Retico Rubber Inc. Summary

The disposal of discarded tires in North America is a severe environmental and logistical problem.

Incineration, pyrolysis or landfill disposal do not provide a feasible solution.

The G7-Retico process received a clean bill of health from the Ontario Ministry of the Environment. The first plant in Ayr, Ontario, started operating in December of 1986.

Rubber granules, derived from the tires, are formed into new products at the plant. A range of granule sizes are being sold to other rubber goods' producers. Additional products are being developed on a continuous basis. New markets are being currently developed.

The company's plan is to build additional tire recycling plants in North America and overseas.

Our process can also be used for the recycling of plastics. Compounding of recycled rubber and plastics is included in our current research and development program.

MINIMIZING HEAVY METAL HYDROXIDE SLUDGES CONTAINING VOLATILE ORGANICS

Thomas F. Stanczyk
Recra Environmental, Inc.
Amherst, New York

INTRODUCTION

Electroplating, paint stripping, metal finishing and cleaning are among the operations generating metal bearing wastewaters containing variable concentrations of volatile aliphatic and aromatic hydrocarbons. Conventional usage of chemical precipitation to remove metallics and other soluble nonmetallics from plant effluents has typically resulted in the generation of metal hydroxide sludge. Many of these sludges have the potential for attenuating soluble oils and grease as well as a fraction of the soluble organic content. Since there are a number of reaction mechanisms influencing the absorptive capacity of chemical reagents and sludge conditioners, the mobility of organics entrained within a sludge matrix can pose variable degrees of environmental concern. Solids extracted using the proposed Toxic Characteristic Leach Procedure can yield elevated concentrations of acetone, methylene chloride, toluene, xylenes and phenol, exceeding proposed characteristic standards dictating reclassification of the sludge as hazardous irregardless of metal immobilization.

Liquid-solid phase separation strategies relying on mechanical dewatering generally have the potential for improving the physical stability of the resulting sludge, however, the organic fraction of the resulting cakes will generally be concentrated on a weight basis, posing additional requirements for chemical immobilization. Conventional applications of alkaline-based fixation technologies may attenuate and/or volatilize the volatile organic fraction, but for the most part, the mobility characteristics measured by the quantified degree of solubility and volatility are not adequately addressed, thus dictating alternative disposal strategies.

With the influx of regulatory standards governing the acceptance criteria for sludges requiring land disposal, generators are reassessing disposal practices, instituting minimization strategies that are effective in reducing waste volume, hazard potential and pollutant mobility. Source control strategies can optimize treatment performance in a manner that will minimize the yield of a sludge by-product that could be more hazardous than the waste originally generated. In addition to optimizing sludge reduction, minimization strategies employed with the treatment of wastestreams yielding sludge by-products can eliminate pollutant mobility concerns while enhancing the potential for pollutant reclamation and reuse.

The enclosed sections highlight some of the sludge characteristics and causes of hazards dictating source control strategies which can minimize the environmental impact of volatile organics while attaining optimum reduction in waste volume and hazard.

CHARACTERIZING DEGREE OF CONCERN

Lubrisol, M-50, Oakite 32, Inhibisol, Cleaner 0954, and Kermak 100-W are among a wide array of commercially available trade-name chemical feedstocks utilized in an array of metal finishing applications. The chemicals found in many of these feedstocks can be characterized as hazardous and highly mobile in terms of water solubility and volatility. The chemical constituents found in many of these feedstocks, referenced as Table I, can pose environmental concern with multi-waste media, thus dictating regulatory standards governing waste generation and management.

TABLE I

Chemical Feedstock Characteristics

FEEDSTOCK	HAZARDOUS SUBSTANCE	POTENTIAL REGULATORY IMPACT
Kermak 100-W (Spray Lubricant)	Naphtha	RCRA Hazardous Waste D001
Heavi-Bodied Paint Remover	Methylene Chloride	CERCLA RQ 1 lb. RCRA Hazardous Waste U080, F002
Cleaner 0954 (Brush Wash)	Methyl Ethyl Ketone	CERCLA 5000 lbs RCRA Hazardous Waste U159, D001, F005
Inhibisol	1,1,1-Trichloroethane	CERCLA RQ 1 lb. RCRA Hazardous Waste F002, U226
Oakite 32 (Scale & Rust Remover)	Hydrochloric Acid	CWA & CERCLA RQ 5000 lbs. RCRA Hazardous Waste D002
M-50 Solvent	1,1,1-Trichloroethane	CERCLA RQ 1 lb. RCRA Hazardous Waste U226, F001
Lubrisil	1,1,1-Trichloroethane	CERCLA RQ 1 lb. RCRA Hazardous Waste U226, F002

Maintenance supplies encompassing lubricants, grease, detergents and soluble oils, can contain a wide array of volatile and semi-volatile organic constituents, i.e. naphtha, phenol, benzene, which can be easily mobilized in a wastewater media posing additional hazards and waste management restrictions.

A critical component to waste minimization centers around the procedures associated with feedstock procurement and chemical usage. Industries need to be cognizant of not just the chemical content of a feedstock, but also the properties of hazardous as well as non-hazardous constituents and their potential for mobilizing high molecular weight organics in an aqueous media. For example; the mineral oil, ethylene-propylene and chlorinated paraffin found in

cutting oils can create soluble matrix problems that could involve the interaction of volatile, semi-volatile and high molecular weight organics.

From a regulatory perspective, hazard recognition becomes increasingly important to ensure compliance with a multitude of regulatory standards governing usage, management and control. Table II provides a cross-reference of some of the regulatory standards addressing commonly used solvents found in many of the cleaning and stated metal finishing operations. Many of the toxic and mobility concerns posed by chemical feedstocks can be eliminated by substituting chemicals and/or changing process chemistry.

TABLE II
Regulatory Standards Addressing Usage and Control of Commonly Used Solvents

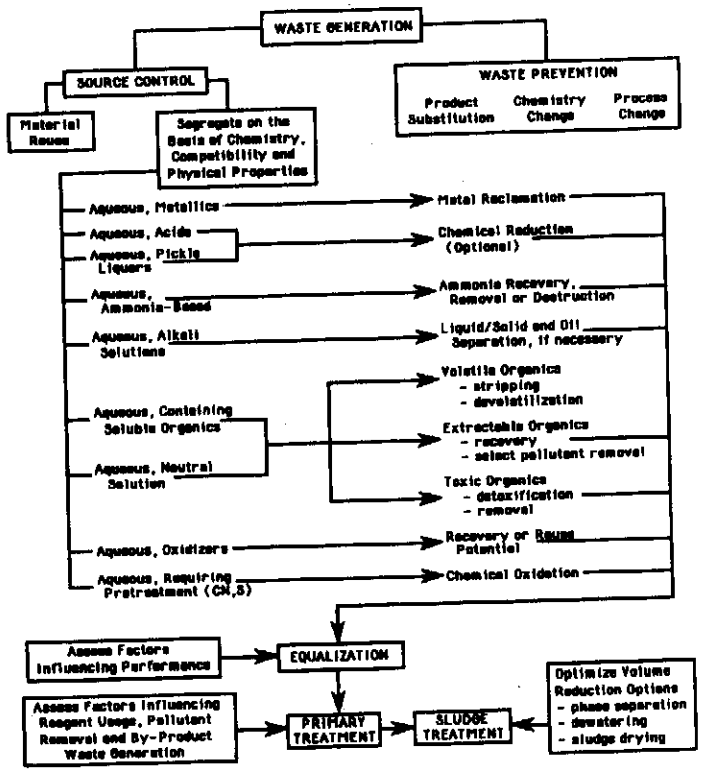
CHEMICAL CONSTITUENTS	APPLICABLE REGULATORY LISTING					
	PP	SARA	HSL	APP. III	APP. IX	TCLP (PART 361 PROP.)
ACETONE		●	●		●	
N-BUTYL ALCOHOL					●	
CHLOROBENZENE	●	●	●	●	●	●
METHYL ETHYL KETONE		●	●		●	●
METHYL ISOBUTYL KETONE			●		●	
METHYLENE CHLORIDE	●	●	●	●	●	●
PERCHLOROETHYLENE	●	●	●	●	●	●
TOLUENE	●	●	●	●	●	●
1,1,1-TRICHLOROETHANE	●	●	●	●	●	●
o,m,p-XYLENES		●	●		●	

APP - Appendix
PP - Priority Pollutants
HSL - Hazardous Substance List

An overall strategy for minimizing the impacts of volatile organics and inorganics on heavy metal sludges can be accomplished using a hierarchy approach and a basic understanding of the chemistry of the waste. A typical flow incorporating the concerns over regulatory and environmental impact can be established using the basic concepts identified on Figure 1.

FIGURE 1

Minimization Strategies Applicable to Wastewaters Generating Heavy Metal Hydroxide Sludges



The evaluation criteria associated with the generation and management of heavy metal hydroxide sludges should account for the proposed TCLP criteria since the results can significantly vary from the Environmental Protection Agency's EP Toxicity protocol. The proposed regulatory standards for TCLP extracts displaying toxicity characteristics are referenced on Table III.

TABLE II

Proposed Toxicity Characteristic Contaminants and Regulatory Levels

HWNO	CONTAMINANTS	REGULATORY LEVEL (mg/l)
D018	Acrylonitrile	5.0
D004	Arsenic	5.0
D005	Barium	100
D019	Benzene	0.07
D020	Bis(2-chloroethyl) ether	0.05
D006	Cadmium	1.0
D021	Carbon disulfide	14.4
D022	Carbon tetrachloride	0.07
D023	Chlordane	0.03
D024	Chlorobenzene	1.4
D025	Chloroform	0.07
D007	Chromium	5.0
D026	o-Cresol	10.0
D027	m-Cresol	10.0
D028	p-Cresol	10.0
D016	2,4-D	1.4
D029	1,2-Dichlorobenzene	4.3
D030	1,4-Dichlorobenzene	10.8
D031	1,2-Dichloroethane	0.40
D032	1,1-Dichloroethylene	1.0
D033	2,4-Dinitrotoluene	0.13
D012	Endrin	0.003
D034	Heptachlor (and its hydroxide)	0.001
D035	Hexachlorobenzene	0.13
D036	Hexachlorobutadiene	0.72
D037	Hexachloroethane	4.3
D038	Isobutanol	36
D008	Lead	5.0
D013	Lindane	0.06
D014	Methoxychlor	1.4
D039	Methylene Chloride	8.6
D040	Methylethylketone	7.2
D041	Nitrobenzene	0.13
D042	Pentachlorophenol	3.6
D043	Phenol	14.4
D044	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D045	1,1,1,2-Tetrachloroethane	10.0
D046	1,1,2,2-Tetrachloroethane	1.3
D047	Tetrachloroethylene	0.1
D048	2,3,4,6-Tetrachlorophenol	1.5
D049	Toluene	14.4
D015	Toxaphene	0.07
D050	1,1,1-Trichloroethane	30
D051	1,1,2-Trichloroethane	1.2
D052	Trichloroethylene	0.07
D053	2,4,5-Trichlorophenol	5.8
D054	2,4,6-Trichlorophenol	0.30
D017	2,4,5-TP (Silvex)	0.14
D055	Vinyl Chloride	0.05

With an inorganic-based sludge, consideration should be given to the potential mobilization of attenuated organics, especially in terms of the solubility of many commonly found solvents summarized under ambient temperature as follow:

methyl ethyl ketone	353,000 ppm
toluene	435 ppm
xylene	183 ppm
methylene chloride	16,700 ppm
1,1,1-trichloroethane	4,400 ppm
cresols	24,000-31,000 ppm

In consideration of the factors influencing the mobility of soluble metals and organics, each waste evaluation should address the following questions:

- Are the wastewaters requiring treatment creating a sludge by-product which can be conceivably more hazardous?
- Are there specific properties and/or constituents within a sludge matrix which can be eliminated and/or modified through source segregation and control?
- Can the waste constituents found in the sludge be removed and/or immobilized to reduce hazard, toxicity and pollutant mobility concerns?

- o Are there any sludge properties and/or constituents restricting treatment and landfill acceptance? If so, can the sludge be treated or can the wastewaters be segregated and pretreated?
- o Can the treatment strategies associated with sludge generation be modified to allow for metals reclamation and purification?

METAL-BEARING WASTEWATER

There are several mechanisms for isolating and removing soluble metallics including metal chelants from generally corrosive liquids.

TABLE IV

Precipitation Reactions

$Cd^{+2} + 2OH^{-}$	$\rightarrow Cd(OH)_2 \downarrow$,	$K_{sp} = 2.8 \times 10^{-14}$	@ 25°C
$Cr^{+3} + 3OH^{-}$	$\rightarrow Cr(OH)_3 \downarrow$,	$K_{sp} = 7 \times 10^{-31}$	@ 25°C
$Co^{+2} + 2OH^{-}$	$\rightarrow Co(OH)_2 \downarrow$,	$K_{sp} = 2 \times 10^{-16}$	@ 25°C
$Cu^{+2} + 2OH^{-}$	$\rightarrow Cu(OH)_2 \downarrow$,	$K_{sp} = 2.2 \times 10^{-20}$	@ 25°C
$Ba^{+2} + CO_3^{-2}$	$\rightarrow BaCO_3 \downarrow$,	$K_{sp} = 1.6 \times 10^{-9}$	@ 25°C
$Ba^{+2} + SO_4^{-4}$	$\rightarrow BaSO_4 \downarrow$,	$K_{sp} = 1 \times 10^{-10}$	@ 25°C
$Pb^{+2} + CO_3^{-3}$	$\rightarrow PbCO_3 \downarrow$,	$K_{sp} = 1.5 \times 10^{-13}$	@ 25°C
$Pb^{+2} + 2OH^{-}$	$\rightarrow Pb(OH)_2 \downarrow$,	$K_{sp} = 4 \times 10^{-15}$	@ 25°C
$Mn^{+2} + CO_3^{-2}$	$\rightarrow MnCO_3 \downarrow$,	$K_{sp} = 8.8 \times 10^{-11}$	@ 25°C
$Mn^{+2} + 2OH^{-}$	$\rightarrow Mn(OH)_2 \downarrow$,	$K_{sp} = 1.6 \times 10^{-13}$	@ 25°C
$Mg^{+2} + SO_4^{-2}$	$\rightarrow MgSO_4 \downarrow$,	$K_{sp} = 6.8 \times 10^{-7}$	@ 25°C
$Ni^{+2} + 2OH^{-}$	$\rightarrow Ni(OH)_2 \downarrow$,	$K_{sp} = 2 \times 10^{-18}$	@ 25°C
$Zn^{+2} + 2OH^{-}$	$\rightarrow Zn(OH)_2 \downarrow$,	$K_{sp} = 7 \times 10^{-18}$	@ 25°C

Precipitation, coprecipitation or cocrystallization are among the common approaches to removing metal pollutants from an aqueous media. Some of the typical reaction mechanisms are summarized on Table IV.

In terms of ensuring optimum removal and immobilization, the chemistry of the pollutants need to be well understood. Beryllium and antimony can be quantitatively coprecipitated with a variety of hydroxides depending on the pH used. Sulfides, sulfur, calcium silicate, several phosphates, sulfates and several carbonates are all documented for their specific application to coprecipitation of metals, including but not limited to, mercury, arsenic and selenium.

There are several mechanisms whereby organics can be applied as metal coprecipitates providing the proper state of the metal is well understood. As^{+3}, Se^{+4}, Cr^{+6}, Pb^{+2}, Fe^{+2}, and Fe^{+3} can be concentrated by coprecipitation using diethyldithiocarbamate. Thionalide has been used as a coprecipitate for arsenic and antimony at ppb levels in highly elevated salt environments. Other reagents having documented success and potential applicability to source reduction include coprecipitations with quanidates, thioxinates, EDTA, alpha-mercaptobenzothiazole, cupferron, and phenylfluorone.

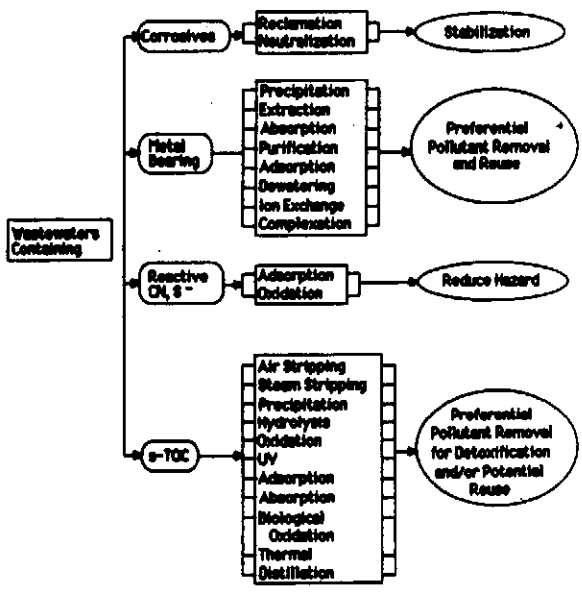
Another strategy having application to metal isolation and potential recycling is electrodeposition.

Other methods, each having specific application to the isolation and concentration of metals, include: evaporation; freezing; sorption which includes absorption, adsorption, ion-exchange, membrane and combinations thereof; solvent extraction; and reverse osmosis. Despite the many advantages of preconcentration techniques, it is important to consider physical and chemical variables having the potential for reducing performance efficiency. Some examples of the stated metal removal strategies are summarized as follows:

- o evaporation of wastewaters to recover metals of specific reuse value; i.e., mercury.
- o evaporation with reduction to remove metal halides and oxyhalides of selenium and tellurium.
- o activated carbon, oxidized with nitric acid, has been used to extract divalent nickel, cadmium, cobalt, zinc, manganese, and mercury from wastewaters including brine solutions.
- o zeolite extraction of copper, nickel, zinc and cobalt.
- o starch xanthate as an insoluble material was used to extract metals without pH dependency.
- o several natural materials; i.e. peat moss, protein containing species (wool, hair, feathers), peanut skins, walnut meal and various woods including cellulosic materials, have extracted metals from aqueous media.

FIGURE 2

Waste Management Strategies
Having Application to Wastewaters



- o shredded tires, including carbon black, were documented as additives to remove mercury from aqueous solutions.
- o chelating polymer resins are employed to remove trace metals.
- o cation exchange resins have been used to separate many transition metals such as Fe(III), Cu(II), Zn(II), Ni(II), Ag(I), Mn(II), etc.
- o chelate-type complexes have been documented with oximes, hydrooxyquinolines, nitrosophenols, naphthols, dithiocarbamates, xanthates, and high molecular weight amines.

Some of the summarized waste management strategies having application to industrial wastewaters including those containing metals as prime contaminants are illustrated as referenced in Figure 2.

HEAVY METAL SLUDGES

Chemical precipitation of wastewaters containing soluble and/or suspended concentrations of metallics and salts (sulfate, phosphate, fluoride) will generally produce insoluble by-products requiring liquid-solid phase separation. The separation technologies may involve one of many commercially available dewatering units including units having application to thermal drying.

TABLE V

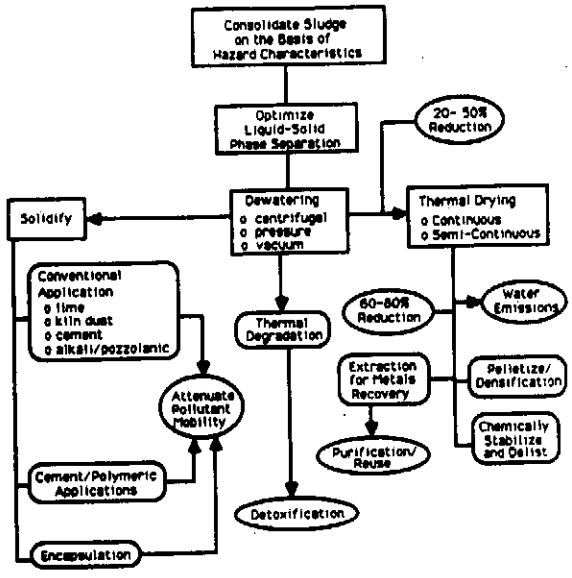
Typical Properties and Content of Metal Hydroxide Sludges

CONSTITUENT/ CHARACTERISTIC	CONC. RANGE (%)
Cadmium	0-50
Hexavalent chromium	0-50
Nickel	0-50
Cyanide (complexed)	0-50
Copper	0-50
Zinc	0-50
Aluminum	0-50
Arsenic	0-50
Barium	0-50
Mercury	0-50
Silver	0-50
Lead	0-50
Selenium	0-50
Tin	0-50
Chromium (total)	0-50
Titanium	0-50
Iron	0-50
Phenol	0-50
Volatile organics	0-50
Fluoride	0-50
Ammonia	0-50
Water	0-50
Phosphates	0-50
Detergents	0-50
Alkalinity	0-50
T.O.C.	0-50
Sulfide	0-50
Specific gravity	1.0-1.5
pH	5-14 units

The resulting solid by-products are generally referred to as sludge. The physical properties (i.e., solid content, free liquid potential) and chemical content of these sludges can vary significantly as summarized on Table V. The concentrations of hazardous constituents in the sludge matrix will generally be dictated by chemical usage and the type of operation(s). However, these are not the only factors influencing waste properties and the requirements for additional sludge treatment. Plant practices generally governing source control (i.e., material usage, transfer, segregation, packaging, and/or storage) can play an important role in any treatment strategy encompassing sludge reduction, purification and/or immobilization. Many of the wastewaters contributing to the sludge matrix have the potential for containing variable concentrations of soluble organics. These organics can originate from residual oil and grease, cleaning solutions, metal finishing operations, and chemical detergents. These organics can be mobile in an aqueous media as well as attenuated and concentrated in the sludge matrix. The resulting properties could pose problems relative to optimum treatment performance, sludge stabilization, and disposal costs. As such, optional strategies should focus either on liquid/solid phase separation strategies and/or immobilization technologies. An overall strategy is summarized as referenced in Figure 3. Some of the operating considerations impacting selection and performance are summarized as follows.

FIGURE 3

Waste Management Strategies
Applicable to Metal Hydroxide Sludges



Liquid-Solid Phase Separation

As previously noted, the total solids content as well as the chemical loadings of heavy metal sludges can vary significantly. The organic content will typically represent the volatile fraction, but the presence of higher molecular weight aliphatic and aromatic organics cannot be discounted. For example, phenolics can be found in many sludges as a result of its use as a biocide in many soluble oils which are partially absorbed during the chemical precipitation process.

Liquid-solid phase separation strategies can focus primarily on optimum volume reduction but this approach many not ensure optimum immobilization of the pollutants. Ideally, soluble organics should be removed before the chemical precipitation phase; however, if this approach is not feasible, reduction strategies should be assessed in terms of reducing volume as well as hazards potentially characteristic of the constituents comprising the sludge. In this regard, emphasis should be placed on technical options which are effective in optimizing the removal of entrained liquids; whereas liquids can be defined in this context as water as well as volatile solvents.

Moisture removal by mechanical means (i.e., vacuum, centrifugal and/or pressure dewatering systems) can prove effective in reducing volume, however, the entrained organic content is generally concentrated.

Each option has applicability to metal hydroxide sludges. The performance efficiency will generally be dictated by the nature of the waste, the degree of chemical conditioning, the frequency of use, the in-house maintenance practices and the desired end products.

The solids generated with dewatering may range in total solid content from a low of 15-20% by weight to a high of 50-60% by weight. Organics in the form of soluble or emulsified oils, i.e., machine and/or cutting fluids, can interfere with the performance efficiency, dictating that the sludge be chemically conditioned prior to dewatering.

In some cases, it may prove attractive to dewater high solid content residues, generated at the source, prior to treatment.

Figure 4 is a cross-sectional view of a fiber cloth belt-type rotary vacuum filter. In terms of optimizing the performance of vacuum filters, considerations should be given to:

- o the type and degree of chemical conditioning,
- o specific resistance,
- o cake thickness and weight,
- o compressibility,
- o form time,
- o organic content,
- o particle size,
- o effluent and cake characteristics, and
- o cycle time.

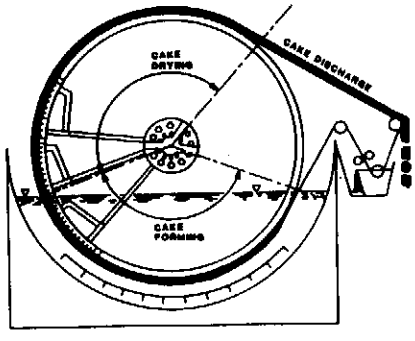


FIGURE 4
Cross Sectional View of a Fiber Cloth - Belt Type - Rotary Vacuum Filter

Extraction/Purification

Recent applications of extraction technologies have been modified to allow for the direct treatment of sludges. The process basically entails:

- o extraction with a solvent or aqueous media adjusted for pH and maximum solubility of the constituents of concern,
- o removal of constituents from the extraction media,
- o recovery of the extraction fluid.

This process sequence is being utilized to recover feedstock constituents as well as reducing the concentration of hazardous constituents preventing metal purification and/or direct land disposal. Copper and nickel are two metals which are commonly recovered using an extraction process.

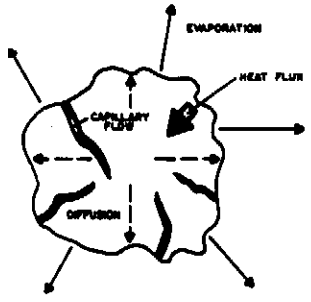
With rising disposal costs, industries are finding that metal purification and recovery techniques are economically viable. The feasibility of reclaiming metals from sludge improves with source segregation, treatment and feedstock control. Among the techniques warranting consideration in the strategy plan are electrolytic deposition, leaching/extraction, electrowinning, precipitation, oxidation and ion exchange.

Sludge Drying/Volatile Stripping

Unlike the removal of water using mechanical dewatering unit operations, drying is a process whereby moisture entrained within a sludge is evaporated through heating, producing a relatively dry solid. This technology has been utilized successfully in industry for over fifty years and it has found, as of late, popularity with residues typically generated from mechanical dewatering. Dewatering units generating filter cakes at a 25-35% by weight total solid content can be further dewatered, producing dry solids displaying 85-95% total solids.

FIGURE 6

Evaporation Mechanisms



The application of drying technology to waste sludges should be approached as a science. Each dryer will react differently and their performance will reflect the processing variances dictated by material particle size, capillary voids, retention mixing action and sludge make-up. In most applications, the drying step is preceded by a mechanical dewatering system, i.e., vacuum or pressure. Figure 5 illustrates the evaporation mechanisms distinguishing diffusion and capillary flow.

Water is generally present in hydroxide sludges on the surface of conditioning additives but it can also be mechanically bound and chemically hydrated. Residual levels of solvents are generally present in a similar manner. Therefore, the drying process must be effective in removing the liquid found in the interstices of solids using diffusion and capillary action. The drying process follows a logical sequence of steps entailing:

- the addition of heat to the sludge,
- evaporating the moisture at a rate equating to the influent moisture level,
- attaining a critical end point where the drying rate begins to fall.

The sludge characteristics during the drying cycle will undergo change in appearance varying from free boiling of liquid, plastic shearing, wet granular to dry granular material. Drying over continued periods of time can yield free-flowing, dry powdery residue.

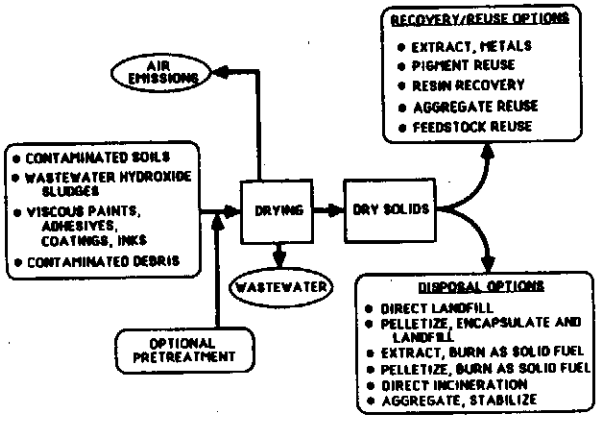
Agitation is a critical component of systems on the market today. The proper mix will have a significant impact on drying rates. With sludge containing volatile impurities, the agitation factor becomes increasingly important to enhance pollutant removal and bring solid particles into contact with the heat-transfer surface.

There are a number of drying units currently available and applicable to metal hydroxide sludges as well as sludges containing high volatile organics. Applications range from cored shaft/blades for extended heat transfer, to thin film, spray drying, and high speed shear relying on external radiant heat sources. In most cases, the units are simplistic in terms of material loading, processing, unloading and emission/dust control. Some of the units discharge the resulting powder into bags minimizing employee and work place exposure.

Figure 6 provides an overview of strategies having application to hydroxide sludges and other solid by-products of drying operations. Drying can have wide applications, yielding a number of benefits if the chemistry of the sludge and the factors influencing the mobility of water and/or volatile constituents are well understood.

FIGURE 6

Strategies Applicable to Solid By-Products of Drying Operations



The following benefits are potentially achievable with drying:

- o filter cakes can be reduced an additional 60-80% by volume optimizing reduction of waste volume.
- o the dried residues will display physical properties amenable to direct disposal via landfill.
- o purification techniques requiring metal reclamation and reuse can be made feasible minimizing requirements for treatment.
- o the dried residues can be treated in a manner that will remove volatile organic constituents to levels that will meet EPA's land disposal standards including the TCLP performance standards.
- o the metal constituents found in the sludges are effectively immobilized and amenable to potential delisting of hazardous characteristics.
- o disposal costs are significantly reduced by as much as 60-70%.
- o pay-out analysis shows capital investment recovery within relatively short periods of time.
- o the risks associated with large volumes of waste being shipped offsite will be significantly reduced.
- o off-spec charges and the potential need for solidification are eliminated.

Stabilization/Solidification

In light of the stated regulatory trends, stabilization/solidification (S/S) technologies have been applied with inorganic and, to a limited degree, organic wastes with the primary goal of ensuring the safe, ultimate disposal of hazardous waste through landfilling or other applicable alternatives. The primary goals of S/S, irrespective of methodology, are:

- o to improve the handling, load bearing capacity and physical characteristics of the waste;
- o to decrease the surface area across which transfer or loss of contained pollutants can occur;
- o to limit the solubility of any pollutants contained in the waste; and
- o to detoxify and/or remove pollutants of concern.

S/S technologies utilizing cementitious/pozzolanic reagent(s) have been successful in attaining the stated goals for wastes categorized primarily as inorganic in nature.

Metal hydroxide sludges can be effectively solidified with the addition of one or more chemical reagents causing change in physical strength and chemical mobility. A number of the conventional technologies have demonstrated applicability to metal hydroxide sludges. However, outside the interest of improving physical strength and load bearing capacity, generators must be cognizant of how the reagents being applied are interacted with the sludge contents which are influencing pollutant mobility. In many cases, pozzolanic treatment of metal hydroxide sludges resulted in increased rates of metal and organic leachability. Waste contaminants such as mercury, arsenic, and phenol are typically more mobile under alkaline conditions.

The chemistry of the sludge has to be well understood to ensure effective immobilization. S/S technologies have reportedly demonstrated limited success in preventing the dissolution of organic constituents into the environment. This is not to say that an organic waste cannot be physically solidified, it simply implies that conventional S/S applications have had limited success in actually stabilizing an organic; whereby stabilization may be defined as a process of fully or partially bonding organic waste by addition of a supporting medium, a binder, or, if necessary, a modifier. In the context of the stated goals, a stabilization process will involve a chemical interaction between the waste and a binding agent. Few incentives for the development of stabilization techniques for organic waste have been available until recently promulgated regulatory trends have made it economically attractive to optimize the performance and applicability of stabilization technologies for organic waste.

With respect to organic waste, literature provides limited references to the potential mechanisms of bonding or of interferences to bonding in stabilized waste. The following mechanisms are generally cited and utilized:

- o macroencapsulation,
- o microencapsulation,
- o adsorption, and
- o physical/chemical fixation.

With organics, the stated mechanisms may involve one or more of the following bonding mechanisms:

- o physical entrapment within an impermeable coating which is indefinitely stable under physical and chemical conditions. This mechanism, which is strictly questionable, would appear to have limited applicability in attaining EPA's proposed performance standards.
- o physical entrapment in which the waste is heterogenously, but fairly, dispersed within a solid matrix. The concepts of microencapsulation, which generally entail blending of incompatible chemicals, warrants additional evaluation in light of recent developments involving cement/polymer techniques.
- o chemical fixation which, unlike microencapsulation, will rely on chemical interaction varying from the relatively weak London dispersion forces of two non-polar materials to very strong chemical bonds.
- o fixation, which involves dispersing a waste in a porous solid matrix and relies on physical adsorption (London dispersion or Van der Waals forces) or chemisorbtion (formation of chemical bonds).
- o colloidal dispersion of a waste in a solid. This combination of microencapsulation and chemical fixation techniques warrants additional evaluation in terms of defining the mode of bonding and the factors influencing molecular interactions or chemical bonds.
- o polymerization and waste interaction allowing for the generation of solid hydrophobic material. This concept would appear applicable to the inclusion of unreactive waste materials. Expanding this concept in line with conventional S/S concepts warrants further development.

The chemistry of the sludge has to be well understood to ensure effective immobilization. Organics, specifically low molecular weight solvents, will interfere with hydration reactions occurring with alkaline reagent treatment techniques. Residual solvents and oils can serve as carriers for other inorganic and organic constituents, increasing substantially, rates of leachability. Many sludges may appear physically solidified, but there has been no impact on chemical immobilization.

It is also important to take into account the operating variables of the desired end product. Reagent selection and dosage can be impacted by the amount of water impurities in the sludge as well as the time allowed for curing. Solidifying a waste sludge after dewatering can significantly reduce reagent requirements resulting in volume reduction instead of volume increase. Extending the curing periods can reduce reagent requirements. Dewatering performed in conjunction with drying can totally eliminate the need for additional stabilization.

SUMMARY

Industries have found practical solutions to the management and minimization of sludge generation. Metal hydroxide sludges can be effectively reduced by developing for implementation a waste strategy plan that accounts for source generation, segregation, treatment, feedstock usage and material reclamation.

For the purpose of a comparative analysis, the results attained after dewatering, solidifying, and drying a control residue containing a high concentration of volatile organics and water were identified in terms of changes in total solids and residual volatiles. The results are schematically illustrated on Figures 7 and 8.

FIGURE 7

% Total Solids as a Function of Treatment

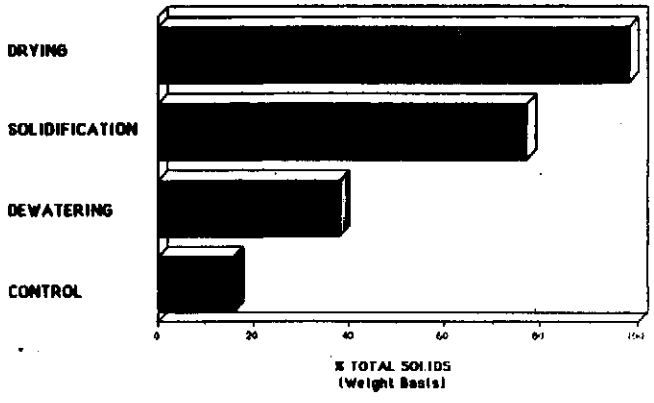
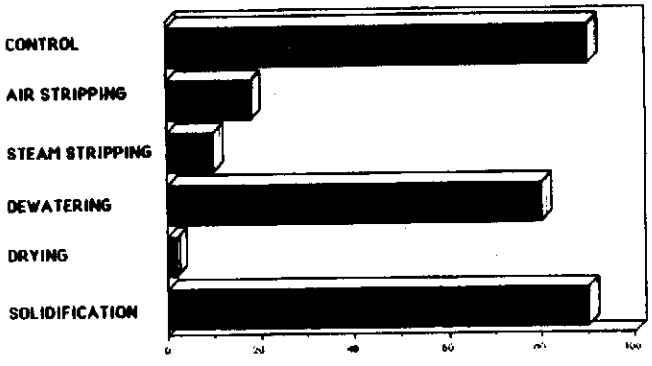


FIGURE 8
Residual Volatile Organics as a Function of Treatment



With greater emphasis being placed on restrictions to direct land disposal of hazardous wastes, industry must be prepared to reassess existing practices in a manner that will result in short and long-term options effective in metal reclamation/reuse, sludge reduction/detoxification and safe disposal within the constraints of pending regulatory acceptance criteria.

PROBLEMS IN PROCURING TECHNOLOGICAL APPROACHES TO IN-PLANT WASTE MINIMIZATION

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ABSTRACT

Technology vendors often extol the unique features of their products. Many times specific operations are associated with propriety equipment or processes. It is difficult for a company to evaluate a vendor's claims except by talking to past customers whose problems and applications may be different. Often it is nearly impossible to compare one vendor to another. However, by preparing detailed plans and specifications for the application of a generic technology to an in-plant waste minimization problem, it is possible to get technology vendors to bid against one another on an equivalent basis. Details will be presented on utilizing this approach along with a description of how it compares to a direct approach using a single prequalified vendor.

INTRODUCTION

It is not easy to turn a waste minimization opportunity into reality if technology is involved. In this emerging field, many technologies are still unproven. Many engineers outside the vendor firms are unfamiliar with the technologies. Each firm facing the purchase of waste minimization technology must derive a process to select the proper piece of equipment and see to it that it is properly installed and operated. This process must be a sound blend of independent engineering supplemented with a healthy dose of vendor know-how. Finding the proper combination of these approaches will maximize the chances of finding a good match. The difference in the approaches will be highlighted in this paper. However, the challenge to the reader is to find a way to meld them.

FEASIBILITY STUDY

In order to conduct a meaningful engineering feasibility study, it is important that the engineer work with a full "menu"; i.e. that all potential options for reducing waste generation are considered. Adequate technical and economic information must be collected on each option. The initial screening of alternatives would examine the following points:

- Implementability and Feasibility
- Risk to Production and Quality Control
- Regulatory Considerations - e.g., permits
- Costs and Return on Investment
- Environmental Protection and Health Risks.

If there are a large number of options, some form of scoring system may be required to limit the gathering of further information to a smaller number of primary options.

Once several primary options have been selected, more detailed information must be collected for the feasibility study. This information may include:

- Description of Technology or Practice
- Special Design Considerations
- Environmental Controls; Does Process Create New Waste Disposal Problems?
- Operational, Maintenance and Monitoring Requirements
- On-site and Off-site Handling Needs
- Safety and Health Risks
- Cost Control.

Collecting this information takes time and has a cost associated with it. Often there is a tendency to want to short cut this process. Outside engineering assistance may be utilized in the feasibility study to ensure adequate coverage of the very wide range of technologies which may be utilized to help minimize a priority waste stream. A company will miss opportunities if it jumps too quickly for a particular vendor solution without proper consideration of other generic technologies.

Within the feasibility study, a technical analysis of the primary options will examine reliability, implementability, safety, and likelihood of meeting the waste minimization goals. A cost analysis will include capital and construction estimates along with likely return-on-investment calculations. Finally, a number of institutional concerns will be addressed including: regulatory considerations, on-site and off-site requirements, worker health and safety issues, worker and community relations benefits, and ability to maintain all environment protection considerations. In each of these areas, the project team should address all risks to production quantity and quality control that the options may cause.

If a technological option is selected, the engineer must determine the need for treatability and even pilot-scale testing. With this information in hand, there are two approaches to bringing the technology on-line -- engineering approach and the vendor approach.

ENGINEERING APPROACH

The engineering approach to the use of waste minimization technology will focus on <u>generic</u> options. A conceptual engineering design consists of the following items:

- Preliminary design criteria
- Facility layouts
- Budget cost estimates
- Operating and maintenance requirements
- Implementation schedule
- Institutional requirements
- Phasing considerations.

These engineering functions differ little from other repair and expansion items that are commonly faced by the facility. However, many of the technologies currently utilized in waste minimization have a great deal of proprietary information which is not readily available to the engineer. The vendors use this secrecy to try to force the facility to use their engineering and hence, their process. Sometimes an independent engineer who has a good working knowledge of the generic technology involved can work with vendors which come closest to the desired system to make certain that they provide information sufficient to enable each to bid. There is little question that this is a very sensitive topic. A bid specification document is then prepared and the bidding procedure is conducted. When selecting an independent engineer, make certain he has process engineering capability as well as the proven capability of producing plans and specifications for bidding purposes.

The engineer is utilized to prequalify the bidders and provide oversight of the installation and shakedown of the equipment. In some cases, operation and maintenance manuals and specialized training may be provided by the engineer. Finally, the engineer may be utilized to provide an independent determination of the effectiveness of the system.

VENDOR APPROACH

In some cases, the facility chooses to work directly with a vendor that has a waste minimization option which has been demonstrated in a particular application. The following information should be sought from the vendor:

- Description of the technology
- History of development
- Identification of effective operating range
- Identification of applications
- Advantages over existing comparable technologies
- Identification of health, safety, and environmental problems
- Conditions under which proprietary information will be disclosed
- Regulatory compliance
- Ability to prepare operations and maintenance plans in advance
- Ability to provide follow-up to the sale.

You may want your implementation team to check on all the information provided. If the facility personnel are too busy, be certain to get independent assistance in verifying the information.

Also important are the vendor capabilities. First look at the other technologies developed by the vendors. Some entrepreneur/inventors are constantly trying to bring new ideas to the market. However, they may lack the sophistication of financial backing to complete a reasonable round of pilot-scale tests. Second, you want to look at the experience of the vendor's personnel as well as their dedication and credentials. It is not uncommon to have frequent employee turnover along the often rocky road to the commercialization

of a new technology. Third, look at their treatability testing program capability for your application. Is this capability in-house, or do they subcontract the work? Can they properly scale the equipment to meet your needs? Finally, how sure are they about the reliability of their equipment? If the plant's production is dependent on this equipment operating, you may want some sort of performance guarantee. Although many vendors may be unable to provide guarantees, they may be more willing to compromise on other items where they have taken a strong stand such as the proprietary issues.

When working with a vendor, make sure your engineer agrees to the vendor's plans and specifications. Avoid the use of "free" engineering (or very low-cost engineering) from the vendor, especially when cost estimates and means of containing costs are needed. You may wish to have independent value engineering performed on the option. This is when a team of independent engineers examines the approach to see if it can be accomplished at a lower cost. A critical area of concern involves the specification of peripheral equipment. The vendor may have a good technology, but have little mechanical experience in delivering your waste stream to the equipment. Using a bidding document in the engineering approach will enable you to independently select a proper peripheral for your application. Finally, remember that confidentiality is a two-way street. If the vendor gets you to hold information confidentially, you should see to it that they cannot use your installation either verbally or in written form in any sales promotion. In every case, the plan should provide for vendor-independent documentation of the waste minimization effectiveness of the equipment.

TRANSLATION OF THE PROGRAM

This paper has provided some preliminary ideas for the development and implementation of a waste minimization program. Proper care and attention must be taken to ensure that this program is translated into a form which can describe the program to the following parties:

- Management
- Employees, public
- Production personnel
- Regulators
- Insurers
- Customers.

Constant feedback is needed at each step to ensure the continuance of the program. The program must be a dynamic one to allow it to accomodate economic shifts and the development of new minimization options. Finally, any opportunities to work with a trade organization should be explored to help develop options for the mature phases and to disseminate information on successful options for the earlier phases.

Copies of the slides used in this presentation will be sent to those requesting them. Please contact ChemCycle Corporation, 129 South Street, Boston, MA 02111, or call 617-451-0922.

WASTE MINIMIZATION FOR SMALL QUANTITY GENERATORS

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INTRODUCTION

The proper management of hazardous substances, including waste, is one of industry's major concerns. Virtually every industrial and manufacturing process involves hazardous substances or produces hazardous waste. From an economic standpoint, the management of these materials and wastes produce costs that can affect a firm's ability to compete in the marketplace. As a result, many larger businesses have established waste reduction programs and many smaller firms are beginning to explore the advantages of waste reduction as well.

Waste reduction may be thought of as a concept that implies the source reduction as well as the minimization of waste. Reducing waste at the source implies an up-stream approach that emphasizes reducing the generation of waste at the source. Waste minimization, on the other hand, implies a down-stream approach that emphasizes the recycling, reuse, exchange, and treatment alternatives such as incineration for the management of wastes. Though these terms focus on two different approaches, they attempt to accomplish the same outcome, i.e., decreasing the amount of waste that is generated.

WASTE MINIMIZATION INCENTIVES

The incentives for implementing waste minimization programs maybe categorized generically as: economic concerns; regulatory concerns; and public relation concerns. Economic pressures (e.g., disposal costs of $200 per drum or more) are encouraging industry to become more efficient and environmentally responsible in the management of its hazardous substances and wastes. Other economic incentives for waste minimization include: deriving income through the sale or reuse of waste materials; reducing the costs for wastewater treatment; lowering risks for spills, accidents and

emergencies; and lowering long-term liability and insurance costs. For example, the costs of meeting wastewater treatment standards can be high. Pretreatment and effluent requirements are forcing industries to install costly wastewater treatment facilities. By minimizing waste, companies can reduce this expense. Many companies are establishing waste minimization programs for the purposes of: lowering operating costs through the substitution of less expensive raw materials; lowering energy costs through the use of new and more efficient process equipment; and increasing safety by reducing employee exposure to hazardous substances.

In addition to assisting industry in reducing the costs associated with the management of hazardous substances and wastes, waste minimization can assist firms in reducing the potential liability associated with the management of these materials. Liability insurance premiums for firms generating hazardous waste have increased by hundreds of percent in the last five years. By minimizing the hazardous waste produced, generators can help reduce the long-term liability associated with the management of these wastes. Hazardous substance spills, accidents, and other types of environmental emergencies can cost businesses tens of thousands of dollars. These risks can also be reduced with proper management of the hazardous substances used, and the management of the wastes generated.

The recent hazardous waste regulations banning the land disposal of over 400 chemicals and waste streams have significantly increased treatment requirements, thus giving added incentives for implementing waste minimization programs. In addition, the administrative and managerial work required to comply with environmental regulations can become an important operating cost for a firm.

While the strongest incentives for reducing waste generation are undoubtedly economic and regulatory, many companies are implementing waste minimization programs out of a sensitivity to public concern over toxic chemicals. This environmental concern by firms is perceived to have long-term benefits, such as good public relations between companies and local communities.

In addition to reducing costs and increasing profits, an efficient hazardous waste minimization program can reduce the amount of wastes for disposal, consequently reducing potential environmental impacts on the community; and reduce the number of hazardous

materials used in the workplace, thus making a safer work environment. By reducing the amount of hazardous waste generated, companies can show the public and their potential customers that they are making an effort to curtail the generation of hazardous waste which has the potential to adversely affect human health and the environment.

CURRENT WASTE MINIMIZATION REQUIREMENTS

With the 1984 Amendments to the Resource Conservation and Recovery Act (RCRA), the U. S. Congress declared a national policy that, whenever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. As a result, a new recommended strategy for waste management has evolved. This new strategy includes waste minimization as an important step to be considered in the overall approach to waste management.

The requirements related to waste minimization contained in the 1984 Amendments to RCRA are:

- Generators must certify on their manifests that they have a program in place for volume and toxicity waste reduction;
- Any new treatment, storage, or disposal permit must include a waste minimization certification statement; and
- As part of the generator's biannual report (current regulations in the state of Florida require an annual report), generators must describe efforts undertaken during the year to reduce volume and toxicity of waste generated and document actual reductions achieved.

ESTABLISHING A WASTE MINIMIZATION PROGRAM

In order to establish a successful waste minimization program a business or organization should incorporate four essential components into the development of the program. These components are: planning; auditing; implementation; and communication.

The first step in accomplishing a successful waste minimization program is establishing the procedures and policies which a company or organization will use in implementing the waste minimization program. The goal of this planning process is to reduce the generation of hazardous waste. The procedures and policies should address areas of production as well as other areas concerning the management of hazardous substances and wastes.

Once the decision is made to establish a waste minimization program, a written plan should be developed. This plan should focus on areas such as: improving material handling; establishing management initiatives; providing employee training; improving scheduling; improving spill and leak prevention; improving preventive and corrective maintenance procedures; establishing inventory controls; and segregating waste streams at the source of waste generation.

After the development of a frame work for implementing a waste minimization program, a waste minimization audit should be conducted. A waste minimization audit provides a means of improving business operations by identifying areas of strength and weakness in the management of hazardous substances and wastes. The waste minimization audit should identify hazardous substances in waste or emissions, and the sources of these substances. In conducting the audit, a company or organization should set priorities for various waste reduction activities and analyze whether the waste minimization approaches are technically and economically feasible, and environmentally beneficial. A comparison of the waste minimization and management alternatives should be made, and an evaluation of the results of the waste minimization audit should be conducted to make recommendations based on the results.

Once the waste minimization audit has been conducted and the procedures and policies have been established, a company or organization must implement these procedures and policies. This implementation phase will require an evaluation of waste minimization technologies. Justification for implementing waste reduction activities will be based, to a great extent, on capital expenditures. A feasibility study should be conducted in order to determine the best technology to be used, special design considerations, environmental controls, operational maintenance and monitoring requirements, off-site and on-site handling needs, safety and health risks, and operating costs.

An essential component of the waste minimization program is the linkage between management and operating personnel. A waste minimization program is virtually useless unless the personnel managing hazardous substances and wastes are made aware of the goals of the corporate or organizational policies and procedures. Management must make employees aware of the waste minimization effort. Employee training is essential if the waste minimization effort is to be successful. With the help from all levels of personnel, the waste minimization effort will have a good chance to succeed.

MARKETING SURPLUS CHEMICALS

Philippe LaRoche
Canadian Chemical Exchange Limited

CAN YOUR WASTE BE CLASSIFIED AS SURPLUS CHEMICAL ?

As soon as a waste is generated, we are naturally inclined to find a way to dispose of it, either by incineration, land fill or any other way of disposal, at the lowest possible cost, as fast as possible, and with the least paperwork.

With the help of waste exchanges and government initiatives, generators now have new options of transfering those wastes to other companies who can use them in their own production. Success of those waste exchanges is getting more evident and no effort should be spared in order to improve their efficiency, and therefore our environment.

Many obsolete materials or by-products could be regarded as surplus chemicals , instead of waste materials. Each waste or by-product generated should be carefully studied to evaluate its potential of being marketed as a surplus chemical before being classified as waste.

Most potential users of a product will openly consider using a surplus chemical but will be much more cautious when dealing with a product classified as waste.

Just by the nature of things, no one likes to use someone else's wastes. This attitude is obvious in our personal lives, and is also applicable in our business lives.

Furthermore, and on a marketing standpoint, it is much easier to sell a surplus chemical for a certain amount of money than selling waste materials. When wastes are marketed, buyers will use the argument that the material is of no value to the generator and will consequently offer a very nominal price, if any.

Just to confirm our point of wastes versus surpluses, many chemical companies defined as generators will prefer having a "Resource Recovery Division" or an "Investment Recovery Department", rather than a "Waste Disposal Department".

MINIMUM OF REGULATIONS FOR SURPLUS (OR RECYCLABLE) CHEMICALS

A very important consequence of classifying a waste or by-product as a surplus chemical is the fact that surplus chemicals are exempted from the disposal regulations.

In Canada, only the "Transportation of Dangerous Goods Act" applies when dealing with surplus chemicals. In the province of Ontario, "recyclable materials" are exempted from the regulation 309 of the Environmental Protection Act.

Because there is no need for manifests when dealing with surplus chemicals, the paperwork involved in a transfer from a generator to a user is down to a minimum. This is a very good incentive for marketing surplus chemicals, instead of disposing of them.

An important part of the transations performed by the Canadian Chemical Exchange involves products sold as surplus chemicals, that would otherwise have been treated as wastes, with a minimum investment recovery or high disposal costs, and a lot of paperwork. No problems have been encoutered in transfering those surplus chemicals within Canada, within the U.S.A. or between those two countries.

QUALITY AND PACKAGING OF SURPLUS CHEMICALS

In the marketing of surplus chemicals, a lot of care must be given to the quality and packaging of all products transfered.

The following steps are therefore strictly observed by the Canadian Chemical Exchange:

1- All products must be sampled prior to shipment, as well as every different lot of the same product. Samples must then be sent to the potential user of the material, for a physical inspection or a laboratory analysis, when needed.

2- When dealing with USP or cosmetic grade products, recent certificates of analysis must be available. If not available, products must be treated as technical grade material, unless a complete analysis is perfomed to confirm its USP or cosmetic status.

3- Chemicals shipped in drums, bags, pails, gaylords, etc... must be thoroughly inspected and checked for any damaged or off-specs batches. Drums containing rust or loose linings are automatically rejected (sealed drums are inspected at random). All bags are individually inspected for damages or other defects.

4- Lot numbers must be verified with the manufacturer to insure that the shelf-life of the product has not expired. When the shelf-life is expired, potential users must be aware of it in order to proceed with the evaluation of the material in their own laboratory, or by a private firm. (That service is also provided by the Canadian Chemical Exchange).

5- A technical data sheet from the manufacturer and a Material Safety Data Sheet must be on hand prior to shipment, in order to check the properties of the material, and to comply with the safety and labeling regulations.

6- When products must be repackaged, because of damaged or leaking containers or bags, the operation is carefully monitored by a qualified technician. USP or cosmetic grade products are never repackaged, but merely disposed of.

7- All drums are carefully cleaned or repainted, bags are cleaned and repalletized, weights are checked, safety labels are replaced when needed, etc...

8- Products not meeting the requirements of the Canadian Chemical Exchange are automatically rejected. Generators are then advised than their products can not be considered as surplus chemicals but classified as wastes, and treated accordingly.

By enforcing those procedures, we protect the credibility of our Exchange and our reputation. We know by experience that in order to deal with large chemical companies, we need to offer a lot more than a "good price". Each transaction must be performed in a professional way, with the objective of assuring a total satisfaction to the buyer and a long-term mutually beneficial relationship.

Some brokers are in the business of doing a fast profit, without the quality of the products in mind. Users should carefully check the integrity of any broker, ask for references, and verify the quality of all products offered to them.

EXAMPLES OF SURPLUS CHEMICAL TRANSFERS

1- PRODUCT: **ALUMINA TRIHYDRATE**

GENERATOR: Manufacturer of Aluminium Parts
By-Product from the anodizing division
Location: Hamilton, Ontario

NEW USER: Carpet Manufacturer
Used as Fire Retardant
Location: Montreal, Quebec

QUANTITY: 19,400 kgs / Every 3 weeks (336 tons/year)

MARKET VALUE: $ 106,480.00 per year

BENEFITS: Savings in disposal costs for the generator
Savings in raw material costs for the user.

2- PRODUCT: **METHYL METHACRYLATE**

GENERATOR: Liquid Terminal / Harbor
Flushings from lines
Location: Montreal, Quebec.

NEW USER: Manufacturer of Plexiglass
Used as Raw Material
Location: Pennsylvania State, U.S.A.

QUANTITY: 18,500 kgs / Every 18 months

MARKET VALUE: $ 32,745.00 per shipment

BENEFITS: Savings for the generator of $ 28,000.00 in disposal costs each time. Savings in raw material costs for the user. Better environment control for the liquid terminal managers.

3- PRODUCT: **ETHYL ACETATE**

GENERATOR: Major Pharmaceutical company
Recovered Ethyl Acetate with 2 % water content
Location: Toronto, Ontario.

NEW USER: Inks Manufacturer
Used as Solvent
Location: Montreal, Quebec.

QUANTITY: 2,700 kgs / Every two weeks

MARKET VALUE: $ 3,240.00 per shipment

BENEFITS: Savings for the generator in disposal costs.
Savings in raw material costs for the user.

4- PRODUCT: **HYDROCARBON RESIN**

GENERATOR: Chemical Distributor
Slow-moving Inventory
Location: Montreal, Quebec.

NEW USER: Adhesives Manufacturer
Used as Raw Material
Location: Minnesota State, U.S.A.

QUANTITY: 17,500 kgs / One time shipment

MARKET VALUE: $ 24,500.00

BENEFITS: Savings for the generator in disposal costs.
Savings in raw material costs for the user.

5- PRODUCT: **AMINO 5- 2, NAPHTHALENE SULFONIC ACID**

GENERATOR: Major Pharmaceutical company
Obsolete material / Outdated
Location: Toronto, Ontario.

NEW USER: Dyes Manufacturer
Used as Azo dye intermediate
Location: New York State, U.S.A.

QUANTITY: 2,940 kgs / One time shipment

MARKET VALUE: $ 12,465.00

BENEFITS: Savings for the generator in disposal costs.
Savings in raw material costs for the user.

6- PRODUCT: **MAGNESIUM OXIDE / U.S.P. / LIGHT**

GENERATOR: Catalysts manufacturer
Obsolete raw material / Caked material
Location: New Jersey State, U.S.A.

NEW USER: Specialties Manufacturer
Used in the manufacturing of Magnesium Stearate / Material was regrinded and repackaged
Location: Montreal, Quebec.

QUANTITY: 15,700 kgs / One time shipment

MARKET VALUE: $ 12,874.00

BENEFITS: Savings for the generator in disposal costs.
Savings in raw material costs for the user.

7- PRODUCT: **SODIUM SULPHATE (SALT CAKE)**

GENERATOR: Railway company
Partly contaminated with grain products due to a loading error.
Location: Mississauga, Ontario.

NEW USER: Pulp and Paper Manufacturer
Used in manufacturing process
Location: LaTuque, Quebec.

QUANTITY: 85,000 kgs / One time shipment

MARKET VALUE: $ 8,300.00

BENEFITS: Savings for the railway company in disposal costs and equipment recovery. Savings in raw material costs for the user.

8- PRODUCT: **SODIUM BISULFATE**

GENERATOR: Chemical distributor
Caked material in damaged drums
Location: Toronto, Ontario.

NEW USER: Manufacturer of swimming pools chemicals
Location: Montreal area, Quebec.

QUANTITY: 215 metric tons / One time shipment

MARKET VALUE: $ 64,500.00

BENEFITS: Savings for the generator in disposal costs, and warehouse space (1,185 drums).
Savings in raw material costs for the user.

9- PRODUCT: 185 SURPLUS CHEMICALS

GENERATOR: Filler for Aerosol Containers
Bankruptcy / Miscellaneous Specialties Chemicals
Location: Montreal area, Quebec,

NEW USER: Specialties Chemicals Manufacturers
Location: Canada and U.S.A.

QUANTITY: 78,900 kgs / One time only

MARKET VALUE: $ 172,000.00

BENEFITS: Savings for the trustee in disposal costs.
Assistance to the trustee in waste management.
Savings in raw material costs for the new users.

10- PRODUCT: ACETONE

GENERATOR: Pharmaceutical company
Recovered Acetone with 5% water content
Location: Montreal area, Quebec.

NEW USER: Yatchs manufacturer
Location: Montreal area, Quebec.

QUANTITY: 6478 kgs / Every 3 months

MARKET VALUE: $ 5,182.40 per shipment

BENEFITS: Savings for the generator in disposal costs.
Savings in raw material costs for the new users.

ROLE OF BROKERS IN WASTE

Shawn Vigodda
President
Whisper Trading Ltd.

"In the industry", I have been known as the "garbage lady". However, progress is being made and this recognition is transforming into "Bag lady". The reason is a simple one!

I no longer have to climb the forty (40) yard containers at the loading dock areas in order to shadily scoop a sample of the "garbage" that is being thrown out!

It has been proven enough times now, that this "garbage" does exist and that, in most cases, it is not really garbage at all. Therefore, I am seen as a respectable business person and, indeed, one who is interested in industrial garbage! This career of mine still finds me, more often than not, walking through a plant with the general manager or production supervisor and picking out interesting materials from the trash bins next to the lines. Sometimes I find myself (with as much composure as possible) running after the maintenance man before he dumps the hopper with its valuable cargo into the compactor. This man may be disposing of my "bread and butter", at which time we usually look for a "bag"... in which to stuff the exquisite samples. With my exciting new product stuffed in bags, I am able to make a respectable exit through the manufacturer's foyer and I am on my way to being a broker.

The role of the Reputable Experienced Broker in the sourcing and marketing of secondary materials is invaluable to the economic growth of our nation. A true waste broker is an entrepreneur determined to make a silk purse out of a sow's ear. With any skill at all, he will sell it at a profit. Unlike the commodities broker at the stock exchange, we have no ready made portfolio of products to buy or sell, unless we source

our own. Often times we must beg industries for the opportunity of proving to them that we can sell their waste. We are inventors of sorts, taking risks with obsolete, surplus or downright waste materials to create uses for these products, or at least channel them into recovery processes where they once again become a primary product or a valuable component. We must build our own portfolio of products from many industries.

As a result of waste brokers, "Product Development" is taking on a new meaning in Canadian and, indeed, North American industry. Product development in the waste field incorporates using a surplus or waste component from a manufacturing process and through great effort, turning that off spec item into a primary ingredient for a slightly different or a totally unrelated finished product from the original.

Slowly, and it is slowly, industry and the business communities are beginning to realize that creative thinking and entrepreneur spirit are required to transform waste into a desirable marketable product. The challenges are still monumental and will take unyielding determination to conquer.

Many companies still deny they have waste. However, most industries will state, when asked, that their waste factor is approximately three to seven percent (3-7%). When challenged, one will find that, indeed, this is true under perfect conditions. Consider; production and scheduling changes, equipment down time and human error all contribute to the making of waste. The true statistics are well into the fourteen to twenty percent (14-20%) range. Industries are lax about this because they have their waste factor, or think they have their waste factor built into their selling prices. Any gain on waste recovery is pure profit. Additional profit is savings in landfill costs.

Brokers are direct lines to information regarding world market trends. Industry is afraid that a broker may profit by marketing its waste and feels that this profit should really stay within the company. Companies believe that sales people working for the company should sell the waste. In this case, the manufacturer fails to realize that its primary business is making widgets. They do not take into consideration all of the positive aspects of working with a good broker.

(1) The broker is very protective of your product. He is always acting in your best interest, making sure that any one market is not saturated and that the price is maintained. After all, it should be that, if a broker is making money, so is the generator, in one way or another.

(2) Unlike an agent, the broker takes all the risks.

(3) Because of the wide spectrum of reutilized wastes, the broker in a close relationship with a customer may be able to have the generator improve on a product so that it is, indeed, no longer a waste but a primary product. This happens frequently in our company. An example of this is - our Vice President of marketing, Mr. Don Smith. He has been in the textile field for thirty (30) years. He suggested to one of our customers that they take one of their by-products and process it just a bit further. This by-product was being sold at a very low level and there were hundreds of thousands of pounds of this material. This customer is 'very high tech' knowledgeable within his field. However, because a waste broker knew there was a certain need for a product, he was able to assist in further product development. This development turned a by-product into a primary product. Now the market's "completely opened up" and at first quality prices.

In the case of Whisper Trading, we, as brokers, offer Canadian industry access to world markets, not only for waste but also for primary product. Waste commodities and first quality are very closely linked, believe it!

Canadian industry is very content to sell domestic. It is much easier and much less of a risk. In most cases it is also more profitable. This is fine as long as there is no competition. But there will be competition. Canadian industry's survival depends on being able to market domestically at world level prices. The broker takes the sting out of marketing offshore. We, for instance, purchase products for export. We purchase the goods and handle every detail from the time of purchase:

Payment
Transportation arrangements
Relabelling or repacking if required
Loading containers
Export Documentation
Letter of Credit

Brokers are essential and are the extra force that is required to make our nation competitive. We must all become aggressive in reducing waste, reutilizing waste and marketing waste so that we may be so efficient that our primary products are produced at competitive levels to ensure that we may export competitively throughout the world.

We must stand up and meet the challenge.

We have the skills to be competitive and brokers play an integral role.

Brokers are true commodity traders.

BROKERING OBSOLETE AND SURPLUS CHEMICALS AND MATERIALS

Jeffrey M. Berman, Park Trading Company

My topic is brokering surplus and obsolete chemicals. However, I actually deal in surplus chemicals. Brokering is putting a buyer and seller together and standing aside for a commission. I buy and sell surplus chemicals, keeping the buyer and seller apart and taking possession of the goods in transit. In doing this, I have more of a say in my profit in each deal. As you read each waste exchange publication, you will notice that surplus chemicals take up little space in those publications and thus account for a small part of the chemicals that are recycled. However, it is an important and, I feel, exciting part of recycling since the chemicals are always changing and new markets have to be developed.

In starting my talk I'd like to give you some background on my company, Park Trading. Fourteen years ago my father, Samuel Berman, was unemployed. He had a metal finishing company that had failed. I, being the oldest of seven children, was now just starting graduate school. My father knew of a warehouse of chemicals that were being auctioned and he also knew of one fellow business man who could use two of the items. At this time my father was fishing around for something to do. He bid, on the whole warehouse, the amount that his friend had offered him for two of the items, and he won the bid. To sell the remaining items, he and I started telephoning companies listed under chemicals in our local yellow pages directory. Usually they would say that they didn't use what we had for sale but that they had surplus chemicals for sale and would we try to sell them. We never expected this to be a continuing endeavor, but, considering that we had nothing else to do in earning a livelihood at that time, we listed the chemicals and offered them, along with the ones we had for sale. Slowly the business grew. We ordered more telephone directories from around the country and the business grew.

WHAT ARE SURPLUS CHEMICALS?

Surplus chemicals are resins, solvents, colors, waxes, oils, pharmaceuticals etc., that have never been used and still, hopefully, have value. Usually they come from original manufacturers who have lost customers for their goods, or from users who have phased out the use of that chemical. Sometimes we're offered surplus laboratory chemicals from schools. Sometimes we're offered surplus that has been abandoned by companies who have gone bankrupt.

ARE ALL SURPLUS CHEMICALS SALEABLE?

No. Usually before we are offered surplus, the owner has explored different methods of moving his material. He can try to work off the material. He can try to send the material back to the distributor or original manufacturer for a restocking charge. He can offer the chemicals to other potential users in his geographic area or, in fact, call on his friendly competitors. What can't be worked off, returned, sold, or given away is offered to us. In many cases

we're the last stop before disposal. Usually the chemicals we are offered will be specialized, difficult to market chemicals. They are not your typical, easy to move commodities. Of course the question also occurs, "Are all surplus chemicals useable?" Again the answer is no. Most of the chemicals offered to us are overaged. In other words, the recommended storage life has expired. In some cases they are off spec and sometimes aren't even in the original packaging from the manufacturer. Sometimes the quantities are not large enough to justify shipping any distance, thus limiting the marketability. So, in many cases, we have specialized chemicals of questionable quality that can be shipped only within a set geographic area. This is, indeed, a formidable task.

WHAT DOES PARK TRADING COMPANY DO?

We specialize in buying and selling surplus chemicals. We try to do back to back deals, taking possession of the goods in transit, between the seller and the buyer. I feel that we are chemical dealers. Brokers bring together buyers and sellers and stand aside for commissions. We keep the buyer and seller apart and hopefully maintain more control over the situation. However, in limited cases, we do broker chemicals, especially when technical expertise is required, the chemicals are extremely hazardous and difficult to ship, or when we don't feel that the risks are worth the profit from a certain deal. Also, if a profit can't be realized from a deal, let's say when the quantity is small, we will put the buyer and seller together at no charge in order to incur goodwill.

HOW DO SURPLUS DEALERS LIKE PARK TRADING ACQUIRE SURPLUS OFFERS?

We advertise in trade journals and newspapers. We have listings in the waste exchange publications. We solicit by telephone and mail. Also there is repeat business and referrals from satisfied clients.

WHEN SHOULD A GENERATOR OF SURPLUS CALL A DEALER?

When the manufacturer of that product won't take back the material or when the owner can't work off or sell the surplus to a friendly competitor. If he's not successful, then he should call us. Sometimes the original manufacturer of a chemical will buy back his own product from Park Trading rather than from the owner. This way he can save manufacturing costs and protect his image in the market place.

WHY SHOULD A DEALER OR BROKER BE USED?

The surplus dealer can save the owner a great deal of time. Usually surplus is offered by the purchasing department of the company. As we all know the purchasing department was created to buy chemicals and not to sell them. Selling surplus in most cases in most companies is not a full time job. We, however, do sell surplus on a full time basis. Dealers specialize in creating deals. We have the expertise in bargaining and have the knowledge of surplus chemical values. We have contacts in the freight industry and the financing to put together surplus deals.

Park Trading can offer your product to many potential customers within a very short time. We've culled from the chemical buying audience those companies who will buy surplus chemicals. Many companies won't buy surplus because the original manufacturer won't guarantee the quality if the material is over the storage life or if the material is being offered as surplus. Also, we protect the identity of an owner who might not want it to be known that he's selling surplus. We advertise the offers under our own name.

CAN THE OWNER OF SURPLUS DEMAND THAT THE DEALER BROKER HIS MATERIAL?

In some cases the answer is yes. A dealer can't be an expert in all areas. He might be an expert in one field from a previous job or educational experience but basically he will have a little knowledge about a lot of different items. Thus if the owner has an item that requires technical expertise or is extremely hazardous, he might want to control the situation. He might want to demand that the surplus dealer take a broker's position and put him in touch with the potential user for a specified broker's fee. I've done this myself at times and like to work from the position, be it dealer or broker, from which I can be most effective.

THE CHANGING IMAGE OF THE DEALER

The image of the surplus dealer is changing. In the past the surplus dealer competed with cheap easy disposal. The dealer was someone who was there to take advantage of a company when it was in the unfortunate position of having surplus. It was just as easy to call a disposal firm as to call a dealer and, in many cases, a company would rather dispose of goods than take the time and effort to enter into a relationship with a surplus dealer. However, now, with stricter disposal laws and rising disposal costs, the surplus dealer is viewed as a more favorable alternative to disposal. Park Trading helps industry realize more value from surplus than ever before. Selling surplus is the best type of disposal, economically and environmentally.

Thus I foresee more activity in the surplus market. As more companies become more environmentally and economically minded, and realize the advantages of using a surplus dealer, we will participate more in the recycling of surplus chemicals.

DEALING WITH INDUSTRIAL WASTES AS COMMODITIES

Daniel Reddington
Commodity Improvisors Inc.

GOOD AFTERNOON:

FIRST, I WANT TO THANK MR. LAUGHLIN ----------AND LEWIS CUTLER OF NEW YORK STATE, FOR INVITING ME TO SHARE WITH YOU SOME OF MY VIEWS ON THE COMMODITY TRADING ASPECTS OF WASTE MATERIALS. MY NAME IS DANIEL REDDINGTON------SINCE THE END OF WORLD WAR TWO, I HAVE BEEN ASSOCIATED WITH THE

BUYING SELLING HEDGING AND ALL AROUND TRADING OF

CRUDE RUBBER COFFEE COCOA BEANS CURRENCY'S AND

MISCELLANEOUS COMMODITIES SUCH AS SPICE. MOST OF THIS TIME WORKING FOR AN INTERNATIONAL TRADING HOUSE IN THE WALL STREET AREA.

SINCE THE EARLY EIGHTIES, RIGHT AFTER THE HUNT BROS MESSED UP THE NORMAL YING AND YANG (GIVE AND TAKE) NATURE OF THE MARKET PLACE I HAVE BEEN RUNNING A SMALL TRADING COMPANY LOCATED ON LONG ISLAND. I CALL MYSELF COMMODITY IMPROVISORS, BECUASE I DEAL IN DISTRESSED (SALVAGE--SALVAGABLE) MATERIALS THAT ARE LOOKING FOR A HOME....

I HAVE FOUND THAT ONE MANS WASTE, IS ANOTHER INDUSTRIES PRIME MATERIAL. I HAVE ALSO DISCOVERED, THE SCITZOPHRONIC NATURE OF WASTE AND SALVAGABLE MATERIALS

I HAVE OBSERVED FOR INSTANCE-----POLYURETHANE SCRAP, CAN DROP IN PRICE FROM THE HIGH 40'S TO THE LOW TEENS, AND BACK TO THE HIGHS AGAIN IN VERY SHORT ORDER.---MAKING IT IMPOSSIBLE TO KEEP ANY SORT OF A DAILY--WEEKLY OR MONTHLY GRAPH ON THE PRICE ACTION OF THIS MATERIAL.

IN OTHER WORDS-----YOU CANNOT CHART THIS COMMODITY FROM A TECHNICAL VIEW POINT.

RECENTLY, I HAVE BEEN DRAWN TO THE RECYLING TIRE PROBLEM---

AS YOU KNOW, WE GENERATE IN THE UNITED STATES ALONE, SOME 250 MILLION USED TIRES PER YEAR.....HOW DO WE DISPOSE OF AND UTILIZE THESE PERFECTLY RECOVERABLE AND VALUABLE ASSETS?

THESE ARE ONLY 2 OF THE MATERIALS IN THIS THROW AWAY SOCIETY THAT PRESENT A PROBLEM.-----NOT TO MENTION PLASTIC GLASS ALUMINUM CANS AND MANY OTHER MATERIALS THAT ARE OUT THERE.-

MANY OF THESE WASTE AND THROW AWAY ITEMS NOT ONLY PRESENT

A PROBLEM....BUT ALSO OFFER AN OPPORTUNITY FOR SOME GROUP

OF FORWARD LOOKING PEOPLE TO ESTABLISH A WORKABLE AND

DELIVERABLE PACKAGE OR CONTRACT THAT CAN BE TRADED--HEDGED

OR JUST PLAIN LAID OFF BY INDUSTRY. SIMULAR TO THE WAY

WE TRADE PORK BELLIES SOYBEANS CORN OR DEUTCHE MARKS.

I DON'T LOOK UPON WASTE AS A PROBLEM----I SEE GREAT

OPPORTUNITIES FOR SOME FAR SIGHTED AND FORWARD LOOKING

GROUP (MAYBE IN THIS VERY ROOM) TO PICK UP THIS OPPORTUNITY

AND RUN WITH IT.

THANK YOU FOR YOUR KINDNESS IN LISTENING TO ME-----IF I CAN

BE OF ANY HELP PLEASE FEEL FREE TO CONTACT ME.

IF YOU HAVE ANY QUESTIONS I HOPE THAT I CAN ANSWER THEM

SATISFACTUALLY.

THANK YOU AND GOOD DAY------

THE MARKETING OF ENVIRONMENTAL SERVICES TO SMALL QUANTITY GENERATORS

Keith C. Coffin
Safety-Kleen Canada Ltd.

INTRODUCTION

When I first agreed to accept this paper presentation, I decided to draw upon by vast experience as a youth who was raised on television. Therefore, I've decided to show a video that will in part explain how our Company has been so succussful in penetrating the small quantity generator market of the waste management field.

Before we review the video and begin discussing the small quantity generator, it would be advantageous to lay the following groundwork.

The concept of waste management for small quantity generators is nothing new. Every household in America produces some form of waste that needs to be disposed of or treated. For the most part, landfill, incineration, or public sewage systems have supplied the answer to these disposal questions.

The topic this paper shall address is that of small quantity generators who are of an industrial or commercial nature. This market segment is one that accounts for much of our industrial pollution, yet is frequently overlooked by waste management companies for a number of reasons. The most important of these reasons being the ability to turn a profit. Safety-Kleen is one company that has successfully penetrated this market segemnt. We currently service over 17,000 small quantity generators of waste in Canada alone.

We have developed a certain degree of expertise in this area and we would like to share some of it with you. In particular, with regards to the Marketing of services to the S.Q.G..

In preparing this paper, I have made a couple of assumptions. The first one being that everyone has some knowledge of basic marketing concepts or principles. The second assumption I made is that this paper would be of more benefit to those interested in this topic if it were in point form.

DEFINING THE MARKET

The first issue we must address is defining the market to which we are referring and its nature. A small quantity generator (according to the E.P.A.) of waste, is anyone who produces between 100 and 1,000 (waste) kilograms during a calendar month. This definition effectively eliminates most of America's households. Therefore, we are talking about small industrial and commercial concerns. Larger companies may also fall into the S.Q.G. segment of the market if their process only produces amounts of waste that are between the 100 and 1,000 kg. level.

MARKET CHARACTERISTICS

1. More Than Just A Disposal Service

The first characteristic that is noteworthy, is that not all of the companies that fall into the small quantity generator segment are governed by environmental legislation. Companies may be exempt based on the type of waste they are producing, or the manner in which it is produced. Whether or not a company is exempt from environmental law has little to do with how knowledgeable they might be on environmental matters. Therefore, the service provided should be more than just a disposal or waste treatment service.

MARKET CHARACTERISTICS

2. Understanding Legal Requirements

Most S.Q.G. have little understanding of environmental legalities. This is perhaps the single most important factor when trying to penetrate this segment of the market. While everybody has an environmental conscience, not everyone is capable of making the right decision given certain economic parameters. If a small quantity generator is aware of waste regulations, yet he continues to improperly dispose of his waste, it is problably due to the cost of proper disposal.

MARKET CHARACTERISTICS

3. Affordability

A decision to illegally dump is an economic one. Ignorance of the law and the possible legal repercussions of not complying serve as allies. Therefore, if we are to address this market we must acknowledge that to garner business we must first educate small quantity generators on hazardous waste regulations. Then we must keep the cost of such services at an affordable rate. This reduces the desire to disregard the law.

SMALL GENERATORS: COLLECTION AND RECYCLING OPPORTUNITIES

Wm. Kowalchuk, Varnicolor Chemical Limited

Madam Chairwoman, fellow speakers, and guests. Varnicolor Chemical Limited has been reclaiming solvents for over 25 years. The company was founded by Severin Argenton, because he was dismayed about the waste of still useful chemicals, and because of his concern that the environment would be damaged.

Varnicolor to this day sells reclaim on the basis of environmental protection and not on the basis that laws and regulations are the driving force behind recycling or indeed disposal.

Our company encourages the recycling or reclaim of a wide range of chemicals from paint solvents to CFC's. We do this because it saves our customers money, and because we can earn our keep by providing such a service.

Our main customers in the beginning were one and two drum a week customers. The firms were in the chemical industry and they were "trying out" a claim by Severin Argenton our founder that even $.39 a gallon material was worth recovering. From that point, Varnicolor has grown and now serves customers from all over Ontario in the paint, automotive, and high tech industries.

One of the biggest problems we've had in the promotion of recycling or reclaim is to get the confidence of buyers, production engineers, quality control scientist, and others at the plant level. Often reclaim or recycling are words which suppliers of new, virgin product turn into disincentives to reclaim. I've often thought that like Xerox, it might be wise to invent a new word to describe our service. For example XEMOXOPHY could describe the act of cleaning chemicals so that they will be as useful as the virgin material. Such a word could be useful in describing that what Varnicolor does is make the chemicals it handles as waste into product for reuse by its customers, and garbage which is now low in volume and more easily disposed. In one instance we can claim that the customers waste is recovered as 2 products leaving almost no waste to be disposed.

I hope that my brief commercial on behalf of Varnicolor will acquaint you with our purpose and service, and that you'll keep us in mind when solving your client's problems.

Varnicolor has, over the last year become concerned about small quantity generators as opposed to small generators indicated in the title of my talk. This concern began with the large number of calls we began to receive from environmentalists, municipalities, and citizens. It is clear from Regulation 309 in Ontario, and E.P.A. regulations in the U.S.A, that small quantity generators have been considered and have been purposely treated differently. The regulations to control, register, and monitor small quantity generators could easily be put in place, but the supervision, response, and administration of this category of waste generators would be impossible for government to establish.

This is rather ironic, because it is the citizen, the homeowner, the voter who has campaigned to clean up the environment. The pressure is on the local, state, provincial and national governments to clean up the pollution, to get control of the waste stream and to ensure better management of all waste. The constituents are pressing representatives and the representatives are pressing industry.

Over the last ten years, the agencies charged with protecting the environment have gone a long way towards doing just that. We are all now at the stage where we have a pretty good grasp on where waste is generated, how it is moved, who moves it, and where it ends up. We also generally support in house waste reduction programs to clean or distill some chemicals in small quantities. The effort demanded by the public in my opinion goes ahead of what government and industry is now doing. The public want all of the waste accounted for and all of it properly handled. This includes the material generated at the household as well as in industry.

In Ontario, the public strongly supports the four R's. In the United States, the public and industry support programs similar to the 4 R's on a private basis.

In Ontario, the government and the municipal authorities fund and encourage the proper disposal of hazardous chemical waste from households. Our experience also points to the desire of the local community to encourage the 4 R's. Once material is collected, the public would much rather see it reclaimed then destroyed.

Varnicolor began last year to encourage recycling among auto related service outlets within the context of Regulation 309. The selling of the auto body shops and the dealerships on the notion of recycling began in the Kitchener area. We went in with an offer to pick up waste paint and solvents and to clean them for use as a gun wash. Without emphasizing Ministry of the Environment regulations. We got 65 out of 90 potential contracts within the first month. Since then additional shops have joined our efforts to protect the environment. We push the idea of saving the environment first, the saving of money second, and hardly ever use the Ministry regulations, except in a positive way.

We do, in this way, forge a progressive relationship between government and industry to keep our environment pure.

Small quantity generators may be found in the community at the household level, in small industry, among contractors, and in large industry.

Since our push at the auto service level we have begun working with a firm which specializes in serving body shops. They will look after pickups throughout Ontario on a non-subsidy basis. They will be selling service and savings in this sector. Free enterprise principles can and do promote environmental quality. In my opinion selling waste management is superior to using regulations as the only reason for doing business.

We are now looking at community level pickup of waste from households. Up to now, the special waste days have operated on the depot concepts. Municipalities would set up special depots and organize several Saturdays when people could drop off hazardous waste in original containers. While responses have been good to these programs in Waterloo region since 1983, there are indications in this region and in others that more service should be provided.

My study of this matter indicates that the most popular method of waste management at the household level is storage. Paints, oils, and solvents often are left by painters for "touch up" purposes and then simply passed on to the next buyer of the home. My son-in-law called me after he bought his first home and asked what he could do with over 70 containers of paints and solvents.

The public demand for service leads me to believe that Varnicolor could, with sufficient government support, organize a door to door pickup service. The quantities of chemical being disposed of in the Metro area is said to be 34 litres per home per year. In Waterloo Region, this would be 3.4 million litres of paint solvent and cleaner requiring pickup and disposal. A door to door service could be set up and with the aid of a computer to serve a fairly large metropolitan area if pickups were scheduled 30 days ahead of time by sector, and all pickups were in original containers. The depot pickup system could continue at landfill stations as well as other sites. The staff, trained for the door to door pickup service, could also do bulking at the depots.

Based on our research for every 25,000 households, it would require a pickup vehicle, an office staff, and a field person.

Additional pickup staff and a transfer site would be required in larger centers.

There are a number of opportunities out there to serve small generators with reclaim services. I feel that many of you might want to explore these as part of your current activity. I'm sure the body shop business will flourish. The household service can be organized by municipalities or by private firms. We would be happy to consult on this possibility with you.

I think, however, that many of you concerned with exchange of waste, may also see some opportunities. For example, cleaning chemicals which are slightly contaminated. The industries you serve may also have many waste streams, some of which can be recycled. For example, a customer may have an acid wash for disposal and some non-reactive solvents which could be recycled. Instead of throwing the two together for disposal, saving it separately could lead to savings by reclaim of the solvents.

Disposal companies will more and more be under pressure to not only dispose, but to find ways of recycling. Varnicolor is always interested in new opportunities. We invite your inquiries.

Small quantity generators do have problems. For example, it might take more than three months to save even one drum of a particular waste. To do recycling the 90 days limit is violated.

Another concern is that segregation of chemicals is undesirable when bulking waste for disposal, but highly desirable when recycling. The concept of reclaim and reuse as a first principle depends on the facilities being put into place. Your customers may have to reorganize their systems of collection, and storage to make reclaim effective.

The whole range of solvents from Acetone to Xylol and most chlorinated and fluorinated solvents can often be recycled. Some may be generated in one drum a year lots, while others in the tens of thousand litres per month. We can usually help by ensuring a maximum reclaim and proper disposal of residue. The possibilities for you have just expanded. As a trader in waste exchange or a disposal/transport agent, you are invited to offer reclaim as an added service. Where I can, I will assist on behalf of Varnicolor.

Our President, Severin Argenton, built a business on the logic of not throwing away any usable material. That philosophy is the driving force behind our ability to serve the environmental interests of the public and the practical interests of your clients and ours.

HAMILTON AUTOBODY REPAIR ASSOCIATION: A COLLECTIVE APPROACH TO WASTE REDUCTION

R. G. Buggeln, C. L. Procopio & D. A. Cobb

INTRODUCTION

The threat of monetary penalty seems to be the most effective measure that government agencies use to provoke industries into reducing the discharges of wastes into the environment. However, there is also a variety of government programs and financial incentives to encourage industries to apply the "4 Rs": reduce, recover, reuse and recycle. In a subtle way, industries are being asked to change their corporate thinking and to become "materials handlers"-- that is, to abandon the distinction between desirable, manufactured products and production wastes and to treat all end products as by-products of the overall manufacturing process. While this conceptual reorganization must occur within both large and small industries, the "economy of scale" places some special demands on those industries that may be classified as small quantity waste generators.

The following paper outlines some of the general characteristics of small quantity waste generators and reports on the approach which the Hamilton Autobody Repair Association (HARA) is taking in the matter of the solvent/paint by-product of autobody refinishing.

SOME CHARACTERISTICS OF SMALL QUANTITY GENERATORS

There are two interacting categories of industrial waste management problems, brought on by economy of scale, that beset small quantity generators. The first category may be referred to as social; the second, material. The social problem is an educational one, and its dimension may be illustrated by example. A large firm generates 1,000 gallons/month of waste product X that can be recycled after some refining. We may estimate that perhaps 10 individuals in that firm---from the chief executive officer to the process line foreman---may have to be educated that saving product X for internal or external reuse/recycling is worthwhile. On the other hand, if the total output of waste product X from 35 small companies is 1,000 gallons/month, perhaps 2-4 individuals per company may need to be convinced of the <u>potential</u> value of the small quantity of product X that they produce. The educational requirement per 1,000 gallons of X is 10 individuals for the large firm, but on the order of 70-140 individuals for a pool of 35 small companies.

The material problems relate to product X, supplied in 1,000 gallon/month quantities by 1 large firm versus 35 small ones. Some of the important considerations if product X were potentially offered in the market place are: uniformity and scheduled availability of product; transportation/collection logistics, etc.

The 35 companies potentially represent a "critical mass" insofar as the production/availability of 1,000 gallons/month of product X is concerned. However, an intercompany alliance must be established in order to thoroughly investigate the objective of supplying this product. In many industrial sectors such business alliances are formalized as industrial, manufacturer or trade associations. In such associations, a strong, motivated and knowledgeable leadership, drawn from the collective membership, is the instrument by which enlightenment of fellow members can occur for the benefit of the entire association.

The role and responsibility of the executive of the 35-member association producing product X would be to arrange investigations on the feasibility of producing a marketable, 1,000 gallon/month supply of product X by the association. In theory, therefore, the existence of a cooperative association of fellow small businessmen---a critical mass---provides the framework for dealing with some of the social and material aspects of the economy of scale in certain areas of industrial waste management.

THE HAMILTON AUTOBODY REPAIR ASSOCIATION

The 55-member Hamilton Autobody Repair Association (HARA) is an example of an association of small waste generators which is methodically exploring alternative measures for dealing with the waste paint/solvent residues which accumulate as a by-product of painting motor vehicle bodies. HARA represents about 90% of the licensed autobody repair shops in Hamilton, Ontario, and the surrounding communities of Stoney Creek, Dundas, Ancaster and Burlington; the association serves a population of approximately 500,000.

The source of waste solvents derive from left over formulations of paints and lacquers that were prepared with various special solvents (reducers or thinners). As well, an all-purpose solvent is frequently used for cleaning paint spray equipment. The spent solvent/paint mixtures are hazardous substances and current regulations in the Province of Ontario prohibit long term storage of large volumes of this material. This legislation calls for the disposal of waste solvents via a licensed carrier and disposal service with appropriate documentation to track the movement of the materials from the waste generator to the disposal agency.

The increasing expense of waste solvent disposal was voiced by the HARA membership and the HARA executive responded by commissioning a study of the association's waste solvent problem. A three-phase study was initiated through the ON-SITE program (an industrial waste management job creation program currently in

place in the Provinces of Ontario, Quebec, Alberta and British Columbia).

Phase I---Waste solvent generation by HARA

In the ON-SITE study, 13 shops were asked to participate in a survey. They were selected on the basis of shop size and length of time in business. A questionnaire was drawn up and data on virgin solvent purchases, waste solvent generation and disposal practices were obtained during July-August, 1987. The results of the survey are summarized in TABLE I.

For the 13 shops, the purchases of solvents for paint and lacquer formulations averaged 120 liters/month. This number can be extrapolated to estimate a total volume of over 7,000 liters/month (~1,500 gallons) for all 60 licensed shops in the Hamilton area (HARA members plus non-members). Only 6 of the 13 shops (43%) purchased a general utility (cleaning) solvent service, so the estimated usage throughout the industry (26 of the 60 shops) would be about 500 liters/month.

Production of waste thinner/reducer paint formulations averaged about 40 liters/month in the sample of 13 shops, or an estimated 2,400 liters/month for all 60 shops. This latter figure may be an underestimate due to the wide variation in solvent use and handling, i.e., excessive solvent use, casual evaporation from open containers, non-approved disposal methods, etc. This material is about 2,400/7,400 x 100 = 34% of the volume of thinners and reducers purchased each month (exclusive of the utility solvent). It should be noted that the waste material is not all spent thinners and reducers. The quantity (%) of recoverable solvent was determined in Phase II of the study presented below.

The average disposal costs sustained by shops participating in a registered carrier pick-up service ranged between $1.00 and $3.60/liter for spent thinner/reducer formulations. The average cost for pick-up, disposal and replacement of the utility cleaning solvent by a commercial vendor was $3.60/liter in July-August, 1987. In 1988, this latter cost has risen by nearly 75%. The retail cost of the utility solvent alone is $1.70/liter.

Phase II---Chemical characterization of waste solvent

The Ontario Waste Management Corporation funded a joint proposal from HARA/ON-SITE and the Ontario Research Foundation to chemically characterize the composition of the waste solvents from the shops surveyed in the ON-SITE study. TABLES II & III give the results of the analyses conducted on samples collected in November, 1987. Approximately 2-3 liters of waste solvent were collected from each shop and whenever possible a pooled sample was obtained from several waste storage drums (see column 3, TABLE II).

Samples of each waste solvent collection were distilled to determine distillation characteristics and to quantify the

TABLE I

Summary of Solvent Purchases and Waste Solvent Generation by HARA

	Average liters/month	
	13 shops	60 shops (estimated)
Solvents:		
A Thinners and reducers for laquer and paint formulations		
Volumes purchased (av. cost/liter - $3.02)	119	7,140
Volumes of spent solvent/ paint waste generated (range of disposal costs - $1.06 - 3.58/liter)	40	2,400
B General utility solvent for equipment cleaning	6 out of 13 shops	26 out of 60 shops (estimated)
Volumes purchased (complete service charge - $3.58/liter - July-Aug 1987; Feb 1988 - 74% increase)	40	494
solvent cost alone - $1.66/ liter - March 1988		

TABLE II

General Assessment of
HARA Waste Solvent Status - November, 1987

Sample #	Approx. volume (liters) of waste solvent/(paint) on hand	Total volume (liters) in storage container(s) /(Number of storage containers sampled)	% distillate recoverable	% residue
1	270	68/(3)	79.4	20.6
2[a]	-	23/(1)	99.0	1.0
3	18	90/(4)	45.5	54.5
4	45	45/(2)	82.0	18.0
5[b]	45	23/(1)	83.2	16.8
6	9	23/(1)	71.8	28.2
7	225	90/(4)	86.8	13.4
8	23	45/(2)	80.9	19.1
9	23	45/(2)	90.9	9.1
10[c]	1665	23/(1)	76.5	23.5
11[c]	810	23/(1)	68.6	31.4
12[c]	45	45/(1)	79.3	20.7
13	270	23/(1)	53.8	46.2
			$\bar{X}$ = 74.9[d]	25.1[d]

[a]utility solvent
[b]spent utility solvent/paint
[c]mixture of paint formulation solvents and spent utility solvent
[d]averages do not include sample #2

TABLE III

Tentative Identification of the Chemical Constituents in HARA Waste Solvents

Compound[a]	Sample # and composition (volume %)					
	1[b,c] (top) %	5[c] %	6[c] %	9[c] %	2[d] %	12[e] %
IPA*	3.3	10.0	0.9	5.4	0.4	5.4
MEK	0.4	0.6	0.1	6.8	2.5	0.2
1,1,1 Trichloroethane	0.8	1.4	0.1	-	1.0	-
Ethyl Acetate	-	-	-	0.5	-	-
n-Butanol	-	9.3	-	-	-	-
Cyclohexane	0.4	-	-	1.0	2.7	-
Benzene	-	-	-	0.1	-	-
Propyl Acetate*	4.1	0.3	0.3	-	0.2	-
C_8 Olefin*	0.1	0.8	0.1	4.4	0.1	0.2
MIBK*	3.3	6.7	5.7	8.6	13.7	6.3
n-Heptane	-	0.2	-	1.0	0.1	-
Methyl Hexane	0.5	0.3	-	1.0	2.5	-
Butyl Acetate*	30.8	21.6	27.9	19.9	16.1	27.2
Toluene*	3.7	1.1	0.1	4.3	2.0	3.0
Methyl Ethyl Cyclopentane	-	-	-	0.5	-	-
Ethyl Benzene*	10.4	7.0	10.0	4.8	10.5	9.1
n-Octane	10.4	0.2	0.5	2.5	-	-
Isobutyl Isobutyrate	2.1	11.6	12.1	5.8	1.4	-
Xylene*	17.3	12.3	24.8	14.6	15.7	32.2
Alkyl benzene (trimethyl)	6.2	3.8	5.1	2.4	4.6	3.7
Di Methyl Cyclohexane	-	-	-	0.7	-	-
Total (%)	93.8	87.2	87.7	84.3	73.5	87.3

[a]water content: 0.05% - 0.5% except 20% in sample No. 1.
[b]bottom: (* above), methoxypropanol, 2-propoxyethanol, methanol.
[c]waste solvents.
[d]utility solvent.
[e]waste solvent + utility solvent.

recoverable solvent. Selected distillates were further analysed by gas chromatography/mass spectrometry (GS/MS) to determine a tentative chemical composition. Water content of the distillates was also measured by Karl Fischer titration.

The average solvent recoveries shown at the bottom of columns 4 & 5 of TABLE II do not include the data from sample #2, a fresh sample of commercial, utility cleaning solvent. The recoverable distillate ranged from 53.8 to 86.8% (by volume) with an average of about 75%. The remaining 25% was paint solids.

Water content of the distillates varied between 0.05 and 0.6% with the exception of sample #1 which contained an unusually high value of 20%. The reason for this high value is not apparent as the solvent storage containers were stored outside, but under cover.

The results of the GC/MS analyses of 6 of the distillates are shown in TABLE III, using the sample identification numbers given in TABLE II. The distillates from sample #s 1, 5, 6 & 9 contain only waste paint formulation thinners and reducers. Sample #2 is a "reference" sample of the utility cleaning solvent and sample # 12 contains a mixture of waste thinners and reducers plus spent, utility cleaning solvent.

In TABLE III, the number at the bottom of each column gives the total components in the distillates which could be quantitatively identified (volume %), with each chemical compound in the left hand column accounting for a given proportion of the total composition. Total volume % characterizations of the distillate compositions ranged from 74 to 94%. A summary comparison of quantitative rankings of the major components in each of the samples is shown in TABLE IV. Butyl acetate and xylene rank 1 & 2, respectively, in 6 distillates and they account for between 32 and nearly 60% of the total content (volume %). Ethyl benzene ranked either 3rd or 4th in 4 of the 6 samples. The lowest volume % of identifiable components is seen in sample # 2, the virgin, utility cleaning solvent (73.5%). It is interesting to note that sample # 12, containing a mixture of the utility wash solvent and spent paint formulation reducers and thinners, had the fewest identifiable components (9). In addition, 6 compounds present in the sample of pure utility solvent (sample # 2) were not detected in the mixed sample # 12. The number of identifiable components in the other samples ranged from 13 to 18.

Phase III---The waste management potential of the HARA "critical mass"

At least 2 motor vehicle body repair shops in southwestern Ontario already distill spent paint formulation thinners and reducers for their own reuse. The 2,400 liters/month of HARA waste solvents (thinners & reducers/paint) could be distilled to recover 75% of the starting materials, or 1,800 liters/month. This material could be used as a utility cleaning solvent. The volume of this HARA-generated cleaning solvent would be about 3.5 times greater than the estimated quantity employed by the HARA

TABLE IV

Quantitative Ranking of Components
in Distillates (from TABLE III)

Compound	Sample # 1	5	6	9	2	12
Butyl Acetate	1	1	1	1	1	1
Xylene	2	2	2	2	2	2
Ethyl benzene	3/4		4		4	3
Methylisobutyl ketone				3	3	4
Isobutyl isobutyrate		3	3			
n-Octane	3/4					
IPA		4				
Methyethyl ketone				4		
Butyl acetate and xylene as % of total	48.1	33.9	52.7	34.5	31.8	59.4

membership. Some shops currently use more expensive thinners and reducers in various clean-up roles and these solvents could be replaced with a cheaper, utility cleaner.

Now that the chemical characteristics of samples of HARA's spent solvent distillate have been obtained---and compared with a commercially available utility solvent---the potential exists to (1) ultimately list the availability of such a distilled product as a cleaner/degreaser on the Provincial waste exchange or (2) investigate other marketing alternatives for the excess solvent generated by the HARA membership. Later this spring, the economic feasibility of the recycling/reuse alternatives will be explored with the aid of an outside consulting firm.

ACKNOWLEDGEMENTS

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THE ESTABLISHMENT OF WEIC IN TAIWAN

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INTRODUCTION

In last decade, economic progress has made the Gross National Product of Taiwan increases 3.16 times to NTD 3,095 billion[1]. Fifty percent of the GNP is from industry production, higher than most industrialized countries. The country now has 60,000 factories spread out the entire island and hardly segregated from communities. The resulted industrial pollution not only threatens the public health but also degrades the quality of our environment.

According to the Environmental Protection Bureau's investigation[2] in 1986, the pollution problem is the second most serious problem in Taiwan (just next to youth crime). The report also predicts that pollution problem will become the most serious one in 1991.

The government recognizes the urgent need of pollution control and has taken some action. Firstly, expand the Environmental Protection Bureau to Environmental Protection Agency on August 1987. Secondly, appropriate NTD 13 billion budget for pollution abatement in 1988, which is double compared to 1987. Thirdly, promulgate related laws and regulations for the environmental protection. Meanwhile, industries are building their treatment plants and new facilities to meet emission/effluent standards. Consulting companies from United States, West Germany, Japan, Denmark have also shown their great interest for pollution controlling market in this country. It is clear that the government and people are trying their best to minimize the pollution problem.

With limited resource and land, waste exchange/recycle/reuse become one of the most attractive ways to minimize wastes, recover useable materials, upgrade the environmental quality as well as to sustain the already developed industries. It is for this reason, Industrial Technology Research Institute(ITRI), a non profit research organization has taken the action to establish Waste Exchange Information Service Center.

THE ANNOUNCEMENT OF WEIC

Since waste exchange information service has been actively promoted in many countries. We took the advantage of the

experience of developed countries[9-12]. We are especially grateful for Clean Japan Center(CJC), Canadian Waste Materials Exchange (CWME) as well as many other exchange centers in the United States and European countries who have generously share their knowledge and experience with us in our planning stage.

The Waste Exchange Information Center (WEIC) was formally annonuced on November 7, 1987. Basically, WEIC is on the model of Canadian Waste Materials Exchange. It is an information clearinghouse without waste handling services. This center is operated by Union Chemical Laboratories, ITRI. The operation of this center is authorized by Environmental Protection Agency, sponsored by Industrial Development Bureau and strongly endorsed by Chinese National Federation of Industries .

To call the public interest in the activity of WEIC, we publicize it via television, newspapers and several maganizes the establishment of WEIC. Introduction brochures are also mailed to over 5,000 factories and companies.

WASTE EXCHANGE PROCEDURES

We utilized DBase III to Write Chinese computer program for all listing materials. The functions of this program include recording lists, sorting listings by waste category and recording transactions. As soon as a material listing form is received by WEIC, it is keyed in the computer file with a code number which is assigned according to the characteristics of the waste.

WEIC publishes a bimonthly listing catalog, which contains "materials available" and "materials wanted" as well as technical reports refering to waste reuse/recycle. All listings are coded confidentially to protect company proprietary. Methods for recycling or reusing the waste material are also suggested.

Response to listing may be made by writing or calling, and identifying the items of interest by code number. Inquiries received by WEIC will be promptly forwarded to the lister who may contact the inquirer. WEIC is not involved in negotiations between the lister and the inquirer.

To evaluate the performance of WEIC and to keep the listings update, the inquirer is asked to notify WEIC whenever a successful transfer occures. The successful transaction records will be filed into the computer and statistics statement can be printed out from the system.

PRIMARY RESULTS OF WEIC

WEIC has published the first and second issues of listing catalogs in February and April 1988 respectively. This bimonthly publication is mailed to about 3,000 factories and some interested parties. Many of them show great interests in our work. We have listed totally 350 listings from November 1987 to March 1988. There are about 200 inquires from both domestic and abroad. Fifty three percent of the inquirers ask how to participate in this activity, 47% are interested in waste exchange. It is shown in Table I that the main listing items are chemicals,

TABLE I

Status of Wastes Listed

1987/11/07 to 1988/04/04

Waste Type	Number of wastes listed		
	Available	Wanted	Responses
Organic Chemicals	62	0	24
Inorganic Chemicals	31	0	4
Solvents	18	6	18
Oil, Fats & Waxes	14	2	4
Acids	12	1	1
Alkalis	12	1	5
Spent catalysts	5	0	3
Metals	6	3	0
Plastics	24	0	1
Rubbers	7	0	2
Textiles	29	1	6
Leather	7	0	1
Wood	9	0	3
Paper	12	1	5
Dust	9	0	3
Mineral residues	13	0	2
Sludge	28	0	8
Miscellaneous	35	2	4
Total	333	17	94

solvents, plastics, textiles and sludge. Among those items, chemicals, solvents, sludge and textiles are of much interest to the industry. So far, WEIC has actively promote one successful exchange and has forwarded 94 inquires to the listers. Many inquirers take samples from listers for analysis before considering whether it is suitable for them to reuse/recycle.

During the first five months operation, WEIC notices that the industry has three "NEED":

1. The industry NEED treatment facility. Many factories ask WEIC where they can find qualified treatment facilities or whether WEIC can treat wastes for them.
2. The industry NEED recycle/reuse/recovery technique and equipment. Many companies do not know how to handle the waste economically. They do not have technique and equipments.
3. The industry NEED the information for waste available and wanted. Many companies do not know what materials are available or what they could be used for.

HOW TO IMPROVE WEIC'S WORK

Dr. Laughlin [3] has mentioned that exchange operators should actively promote the waste exchange concept, offer technical help on waste reuse and recommend areas for R & D. We take these as our future goal. To achieve these goal, the following actions will be taken.

* Further widely spread mailing of the introduction brochure and listing catalogs. Also promotion via the popular media as well as through technical journal and technical conference/workshop.

* Keep contact with other exchanges and research organizations such as CJC in Japan, Ontario Research Foundation (ORF) in Canada, Plastics Institute of America, and so forth. CJC Japan has built several recycle/reuse demonstration plants, ORF Canada publishes Waste Reduction Program Bulletin and has many related research projects. The experience of the other exchange centers and technique developed by other organizations can be great help to our future work.

* To be an "intelligent" exchange. The Ontario Waste Exchange's approach [13] will be modelled on by Union Chemical Laboratories. OWE supports CWME to be more active in pursuing waste exchange opportunities by doing research studies. WEIC will (1) actively match listing wastes with potential users; (2) concentrate on those wastes generated many enquiries but have not transferred, and (3) recommend research subjects according to the need of industry.

* Market research and development in secondary materials industry is necessary in order to establish the outlet for waste materials.

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ACKNOWLEDGEMENT

The following waste exchange centers are highly appreciated for mailing their listing catalogs to us.

Canada:
Canadian Waste Materials Exchange, Alberta Waste Materials Exchange, Manitoba Waste Exchange.

United States:
Northeast Industrial Waste Exchange, Industrial Material Exchange Service, Tennessee Waste Exchange, Southern Waste Information Exchange, Great Lakes Regional Waste Exchange, California Waste Exchange, Industrial Waste Information Exchange, Southeast Waste Exchange.

West Germany:
Deutscher Industrie-und Handelstag(DIHT)

Japan: 宮城縣環境事業公社、群馬縣衛生環境部環境衛生課、埼玉縣環境部環境整備課、橫濱市橫濱商工會議所、富山縣生活環境部環境整備課、福井縣厚生部衛生指導課、愛媛縣保健環境部公害課、大分縣環境保健部環境管理課。

A REVIEW OF THE NORTH AMERICAN WASTE EXCHANGE INDUSTRY

Mark C. Abbott
C. S. Mott Foundation

I. INTRODUCTION

Industrial waste exchanges have evolved into a popular concept in recent years as a result of:

-- the realization that materials from the waste stream of an industry may have a reuse value and that individual companies may not be fully aware of such opportunities;

-- the escalating costs and environmental concerns associated with the management and disposal of industrial waste; and

-- increased government regulations regarding the handling and disposal of industrial waste.

Since 1973, approximately 34 waste exchange programs have been initiated in North America.[1] The purpose of this report is to assess the state of this industry and its future. Specifically, to what extent do waste exchanges offer a practical alternative to conventional waste disposal practices?

This report is based upon a two-month study conducted with the assistance of the C. S. Mott Foundation. The objectives of the study were:

-- to explore the evolution of waste exchanges in the United States and Canada;

-- to examine and profile the existing waste exchanges in the United States and Canada; and

-- to analyze specific waste exchanges in order to identify factors of success and failure.

The information developed during the study was based on the following: An examination of pertinent published material on waste exchange, a survey distributed to exchanges in the United States and Canada, site visits and personal interviews with various exchange managers, and follow-up analysis work.

II. WASTE EXCHANGE DEVELOPMENT

This section describes the development and current state of the industry. It has been kept brief so as not to duplicate previously published material.

A. History

The first exchange was established by the British government in 1942. Its primary purpose was to conserve raw materials and equipment for the war effort. The waste exchange concept did not gain popularity in mainland Europe until 1972 when VNCI Waste Exchange in the Netherlands was established. From 1972 to 1976, approximately 12 exchanges began operation in Western Europe.[1] The first exchanges in North America were established in 1973. The development of exchanges in the United States and Canada took separate courses.[2] In Canada, a national exchange was established and provincial exchanges were set up to work in conjunction with the national exchange. In the United States, exchanges have been established through both government and private sector interests.

B. Exchange Types and Definitions

There are two general types of waste exchanges in operation: The waste information exchange or information clearinghouse and the waste material broker. Whereas the information-type exchange acts simply to link up generators and potential consumers of wastes, the broker normally takes possession of a waste product and acts as a middleman between the producer and the user. As such, brokers will often take legal and physical possession of the material prior to the receipt of the material by a user. Since brokers are usually profit-making companies, they must handle only materials or wastes that have a readily defined market.[3]

Waste information exchanges, on the other hand, are passive in that they do not actively handle the waste, negotiate the transfers, set values, transport materials, or provide legal advice. These exchanges are usually thought of as providing a public service. One of their major roles is to publicize, through a bulletin, listings from potential users requesting a material as well as listings of potential generators seeking to dispose of a material. Listings are grouped according to 11 standard categories in an exchange bulletin. When a potential client inquires about a listing, the inquiry is then relayed to the lister. At this point, the exchange's work is completed.

A typical example of a waste transfer is as follows: An electroplating firm that generates sulfuric acid as a by-product notifies a waste exchange of the acid's availability. The exchange will put firms interested in purchasing the acid for use in say, a steel pickling operation, in contact with the generator for negotiations.[4]

This report focuses mainly on passive waste exchanges. However, the term "passive waste exchange" does not provide a good working definition for many of the exchanges that fall in this category. Whereas, in the past, many exchanges performed purely a clearing-house function, most exchanges now work closely with recyclers and brokers to expand existing markets and identify and develop new ones. In addition, many exchanges spend a good deal of time updating their mailing list, selling display ads, and promoting their services.

C. Recent Trends and the Current State of the Industry

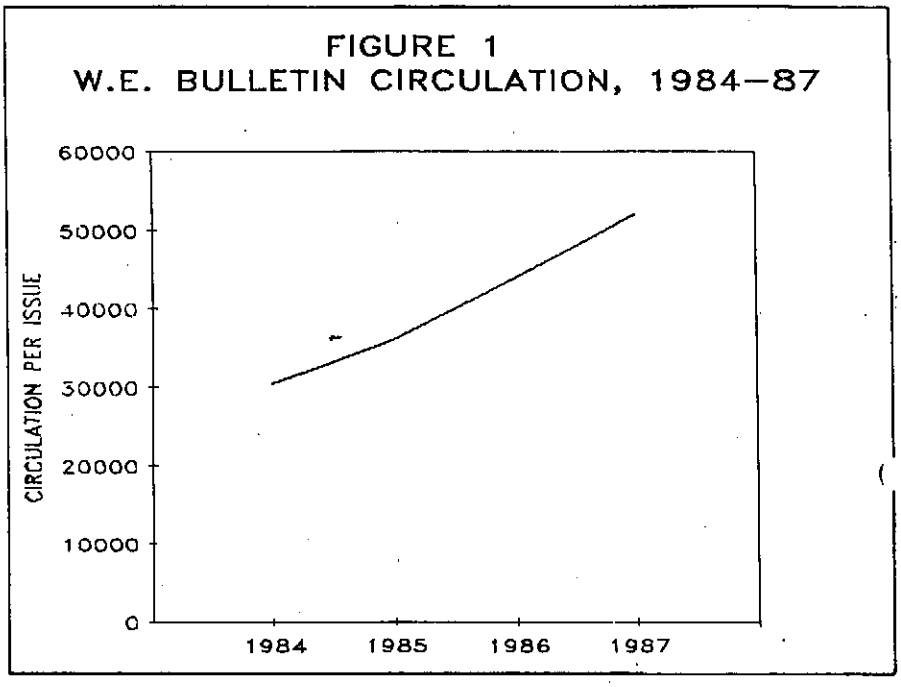
Waste exchanges play a small but potentially significant role in waste management practices. Currently, an estimated 2 to 4 percent of the approximately six million metric tons of potentially reusable hazardous waste generated in this country each year is recovered.[14] Much of this is through source reduction and in-house recycling, strongly promoted by the United States Environmental Protection Agency (EPA). For the small- and medium-size companies, however, these practices may not be technically and financially practicable. Thus, waste exchanges will continue to have a readily available market. There are currently 19 not-for-profit exchanges operating in North America. Fourteen publish bulletins, while the remainder act principally as technical assistance programs.[3]

The exchanges transfer materials from two general classifications -- hazardous wastes and solid wastes. There are several ways of measuring waste exchange activity. These include the number of listings and inquiries, bulletin circulation, the number of successful match-ups, and tonnage of waste transferred. It is often difficult to obtain accurate data on these activities. However, based on available data and informed industry estimates, trends in the industry can be identified, as noted in the following paragraphs.[5]

Figure 1 presents data on the total circulation of waste exchange bulletins from 1984-87. The bulletin circulation for 1987 is 59 percent greater than in 1984. This shows an increased effort by exchange managers to publicize and expand their operations.

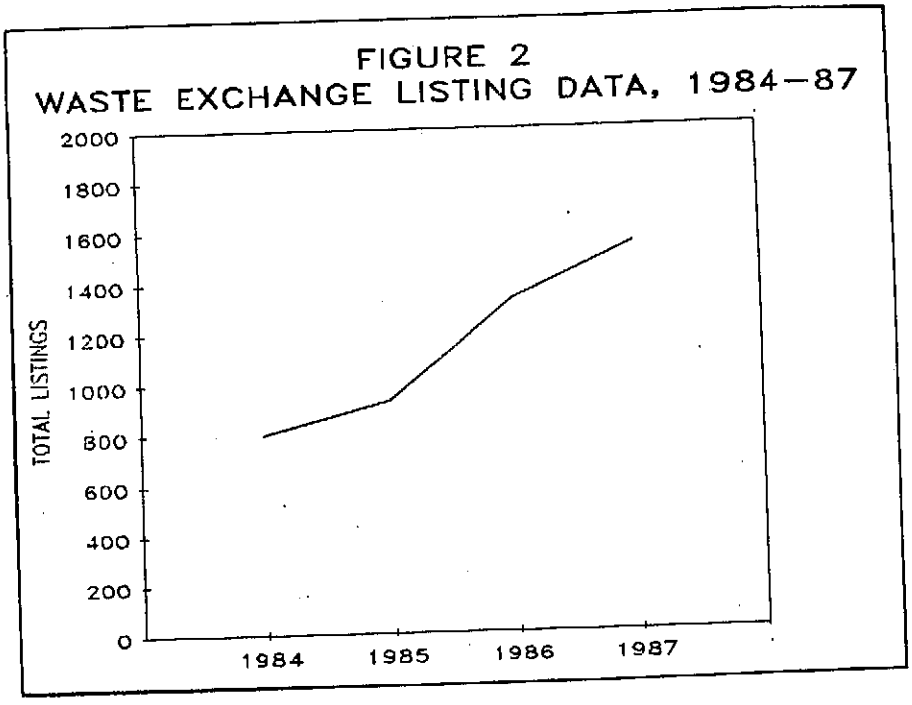
Figure 2 shows the total number of listings for the 1984-87 period which have increased 54 percent since 1984. This increase may be overestimated since some listings are published in more than one bulletin. However, this does not lessen the impact of the 54 percent increase since each duplicated listing reaches a different audience.

As a third measure, the number of inquiries from generators and users correlates with these two indicators, as shown in Figure 3. Inquiries have risen proportionately with increases in circulation and listings.

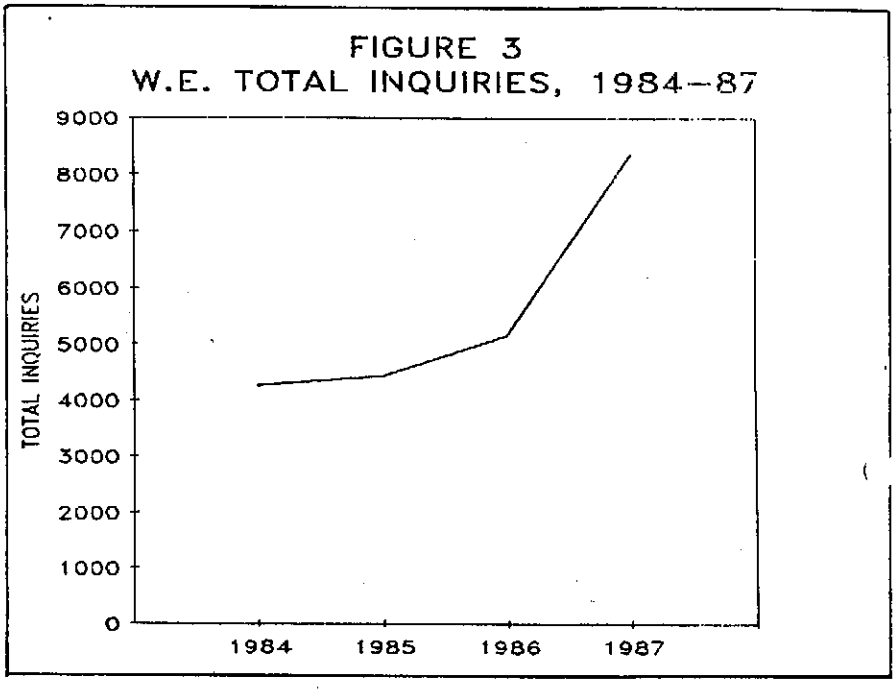


Source: Estimates from industry survey.

FIGURE 2
WASTE EXCHANGE LISTING DATA, 1984–87



Source: Estimates from industry survey.



Source: Estimates from industry survey.

Another measure of activity can be made by breaking down the number of inquiries into "wanted" and available. Historically, most inquiries have been made by industries seeking to dispose of waste. However, from 1986 to 1987, the number of inquiries from industries seeking material rose significantly.[5] This may signal an increased acceptance by industrial managers seeking new sources of materials for their processes, or an increased involvement of brokers and recyclers. For whatever reason, increased involvement by "users" is vital to the exchange industry's success.

Perhaps for those outside the industry the most important measure of judging the success of waste exchanges is through the number of successful match-ups and the tonnage of waste transferred. Regrettably, reliable data on these measures simply are not available for the industry.

Data on the number of successful match-ups can be obtained from only a few of the exchanges because most do not have resources necessary for collecting this information. Moreover, data may show a higher percentage of successful listings than warranted. For example, the Industrial Materials Exchange Service utilizes a system for tracking successful match-ups as a percentage of listings which omits a number of original bulletin listings from the final computation for the following reasons: Unable to contact lister for data; material disposed or no longer available; or lister unable to follow through with contacts.[6] The end result is an inflated percentage of successful listings.

The tonnage of waste transferred is also difficult to document. Only three of the national for-profit exchanges surveyed have attempted to document the amount of waste transferred. The Canadian and Northeast Exchanges transferred an estimated 730 and 3,923 tons of waste respectively in 1986. The Industrial Materials Exchange transferred an estimated 17 million gallons in 1986.[5] According to the survey, the quantity exchanged from year to year varies significantly and does not always correspond to other success indicators. In addition, the different units of measurement (tons, gallons, etc.) and type of transfer (one-shot, sporadic, or continuous) make uniform systems of documentation difficult.

Table 1 provides information on exchanges that published bulletins in 1987.[5] All the United States-based exchanges were established within the last ten years. None are capable of operating without subsidies. Funding sources include state and national governments, universities, trade associations, and private foundations.

As Table 1 indicates, the exchanges collectively published approximately 2,600 listings. The ratio of "available" listings to "wanted" listings is approximately four to one. The number of inquiries received in 1987 was nearly 10,000. The 14 exchanges published three to six bulletins with a combined circulation of 65,175 last year. Six of the exchanges ran display ads in their bulletins as an additional source of income.

TABLE 1
Selected Data From North American Waste Exchanges Publishing Bulletins

	Established	Funding Sponsor	1987 Bulletin Activity: Total Listings: Available	Wanted	Total	Inquiries	1987 Promotion Data: Bulletins Per Year	Circulation	Display Ads	Financial Information: User Fees	1987 Budget
U.S. Multi-State											
1. Great Lakes Regional Waste Exchange	1978	Foundation	151	47	198	587	6	15,000	Yes	--	$ 50,909
2. Industrial Materials Exchange Service	1981	State EPA	416[2]	84[2]	500	1,300	6	10,000	--	--	60,000
3. Northeast Industrial Waste Exchange	1981	States	261	112	373	2,587	4	14,000	Yes	--	133,700
4. Southeast Waste Exchange	1978	EPA/Univ. State/Ind.	329[2]	73[2]	402	1,059	6	3,000	Yes	Yes	112,000
5. Southern Waste Info. Exchange	1982	Univ./Corp./ Trade	81	36	117	500	4	10,000	Yes	Yes	60,000
U.S. Single State											
1. California Waste Exchange	N/A	State	89	20	109[3]	N/A	4	2,000	--		N/A[1]
2. Indiana Waste Exchange	1986	State	59	9	68	48	6	1,450	--	--	45,000
3. Industrial Waste Information Exchange (New Jersey)	1978	Trade	43[2]	22[2]	65	N/A	3	3,200	--	--	N/A[1]
4. Montana Industrial Waste Exchange	1978	State	15[2]	14[2]	29	20	6	400	--	--	6,000
5. Tennessee Waste Exchange	1980	Trade	24	5	29	14	4	75	Yes	Yes	N/A[1]
Canada											
1. Alberta Waste Materials Exchange	N/A	Provincial	248	85	333[3]	N/A	4	750	--		42,000
2. British Columbia Waste Exchange	N/A	National	34	32	66[3]	N/A	4	500	Yes		38,500
3. Canadian Waste Materials Exchange	1977	National/ Provincial	126	42	168	1,618	6	3,700	--	--	38,500
4. Manitoba Waste Exchange	N/A	Provincial	85	32	117[3]	N/A	4	1,100	--	--	14,000
TOTALS			1,961	613	2,574	7,733		65,175			600,609

[1]Not available; exchange not separately budgeted.
[2]Estimation derived from ratio of wanted and available listings in the exchange's latest bulletin.
[3]Represents current listings from latest bulletin.

Source: Estimates from industry survey

As further shown in Table 1, three of the exchanges currently charge a user fee for their services. The total expenditures for the exchanges with separate budgets was $618,700. A reasonable estimate places the total industry budget in 1987 at approximately $675,000.

Of the approximately 2,600 listings published, 62 percent appeared in the bulletins of regional exchanges. Canadian and single-state exchanges published 26 percent and 12 percent respectively. The regional exchanges also accounted for 7,682, or 82 percent of the total inquiries received. Further, the regional exchanges accounted for 80 percent of the bulletins distributed in 1987.

Dividing an exchange budget by the number of bulletins distributed reveals the average cost per issue. Figure 4 displays the cost of publishing a single bulletin for various waste exchanges. The regional exchanges expend approximately $5 to $10 per issue, while the single state exchanges expend $25 to $30, and the Canadian exchanges vary from $10 to $75.

In addition, Table 1 shows another distinguishing characteristic. Exchanges with the lowest cost per issue are the ones with the largest circulation, the most listings and inquiries, and with one exception, display ads in their bulletins. These characteristics may represent differences in philosophy and management practices between regional and state exchanges.

In summary, several observations can be made on the state of the waste exchange industry:

1. In the last decade the waste exchange concept has matured into a viable industry; however, the use of waste exchanges has only scratched the surface of the potential market.

2. All reliable indicators show significant increases in exchange activity in the last two to three years.

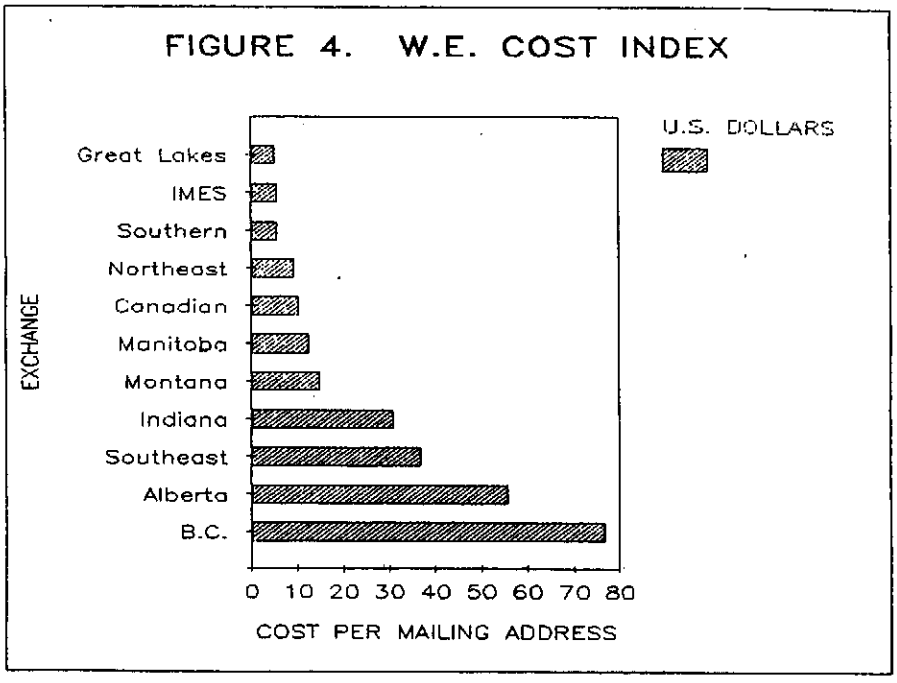
3. Exchanges can be grouped into those which serve states and those which are regional in scope. In general, regional exchanges appear to be more effective.

III. OUTLOOK

This section describes factors that promote and impede success in the waste exchange industry from two viewpoints -- first, issues internal to the industry based on case studies of four individual waste exchanges; and, second, an analysis of external issues and trends affecting the waste exchange industry.

A. Case Studies

These case studies were designed to highlight internal factors that influenced exchange operation. The case studies are based upon site visits and interviews with exchange managers. The exchanges visited were the Great Lakes, Northeast, Industrial Materials, and Indiana exchanges.



Source: Estimates from industry survey.

1. Great Lakes Regional Waste Exchange

The Great Lakes Exchange Program was initiated in 1985 by Waste Systems Institute of Michigan, Inc. (WSI), based in Grand Rapids, Michigan. The program was designed to complement other WSI services which provide information, research, technical assistance, dissemination, and other services in the areas of solid and hazardous waste management, toxics, and pollution control.

WSI's program goes several steps beyond the conventional waste exchange concept by supplementing waste listings with an extensive information and technology section included in the bulletin. William Stough, manager of the exchange, states that these additional materials will make the bulletin a more valuable management tool for industries; possibly providing managers with a greater incentive for participating in the exchange.

The Great Lakes Exchange is the only not-for-profit regional exchange that does not receive government fiscal support. Revenue is generated primarily from private foundations, advertising revenue, and corporate contributions.

This exchange's bulletin is circulated to 15,000 addressees on a bimonthly basis. As Figure 5 shows, WSI's cost of publishing the bulletin is very low -- approximately $3.50 per addressee. One possible drawback to this inexpensive publication is the bulletin quality. The listing section is both difficult to read and use because of the crowded layout and small print.

As noted earlier, this exchange does accept display ads. Of all the regional exchanges, the Great Lakes Exchange has been the most successful at soliciting industry for these ads. The results are mutually beneficial. The exchange provides an excellent marketing and advertising mechanism for waste brokers while furthering the exchange's goal of recycling wastes.

The Great Lakes Exchange is well received by business and industry. WSI has assured this by building an excellent reputation for itself through such programs as:

-- The Michigan Waste Report - the report is a biweekly newsletter which has received wide recognition for its clear and unbiased reporting of timely issues in the waste management field.

-- The Small Quantity Hazardous Waste Generator Program - a program which seeks to notify thousands of small quantity generators who are now subject to new state and federal environmental regulations.

Great Lakes does not attempt to track successful match-ups. The reasons cited for this is two-fold. First, they believe documenting exchanges is a poor use for scarce resources and second, that emphasizing successful match-ups may distract the waste exchange away from its stated objectives by causing them to operate in already established markets and networks.

2. Northeast Industrial Waste Exchange

The Northeast Exchange was established in 1981 in Syracuse, New York by the Central New York Regional Planning Agency. Since then, the program has expanded to cover a 12-state region.

Annual funding support is provided by the U.S. Environmental Protection Agency (EPA), the New York State Environmental Facilities Corporation, the New Hampshire Resource Recovery Association, the Ohio EPA, the Connecticut Hazardous Waste Management Service, the Maryland Department of Natural Resources, and the Pennsylvania Department of Natural Resources.[3] In addition, Delaware, Maine, and Vermont are presently considering supporting the exchange. This exchange is composed of many elements that are absent from less-successful exchanges.

The Northeast Exchange has a very professional and organized staff. Lewis Cutler, manager, has a good working knowledge of waste disposal practices and has the marketing and entrepreneurial skills necessary to run a successful exchange.

The stated objective of the Northeast Exchange is to "match waste generators with recyclers" in three major ways:

a. Publishing a quarterly listing catalog of available and wanted materials;

b. Maintaining an electronic catalog which provides current listing information that can be assessed free of charge by any business possessing a modem and micro computer; and

c. Actively finding recyclers for waste generators by responding to individual telephone inquiries.

The Northeast Exchange has experienced remarkable growth, in large part due to a 1987 EPA grant to publicize their services through different media formats. Inquiries in 1988 have increased seven-fold over 1987.

Northeast's listings catalog content differs from the Great Lakes bulletin in that, aside from listings and display ads, very little other information is included. However, the listings catalog is much easier to read and use than the Great Lakes bulletin.

The technical information and assistance similar to what is provided by the Great Lakes Exchange can be obtained from the New York State Environmental Facilities Corporation (EFC). This organization is closely affiliated with Northeast Exchange and is allowed publishing space in the back of the listings catalog. EFC runs a program called the Industrial Materials Recycling Program (IMRA). IMRA offers technical assistance, an active waste exchange, waste management audits, on-site remediation and technical information.

This exchange spends a considerable amount of time and money documenting transfers. Many of their sponsors require this data and it is also an excellent tool for soliciting new listers. In 1986, 63 percent of all listings received at least one inquiry, and there were approximately 31 successful match-ups.[15]

3. Industrial Materials Exchange Service (IMES)

IMES was established in 1980 in Springfield, Illinois, through EPA support. In 1986, funding responsibility for the program was transferred to the solid waste division of the Illinois EPA (ILEPA). The exchange is operated jointly between the ILEPA and the Illinois Chamber of Commerce in order to ensure that the confidentiality of the exchange clients cannot be breached through the Freedom of Information Act.

IMES is unique in that it is the only regional exchange that is being entirely funded by a single regulatory agency. It might seem that the regulatory nature of ILEPA could hamper the exchange's effectiveness, although at this point in the development of the exchange industry this does not seem to be the case. IMES' bimonthly listing catalog is one of the most active in the industry.

The IMES catalog content differs from other regional bulletins in that it does not offer display ads or substantial additional information or reports. Although IMES lacks some of the characteristics of other successful exchanges, they seem to have developed an excellent network for distributing their bulletin. In addition to generating their own address list, they also have worked out arrangements with approximately nine state or private sector agencies to help distribute the catalogs.

As mentioned previously, IMES also tracks successful transfers. Not excluding any listings, IMES had 74 successful transfers for an 8 percent success rate in 1986.

4. Indiana Waste Exchange

This was the only single-state exchange included in the site visits. The Indiana Exchange began formal operation in 1986 in Indianapolis by Environmental Quality Control (EQC), under contract with the Indiana Department of Environmental Management as the sponsoring organization. The state government views this exchange as a subsidy to business and industry; thus, the exchange provides services primarily to Indiana.

The Indiana Exchange has a staff of two, although they do have other resources from EQC to draw upon. EQC is a not-for-profit corporation composed of leaders from government, education, industry, and the public who engage in environmental planning and problem solving.

Indiana's bulletin is significantly different then that of the other exchanges. Table 1 and Figure 4 show the cost per issue is three to four times greater than most of the regional exchanges, even though their circulation is only about an eighth that of the average regional exchange. Further, EQC's contract states that no commercial advertisements can be included in the bulletin, thus eliminating any prospect of additional outside funding. The bulletin itself is professionally typeset and printed on excellent quality stock.

The Indiana Waste Exchange is representative of many problems facing single-state exchanges. The exchange was initiated by the Indiana government at a time when social and political pressures advocating changes in solid and hazardous waste disposal practices were growing. However, to date, the exchange's potential to provide a valuable service to business and industry has not been realized due to limited outreach and marketing acceptance.

5. Summary

The above case studies were designed to show some of the internal requisites for individual exchange success. One significant factor is managerial philosophy -- Northeast Exchange offers a good example of a successful management style. Lewis Cutler, Manager, aggressively markets the exchange's services with entrepreneurial vigor. As a result, Northeast has been highly successful at soliciting operating support from a wide variety of sources. This has brought increased financial stability since the exchange is not dependent on the budget priorities of a single state or agency. Further, the broadened support has increased catalog coverage allowing exposure to numerous markets. In comparison, IMES is also successful but lacks the broad bases support and entrepreneurial practices that give Northeast such a high number of inquiries.

A second and related factor is bulletin content. The four exchanges profiled all published distinctly different bulletins, each with special strengths and weaknesses. There appears to be a need for a more uniform bulletin format which incorporates the best characteristics from each of the three regional exchanges. For example, the bulletin could include the typesetting and layout of the Northeast, the information and technical sections and extensive display advertisements of the Great Lakes, and an extended version of the mailing and disbursement strategy of IMES.

A third factor is credibility. In addition to solid management and effective publications, credibility can be enhanced through an awareness of generator and user industry issues and technical know-how. Management and staff of a waste exchange must have this know-how to communicate effectively with industry personnel and establish the credibility necessary for providing technical assistance.

B. External Issues Affecting Waste Exchanges

1. Economic Incentives

Escalating costs for disposing of hazardous wastes due to stricter environmental controls, especially on the use of landfills, have led many policymakers as well as waste generators to consider alternative forms of waste management, including the use of waste exchanges. Rising costs associated with hazardous waste disposal have altered the economic feasibility of using waste exchanges.

In order to facilitate a successful transfer, the cost of exchanging a material must be less for both the generator and the user then if no exchange took place at all. This is illustrated by the use of the following formula based upon the calculation of "avoided cost."[8]

Avoided cost value = (A-B) + (C-D-E)

Generators Costs

A. Avoided cost of disposal and transportation; and
B. Incurred cost of transportation to user.

User's Costs

C. Avoided cost of purchasing the raw materials;
D. Incurred cost of purchasing the material from the generator; and
E. Incurred cost of special processing.

When landfill regulations were lax and tipping (i.e., disposal) charges were as low as $10 per ton for hazardous wastes, the above equation would many times work out having a negative "avoided cost value." As disposal costs have increased to as much as $250 per ton, waste exchange related costs become comparatively more attractive. Moreover, the latest round of RCRA amendments under Subtitle D will significantly increase performance standards for solid waste landfills.[3] These new standards are expected to continue to make solid waste dumping costs rise significantly.

2. Landfill Capacity Limitations

In conjunction with the above cost pressures is the fact that solid waste landfills in many areas of the United States are rapidly reaching capacity.

For example, a report by the Illinois EPA measured available disposal capacity in Illinois and reported the following:[9]

-- In 1987, an estimated 52,000,000 cubic yards of solid waste will be disposed of in Illinois. Of this volume, 3 percent will be incinerated, 2 percent recycled, and 95 percent will be landfilled;

-- At current rates of disposal and depletion of landfill capacity, Illinois has approximately 5.3 years before all currently operating landfills reach their permitted capacity;

-- To replace the amount of disposal capacity exhausted annually in Illinois, at the present rate, would require the addition of five new 60-acre landfills annually; and

-- The current national average for reliance of landfilling as a disposal method is 87 percent compared to Illinois' 95 percent. To bring Illinois' waste handling in line with the national average would require a 3,360 tons per day reduction in landfilling. This equates to 3,360 tons per day recycled -- a 300 percent increase over the 840 tons presently being recycled daily.

This combination of a shortage of landfill space, new disposal regulations, and the current under-utilization of alternative waste management practices, combine to form what seems to be an excellent opportunity for growth in both the recycling and waste exchange industries.

3. Public Policies and Regulations

Public policy incentives can aid in promoting the transfer of waste. The most direct is state legislation designed to encourage off-site recycling of hazardous waste. The following paragraphs provide a few examples of such legislation.

In Michigan, amendments to Public Act 64 encourage waste reduction and alternatives to landfills by providing generators with a $10 per ton refund of fee payments for documented reductions in waste generated. This includes successful exchanges of waste through the Great Lakes Exchange.

Second, Title 22, Article 12 of the California Hazardous and Solid Waste Regulations lists all wastes that are considered recyclable. A generator may have to justify to the State Department of Health Services in writing, why a material in their waste stream which appears on the list is not being recycled instead of landfilled. California has also simplified permit requirements for businesses which recycle non-RCRA waste, handle large volume, low-hazardous materials, and use recycled materials as substitutes for raw inputs. [11]

Several other states have enacted legislation affecting hazardous waste which may promote the use of exchanges. In Ohio, The Ohio Environmental Protection Agency has developed a waste stream reference guide which shows alternative management options for different wastes. In addition, the Ohio EPA has the legislative power to inspect individual waste streams for recycling potential.[3]

In Illinois, legislation prohibits the landfill of hazardous waste unless the generator can demonstrate that it is not economically or technically practical to dispose of the waste by any other measure other than the landfill. In New York, taxes based on the amount of hazardous waste generated are waived if the waste is recycled. In addition, the New York State Environmental Facilities Corporation, briefly described in the Northeast case study, aids in recycling industrial waste.

State regulations are related to overarching Federal regulations described in the Resource Conservation and Recovery Act (RCRA) and other statutes affecting the management and disposal of generated wastes. Federal regulations are likely to become more rather than less important in influencing waste management practices. One proposed initiative is described in the following section.

4. The Proposed Hazardous Waste Reduction Act

The Hazardous Waste Reduction Act (HR 2800), introduced in June, 1987, to the United States House of Representatives, could help advance the waste exchange industry. Specifically, the bill would:

-- Make matching grants to states for technical assistance to businesses seeking to utilize waste reduction opportunities;

-- Report to Congress on progress toward achieving industrial waste reduction and on regulations that may inhibit waste reduction; and

-- Establish a national clearinghouse on waste reduction and recycling techniques which will serve as a center for waste reduction technology transfer.

5. Technical Assistance and Support Programs

In order for such waste minimization practices to be successful, environmental managers must be made aware of their options. Toward this means, a number of states have developed technical assistance programs. Following are a few examples of such programs which have been initiated throughout the United States.

The Minnesota Waste Management Board provides technical assistance and grants to encourage waste reduction and recycling. The technical assistance program is funded by the state legislature and ran by the University of Minnesota. The program offers evaluation of waste production and management practices, technology transfer, and an intern engineering program to implement on-site waste minimization practices.[3]

Waste System Institute in Michigan provides technical and information assistance to businesses and industry with environmental compliance problems, including a program called Waste-Help Clearinghouse. This clearinghouse utilizes an 800 number which provides toll free phone access to information, contacts, and resources that can provide assistance for environmental problems.

The North Carolina Pollution Prevention Pays Programs help industry and communities reduce waste generation through technical assistance, research and education, and financial assistance. Staff members conduct industry-specific workshops on the application of pollution prevention techniques and on-site technical assistance.[3]

6. Impediments and Barriers

Impediments to the growth and success of waste exchanges are numerous and often outweigh the incentives. One of the fundamental problems in the exchange industry is lack of steady funding. Waste exchanges expend a great deal of energy trying to secure operating funds whereas this time and money could be better spent improving and expanding exchange services.

Another major obstacle to the exchange industry is industrial management practices. It is often difficult to change established management and disposal techniques utilized by a firm. This reluctance to change established practices has been called "managerial inertia," and may be a significant impediment to growth in the waste exchange industry.[12]

As mentioned earlier, unfavorable economics can present a barrier to successful off-site recycling. Many high-volume wastes have low economic value; therefore, long distance transport may not be cost effective. In addition, most manufacturing processes are not designed to promote recycling. Often, waste streams from different processes are combined making material recovery difficult.[10]

A third major problem confronting the waste exchange industry is inherent in the Federal Hazardous Waste Regulation and liability provisions which address off-site waste management practices. Concerns arise from RCRA and from the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA).

IV. CONCLUSIONS AND RECOMMENDATIONS

The waste exchange industry represents one type of waste minimization. The exchange industry has made excellent progress in the last few years Given the restrictive, complex, and discriminatory nature of the RCRA and CERCLA regulations, the outlook for waste exchange is mixed. As such, if there is going to be continued and substantial growth, certain steps must be taken to lessen the effects of impediments and barriers which face this industry.

In order to expand and grow, the exchange industry must develop a spirit of honest cooperation among the individual exchanges. The continued competition for scarce funds and listings have masked the fact that the service performed by the exchanges is a public service. Waste exchanges must work together to advance the state of the industry.

One possible means of fostering this cooperation is through the formation of a national waste exchange association. At this point, there is no need for a formal association with an office and staff. Rather, there should be an organization composed of managers from each of the exchanges who meet periodically to discuss and promote innovative ideas in the exchange industry.

One proposal which deserves close examination by the exchange managers is a series of joint operating agreements between exchanges to reduce the number of bulletins published. Currently, eight bimonthly or quarterly bulletins are distributed east of the Mississippi, representing a total of 44 bulletins per year that must be reviewed by a company to

keep abreast of current listing information.[3] In addition, generators and recyclers must list in all of the bulletins in order to ensure that the broadest possible market is reached. In this respect, the proliferation of bulletins seems to hinder exchange efforts to link generators and recyclers.

California and Montana currently have the only single state exchanges which publish bulletins in an area not overlapped by a regional exchange. It would be practical and cost effective if the Indiana, New Jersey, and Tennessee exchanges merged their bulletins with those of a regional exchange. This consolidation, and possibly further consolidation among the regional exchanges, could result in the following benefits for the industry:

-- Strengthening the voice and impact of the exchanges.

-- Allowing additional resources to be devoted to promoting exchange services and improving technical assistance and support programs.

-- Forming the basis for a more extensive network between exchanges, possibly leading to the formation of a national data base of listings and a more formal national waste exchange association.

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CHARACTERISTICS OF NORTH AMERICAN WASTE EXCHANGES

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INTRODUCTION

Manufacturing processes typically produce an intended product for use or sale and unwanted wastes or by-products. In addition, through human or mechanical error, manufacturing process may produce off-specification materials that cannot be used for the same purpose or in the same manner as the normal or intended product of the manufacturing process. Overpurchase of raw materials, overproduction, changing production requirements, and the closing of facilities may all result in the accumulation of unused, surplus materials. Ideally, facilities and production processes are designed and managed to minimize the amount of waste that is produced during their operation (1,2,3). However, the generation of some unwanted material is typical, and managers must decide what to do with these wastes, by-products, surplus, and off-spec materials. Managers must choose between two basic options: manage the material at the facility (onsite), or manage the material at an offsite location. Each of these options must be further refined by deciding whether the material will be discarded (disposed) or recycled (4). These basic decisions can be made only after considering a variety of economic, legal, and locational factors. To help with these decisions, managers may be able to draw upon the assistance of economists, lawyers, engineers, and other experts either as company personal or as outside consultants.

If offsite recycling is being considered, potential markets for established by-products and scrap or secondary materials are usually readily identifiable. Markets for scrap material having an established value may be located in the local telephone directory and in publications such as the American Recycling Market Directory (5), the National Directory of Manufacturers Utilizing Recycled Materials (6), the State of Texas Industrial Materials Recycling Directory (7), the Thomas Register of American Manufacturers (8), or the American Metals Market Annual (9). These directories typically include listings for companies that collect and recycle ferrous and non-ferrous metals, glass, paper, plastic, rubber, textile, and related scrap materials. Other, more specialized, publications serving the specific needs of a single industry may also be consulted [e.g., Davison's Textile Blue Book (10), Lockwood's Directory of the Paper and Allied Trades (11), and the Rubber Red Book (12)]. Most of the markets identified through these sources are for non-hazardous material.

SCRAP, SURPLUS CHEMICAL, AND WASTE MATERIAL BROKERS

Scrap brokers are important in organizing markets where material collected by scrap dealers can be bought and sold to scrap consumers. These brokers may be thought of as "wholesale merchants" and they function as a "scrap exchange," as opposed to a waste exchange, whose function is discussed below (13). Scrap brokers invariably specialize in a particular market or material; however, they are not

organized into a single national trade organization and no estimate has been made of the number of brokers that may be active in the various scrap markets.

Surplus chemical brokers can assist in the marketing of surplus, by-product, and off-specification chemicals. These materials may originate from production processes, surplus inventories, or as the result of plant closures. These brokers act as marketing agents for surplus assets and as middlemen between generators and potential users. To succeed, these brokers must maintain extensive contacts with companies that are likely to have surplus chemicals as well as with companies that may be interested in purchasing these same items. They are for-profit companies whose income is derived primarily from resale of purchased surplus chemicals and from fees charged for related services, such as, consulting, material testing, or arranging transportation. In size these brokers may range from one-person operations to companies with branch offices, technical and marketing staffs, and warehousing facilities. Surplus chemical brokers most often take both physical and legal possession of the material and provide storage until a suitable buyer can be located or a sufficient quantity accumulated. Repackaging into larger or smaller lots may also be necessary. Some brokers also market materials through the publication of catalogs or lists. The materials handled by these brokers are usually classified as hazardous materials, rather than hazardous wastes. Surplus chemical brokers are not represented by any organized trade association and no accurate count of their number has been made; however, an estimated fifty surplus chemical brokers are active throughout North America.

Waste material brokers assist generators in the marketing of waste materials that have reuse, recovery, or recycling value. They perform the same basic services as surplus chemical brokers, except that they concentrate on material that has been used rather than surplus or virgin materials. A few brokers may provide assistance with both types of material, but the distinction between the two types of brokers is usually quite sharp. Waste material brokers tend to concentrate on only a few types of closely-related industrial wastes (for example, acids, pickling liquor, glycerine and by-product vegetable oils, refractory bricks, and electroplating sludges). They often trade in materials that would be classified as hazardous wastes. Waste material brokers typically do not publish lists of available and wanted material; they rely instead on individual contacts within the companies of the industrial group(s) that they serve. These brokers may take legal or physical possession of the material, arrange transportation between generator and recycler, or make arrangements to process material before shipment to the next user. Waste material brokers are not represented by any organized trade association and no accurate count of their number has been made; however, an estimated twenty-five waste material brokers are active in North America. This number does not include brokers who trade in the established non-hazardous scrap material markets discussed above.

FUNCTION OF WASTE EXCHANGE PROGRAMS

Although manufacturers have available to them a variety of resources for marketing wastes for offsite recycling, individual company contacts may not be sufficient, and the for-profit brokers discussed above are likely to be most interested in larger quantities of high-value surplus or waste materials. To assist companies in marketing wastes with limited or unknown value, or smaller quantities of wastes, and in identifying new markets, a network of non-profit industrial waste information exchanges has developed since the early 1970's. As economic and regulatory changes

have increased the cost of disposal and limited the number of disposal options (primarily through prohibitions on landfilling certain wastes), many companies have begun to explore the benefits of offsite recycling and have turned to waste exchange programs for information and assistance.

These information exchanges function as centralized clearinghouses for collecting and disseminating information about wastes (including surplus material) available from generators and wastes sought by potential users. Their primary service is to receive from generators listings for materials that are available and from potential users listings for material that they would like to acquire, and to publish and distribute throughout a specific geographic area a periodic catalog of these waste listings. Each listing contains a brief description of the material, quantity, packaging, location, possible use, and frequency of generation. A code number is assigned to each listing so that the identity of the listing firm is kept confidential. A firm interested in a material listed in a particular waste exchange catalog will send a letter-of-inquiry to the clearinghouse, and the clearinghouse will then forward the letter-of-inquiry to the listing firm. That firm may then contact the inquirer and begin the negotiation process, if it so chooses. Once the information is provided, and an initial contact between generator and potential user is established, the clearinghouse usually plays no further role in the negotiations. All negotiations concerning the sale or transfer of waste materials are handled directly by the firms. Some clearinghouses have a non-confidential listing option that allows a listing firm to give permission for the exchange to release its name to an inquirer, thus allowing an inquirer to contact the listing firm directly. In the United States, one exchange (Montana) publishes in its catalog the name of the listing firm, thereby eliminating the need for letters-of-inquiry.

In the typical clearinghouse catalog, available and wanted material listings are assigned to one of eleven categories: Acids, Alkalis, Other Inorganic Chemicals, Solvents, Other Organic Chemicals, Oils and Waxes, Plastics and Rubber, Textiles and Leather, Wood and Paper, Metals and Metal Sludges, and Miscellaneous. The eleven categories were developed in 1985 and are now used by common agreement by most information exchanges (14). These categories allow a generator or potential user to quickly ascertain if the catalog contains material that may be of interest.

HISTORY OF WASTE EXCHANGE PROGRAMS

The earliest waste information exchange appears to have been established in Great Britain in 1942 to conserve materials during World War II. Other programs developed throughout Europe in the early 1970's as services of national chemical industry organizations. Exchanges exists in a number of other countries, such as Australia, Israel and Taiwan. In North America, exchange programs also began to develop in the early 1970's (15, 16, 17). Since that time, approximately forty-three non-profit information exchange programs have been established throughout North America, but only nineteen are still in existence, fourteen of which publish waste material listing catalogs. The five exchanges that do not publish catalogs function primarily as technical assistance programs, although they may use the catalog of another exchange to publish listings for their clients.

Half of the defunct programs were sponsored by trade associations, such as chambers of commerce or industrial associations, and over thirty percent were sponsored by for-profit corporations, such as consultants or materials testing laboratories. In most

cases, the areas once served by the defunct exchanges are still being served by another non-profit exchange, and in some cases the entire operation of the exchange has been absorbed directly by an existing exchange. Most of these exchanges ceased operation because their sponsoring organization could no longer justify the cost of subsidizing the operation of the exchange. Typically, trade associations and for-profit corporations prefer the programs they operate to be self-sufficient and when this does not occur (and it never does in the case of information waste exchanges), they simply cease operating the program or have it absorbed by a larger, multi-state exchange.

The Georgia Waste Exchange is an example of a program that has had a series of sponsors. It was initially organized by the Georgia Department of Natural Resources and, after resistance by industry to its association with a regulatory agency, was transferred to the Business Council of Georgia. It is now operated by American Resource Recovery, Inc., a private, for-profit, non-hazardous waste materials broker.

The desire of industry to keep information about the composition of wastes confidential from regulatory agencies, competitors, and the general public was the primary justification for industry sponsorship of the early exchanges in the United States. The issue of confidentiality became moot as state and federal regulations began requiring increased disclosure about waste production and composition, and as it became apparent that the composition of most waste streams was well-known within the industrial community. However, confidentiality is still retained in most catalogs primarily to allow listers the option of choosing the inquirers with whom they wish to negotiate. Although firms advertise in waste exchange catalogs because they want others to find out about and develop a use for their wastes, to protect trade secrets some generators will require a recycler to sign a non-disclosure statement.

In the United States, of the existing ten programs that publish catalogs, five have been established to serve a single state area and five to serve multi-state areas. In sharp contrast to the defunct programs, only two of the existing programs (New Jersey and Tennessee) are sponsored and funded entirely by trade organizations, while six programs are supported, at least in part, by government funds. Of the two remaining exchanges, the Great Lakes Regional Waste Exchange is funded by a private foundation grant and by funds from its sponsor, a non-profit corporation, while the Southern Waste Information Exchange receives funding from a university, two private waste management companies, and a state chamber of commerce. In fact, all of the multi-state waste exchanges receive funding from more than one source. For example, the Northeast Industrial Waste Exchange is funded by grants from the U. S. Environmental Protection Agency (U.S. EPA), the New York State Environmental Facilities Corporation, the Ohio Environmental Protection Agency, the New Hampshire Resource Recovery Association, the Connecticut Hazardous Waste Management Service, the Pennsylvania Department of Natural Resources, the Maryland Department of Natural Resources, and the Maryland Department of Health and Mental Hygiene. All of the single-state exchanges receive funding from only a single source.

In the United States, two single-state waste exchange programs (Alabama and New Hampshire) do not publish catalogs. The Alabama Waste Exchange is a technical assistance program, while the New Hampshire Waste Exchange functions as a local chapter of the Northeast Industrial Waste Exchange.

The development of the waste exchange concept has taken a different course in Canada where a single national exchange was established in 1973 to serve the entire

country. Provincial exchanges linked to the national exchange now operate in Alberta, British Columbia, Manitoba, and Ontario. All of these exchanges, except Ontario, publish their own catalog in which they may reprint listings from other exchanges to increase market exposure. In Ontario, two local exchanges, Peel and Waterloo, operate primarily as technical assistance programs and do not publish separate catalogs.

In the United States, waste exchanges have been established and have grown through independent initiatives and only recently has the utility of coordination and cooperation been recognized. Examples of cooperation include, reprinting catalog listings, sharing information about waste recycling, and joint sponsorship of an annual waste exchange conference. Increased coordination has closely paralleled the development of multi-state programs and the recognition that wastes often travel across state lines for recycling as well as for disposal.

The development of multi-state programs reflects, in part, the relatively high fixed-costs (primarily staff costs) of operating an exchange and the relatively low marginal costs of distributing a catalog throughout a multi-state area. Programs with service area limited to a single state may miss significant opportunities for clients by failing to expose material listings to potential recycling opportunities that may be available in nearby states. For example, Table I summarizes the information provided by three exchanges concerning the distances that transfered wastes have traveled. As might be expected, approximately 40 percent of the transfers have been less than 160 kilometers. However, nearly 20 percent have traveled more than 800 kilometers. These longer distance recycling opportunities would have been missed by most state-wide exchange. A study prepared for U.S. EPA in 1976 concluded that the most appropriate service area for a waste exchange program would be a major metropolitan or substate area (15). However, since publication of that study, multi-state rather than substate programs have become dominate.

Even though some exchanges have been designed to serve multi-state areas, they typically do not receive direct financial support from all the states within their primary market area. The ten programs in the United States provide direct services to thirty-six states, the District of Columbia, and Puerto Rico. However, only ten states (CA, CT, IL, IN, MD, MT, NY, OH, PA, and SC) provide financial support for a program that serves their state. In addition, seven states distribute the catalog of the Industrial Materials Exchange Service, thus indirectly supporting that exchange (see Figure 1). Although the number of states providing financial support has increased slowly in recent years, the general pattern is that a few states subsidize the provision of waste exchange services in the other states.

Information about the non-profit information exchanges that distribute catalogs are shown in Table II. The Table shows that operating expenses not covered by direct income (i.e., listing, subscription, and advertising fees) are subsidized by a wide variety of funding sources, including trade associations, private corporations, a private foundation, the U.S. EPA, universities, and state regulatory and non-regulatory agencies. The exchanges collectively publish nearly, 2,400 listings of which approximately 75 percent are for "material available" and approximately 25 percent for "material wanted." Six catalogs offer "services available" listings and five exchanges offer display advertising as a service to their clients and as another source of revenue. The exchanges have a collective circulation of nearly 65,000 companies, and budget over $500,000 for their waste management activities. If reasonable estimates of operating expenses are made for the exchanges that were unable to provide budget figures, average yearly expenditures may be estimated at

TABLE I

Distance Traveled by Transfered Waste
(as percent of firms stating distance)

	Name of Exchange			
	Canadian	IMES	Northeast	Average
Kilometers				
< 80	35	22	20	26
81 - 161	10	15	16	14
162 - 322	9	8	22	13
323 - 805	37	22	25	28
806 - 1609	4	25	8	12
>1609	5	8	9	7

TABLE II

Data for Information Exchanges Publishing Catalogs

	Funding Source(s)	Current Listings: Available	Wanted	Total	Services Listings	Display Ads	Issues Per Year	Circulation	Budget
Single-State Exchanges									
California	State	89	20	109	--	--	4	2,000	NA[1]
Indiana	State	47	7	54	--	--	6	1,400	$45,000
Montana	State	11	10	21	--	--	6	200	$5,800
New Jersey	Trade	43	22	65	--	--	3	3,200	NA[1]
Tennessee	Trade	19	2	21	5	--	4	100	NA[1]
Multi-State Exchanges									
Great Lakes	Foundation	143	41	184	--	Yes	6	15,000	$81,000
Ind. Mat. Exch. Ser.	State/EPA	159	62	221	--	--	6	11,000	$60,000
Northeast	States/EPA	179	99	278	--	Yes	4	15,000	$130,000
Southeast	EPA/Univ/State/Ind	145	32	177	27	Yes	6	3,000	$100,000
Southern	Univ/Corp/Trade	78	30	108	72	Yes	4	10,000	NA[1]
Canadian Exchanges									
Alberta	Provincial	248	85	333	39	--	4	750	$42,000
British Columbia	National	34	32	66	27	Yes	4	500	$38,500
Canadian	Nat./Prov.	479	185	664	46	--	6	3,700	$38,500
Manitoba	Provincial	85	32	117	--	--	4	1,100	$14,000
TOTALS		1,759	659	2,418	216			66,950	$554,800

Note:
1. Not Available; exchange program not seperately budgeted.

approximately $650,000. Dividing an exchange's budget by the number of catalogs that it circulates reveals that the single-state exchanges typically expend $25-30 per name on their mailing list, which the multi-state exchanges typically expend $5-10 per name. Table III shows the contact addresses for these exchanges, and the primary market areas for the multi-state exchanges are shown in Figure 1.

BENEFITS OF WASTE EXCHANGE

Generators list material in a clearinghouse catalog for a variety of reasons, most often to explore the extent to which there may be a market for a particular waste. In other cases, a company may already be recycling the material and wishes to ascertain if other recycling options are available. Waste generators benefit from the revenues from the sale of waste and the avoided disposal costs. Since catalogs are widely distributed (circulation averages 10,000 copies per issue for the multi-state exchanges; see Table II) and listing fees are minimal (ranging from no cost to $40.00 per year), listing with an exchange is an inexpensive method of reaching a large and diverse audience. If no inquiries are received about a particular material, a generator has some assurance that it is reasonable to pursue other management options, such as disposal.

Companies seeking wastes may advertise in a clearinghouse catalog for several reasons: brokers seek new sources of material that can be profitably marketed; recyclers wish to identify new costumers; and manufacturers may want to locate new sources of raw material for use as process inputs or energy sources. Since waste exchanges and brokers provide similar services to industry, competition might be expected, but often a cooperative relationship develops. Some exchanges refer clients to brokers who are expert in a particular market or material, and some brokers review waste exchange catalogs for leads for new clients. Brokers may also place wanted listings or display advertisements in exchange catalogs.

Benefits to society as a whole include include decreased dependence on imported resources, savings in energy required for production of new materials, reduction of possible public-health hazards, and decrease in land required for waste disposal (18).

USE OF WASTE EXCHANGES BY INDUSTRY

Various factors affect the use of waste exchanges by industry. Even though a larger company may have the technical personnel needed to identify recycling opportunities that exist within their own manufacturing operation, the feasibility of inter-company waste transfer and reuse may go undetected. Smaller companies typically lack the in-house expertise needed to identity external recycling opportunities. Locally, a company may be well-informed about the recycling opportunities that exist; however they may not know of other opportunities located in adjacent states or cities. Thus, significant reasons exist for both large and small firms to use the specialized information and assistance available from waste exchange clearinghouses.

A number of interrelated factors influence the likelihood of success that a company will have in locating a buyer or seller for its waste materials. First of all, a company must decide to list a material or inquire about a material already listed in an

TABLE III

Information Exchanges in North America Currently Publishing Catalogs

Single-State Exchanges

California Waste Exchange
Department of Health Services
Toxic Substances Control Division
714 P Street
Sacramento, California
(916) 324-1807

Indiana Waste Exchange
Environmental Quality Control, Inc.
PO Box 1220
Indianapolis, Indiana 46206
(317) 634-2142

Montana Industrial Waste Exchange
Montana Chamber of Commerce
PO Box 1730
Helena, Montana 59624
(406) 442-2405

Industrial Waste Information Exchange
New Jersey Chamber of Commerce
5 Commerce Street
Newark, New Jersey 07102
(201) 623-7070

Tennessee Waste Exchange
Tennessee Manufacturers & Taxpayers Association
226 Capitol Blvd., Suite 800
Nashville, Tennessee 37219
(615) 256-5141

Multi-State Exchanges

Great Lakes Regional Waste Exchange
Waste Systems Institute of Michigan, Inc.
470 Market Street, S.W., Suite 100A
Grand Rapids, Michigan 49503
(616) 451-8992

Industrial Materials Exchange Service
Illinois Environmental Protection Agency
2200 Churchill Road, IEPA/DLPC-24
Springfield, Illinois 62706
(217) 524-5025

Northeast Industrial Waste Exchange
Central New York Regional Planning Board
90 Presidential Plaza, Suite 122
Syracuse, New York 13202
(315) 422-6572

Southeast Waste Exchange
University of North Carolina
Urban Institute, UNCC Station
Charlotte, North Carolina 28223
(704) 547-2307

Southern Waste Information Exchange
Florida State University
PO Box 6487
Tallahassee, Florida 32313
(904) 644-5516

Canadian Exchanges

Alberta Waste Materials Exchange
Alberta Research Council
4th Floor Terrace Plaza
4445 Calgary Trail South
Edmonton, Alberta T6H 5R7
(403) 450-5461

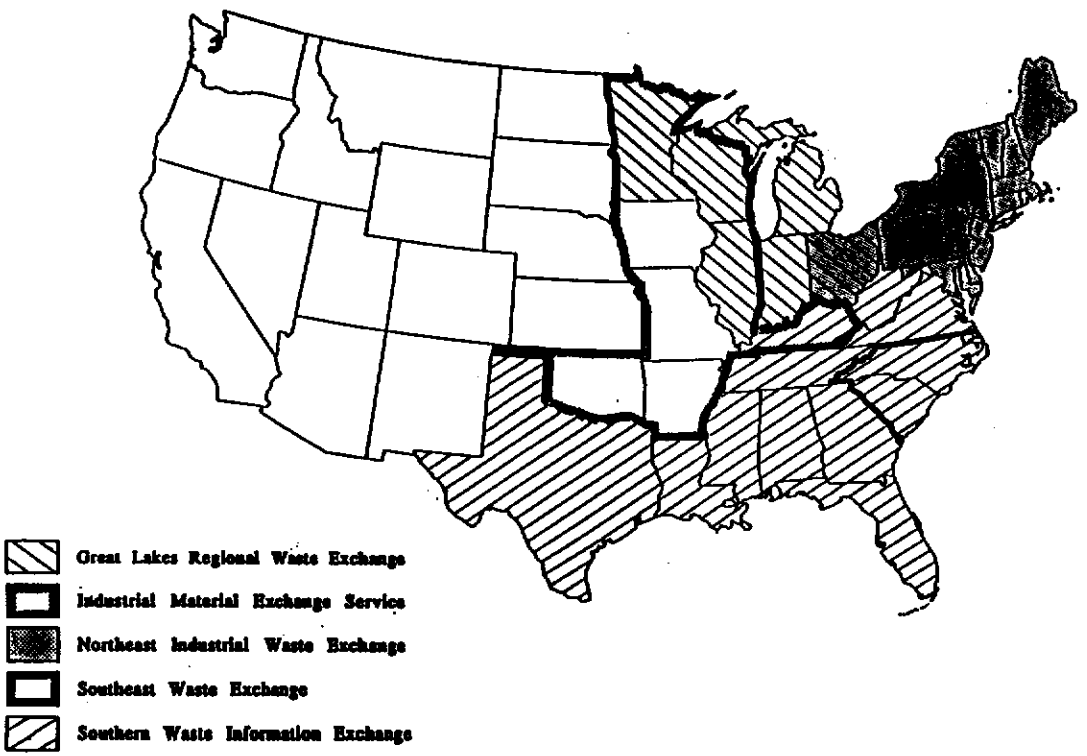
British Columbia Waste Exchange
Recycling Council of British Columbia
2150 Maple St.
Vancouver, British Columbia V6J 3T3
(604) 731-7222

Canadian Waste Materials Exchange
Ontario Research Foundation
Sheridan Park Research Community
Mississauga, Ontario L5K 1B3
(416) 822-4111

Manitoba Waste Exchange
Biomass Energy Institute, Inc.
1329 Niakwa Road
Winnipeg, Manitoba R2J 3T4
(204) 257-3891

FIGURE 1

MARKET AREAS FOR MULTI-STATE WASTE EXCHANGES IN THE UNITED STATES



exchange's catalog. This decision will be based not only on the kind of waste a company produces, but also on the decision-maker's perception of whether offsite recycling is worthwhile investigating. This perception will vary from individual to individual and will be influenced by that person's knowledge of waste recycling and, perhaps, position in the corporate structure. That is why it is important for an exchange's catalog to reach the appropriate corporate decision-maker. Since disposal rather than recycling has historically been the most common management option, corporate decision-makers may require special incentives before recycling is even considered.

Quality and quantity of the material listed are important factors influencing success. Small quantities, mixed waste streams, weak concentrations, and contaminated streams are all difficult to recycle. Generators may need to modify their waste production processes in order to meet the requirements of recyclers. Such modifications could include dewatering, concentration, preventing the mixture of waste streams, avoiding unnecessary contamination, and storage until recyclable quantities have accumulated. Communication between potential buyer and seller must be clear so that each understands the others needs. Quantity, quality, distance, and the value of the material must be favorable. A large quantity of a high value material may be economically transported over a long distance, whereas certified analysis and transportation charges for a small quantity of the same material may be too expensive to justify a sale. Economic considerations are paramount since neither buyer nor seller can be expected to do what is not in their economic self-interest.

The 1984 Amendments to the Recource Conservation and Recovery Act contain requirements that provide an additional incentive for hazardous waste generators to use the services of an industrial waste exchange. These Amendments establish as national policy the minimization of hazardous waste. Section 3002 (b) requires that generators of hazardous waste certify, on the Uniform Hazardous Waste Manifest, that they have in place a program to reduce the quantity and toxicity of the hazardous waste that they generate, to the extent economically practicable, and that the proposed management method is one that minimizes present and future threats to human health and the environment. U.S. EPA has stated that generators who recycle wastes onsite, send their wastes offsite to be recycled, or participate in a waste exchange program are exercising a form of waste minimization that may be used to satisfy the. waste minimization certification requirement (19).

MARKETING ACTIVITIES OF WASTE EXCHANGES

To carry-out their primary function of creating markets for waste materials that have no well-established markets, exchanges employ one or more of the following methods to locate potential buyers and sellers: catalog distribution, active telephone searches, and use of an on-line computer data base.

Most exchanges publish catalogs either bimonthly or quarterly. Since no state possesses the full range of recycling opportunities, it is important that catalogs be distributed to a large, diverse, multi-state audience to achieve maximum exposure for the listed material. Circulation of a listing is enhanced by reprint agreements with other exchanges to increase the number of companies and the geographic area to which a listing is exposed. However, since catalog publication frequencies vary from three to six times per year, new listings may not be circulated from two to four months after they are received by an exchange.

To serve clients more quickly, some exchanges employ direct telephone searches and referrals to potential buyers and sellers. Generators with quantities of waste too small to justify publication in a catalog or who must transfer material before the next catalog can be distributed, may receive direct referrals in this manner. Exchanges that employ direct telephone marketing will often use this technique to begin marketing a listing as soon as it is received and may be able to arrange a successful transfer even before publication of the next catalog.

Another way to expedite transfers is through use of a computer data base of material listings that can be accessed on-line through a modem and microcomputer. Such a data base can be updated immediately whenever a new listing is received by an exchange. The data base can be searched by a client for specific material (available or wanted), and a copy of the data base can be printed to create, in effect, a new catalog whenever one is desired. Such a service was inaugurated in 1985 by the Northeast Industrial Waste Exchange (20). The National Waste Exchange Data Base contains listings submitted by several of the major multi-state waste exchanges in the United States and Canada. It can be used free-of-charge after obtaining a password from the Northeast Exchange. The Data Base may be especially useful as a marketing strategy for waste streams that are not consistently generated and that must be marketed quickly. Waste streams that are produced over the long-term with a fairly consistent composition, quantity, and frequency can be effectively marketed through an exchange's catalog as well as through the on-line Data Base. To be effective as a marketing tool, generators, recyclers, brokers, and exchanges must commit to querying the Data Base routinely.

Figure 2 illustrates the logic, flexibility, and ease with which the Data Base can be searched. Following completion of a search, it is still necessary to send to the appropriate exchange a letter-of-inquiry concerning any listing for which additonal information is desired. However, non-confidential listings submitted to the Data Base by the Southern Waste Information Exchange contain the listing company's name and phone number, enabling the listing company to be contacted directly.

SUCCESS RATES OF WASTE EXCHANGES

Most exchanges do not collection information about completed transfers so, few data are available by which to judge the success of non-profit exchanges. Data from the four exchanges that have published information are summarized below. These exchanges estimate that 20-25 percent of the items listed in their catalogs are successfully transfered.

The Northeast Exchange reported that during 1986, 63 percent of its catalog listings received at least one letter-of-inquiry, and that nearly 4,000 tons of material were exchanged with an estimated value of over $1.2 million (21). In the first five years of operation (1981-1986), the Exchange assisted in the transfer of approximately 45,000 tons of material with an estimated value of nearly $4 million.

The Canadian Exchange has reported that between 1978 and 1986, 90 percent of its listing received inquiries and 20 percent resulted in a successful transfer. Quantity

transferred per year has averaged 280,000 tonnes with an average annual value of $10.4 million (Canadian dollars) (22).

During 1985, the Industrial Material Exchange Service reported that 23 percent of its listings resulted in a successful transfer. During its first five years of operation, IMES helped industry realize benefits of over $9.5 million and fostered the recycling of approximately 62,500 tons of waste or surplus materials. IMES also reported that transfers averaged 430 miles between generator and recycler (23).

During 1985, the Southeast Waste Exchange reported that their activities resulted in the transfer of nearly 12,000 tons of material with an estimated value of over $1 million (24).

Since the reporting of completed transfers is voluntary, it is likely that these data are incomplete and that they understate the extent to which waste exchange programs are able to assist waste generators and recyclers. These data indicate that these exchange collectively assist in the annual transfer of approximately 300,000 tons with an estimated value of nearly $10 million.

Very little information is available about the kind of material transferred or its ultimate disposition. However, based on discussions with waste exchange directors, it is likely that most of the material transferred is classified as non-hazardous and received primarily by commercial recycling and recovery companies. Only small amounts of material appear to move directly into the manufacturing sector for use as raw material substitutes, and this material is most likely to be used either in the operation of a waste water treatment plant, neutralization unit, or as an energy source. In addition, many surplus chemicals are acquired by surplus chemical brokers through waste exchanges.

STATE LEGISLATIVE SUPPORT FOR WASTE EXCHANGES

Little legislation exists which encourages the offsite recycling of hazardous waste. Most states have simply adopted the RCRA regulations pertaining to recycling. Examples from several states that have regulatory programs to encourage recycling are summarized in this section.

Title 22, Article 12, of the California hazardous and solid waste regulations lists wastes that are considered recyclable. The State Department of Health Services may require generators to justify, in writing, why a recyclable waste is being sent offsite for disposal rather than recycling. To assist generators in identifying offsite recycling options, the Department publishes a quarterly waste exchange catalog and a directory of hazardous waste recyclers. In addition, the Department has modified regulatory requirements for hazardous waste facilities in an effort to encourage recycling. For example, the title of facilities that recycle hazardous waste has been changed from "hazardous waste facility" to "resource recycling facility," and permit requirements have been simplified for facilities that recycle non-RCRA wastes and for facilities that handle large-volume, low-hazard materials or that use recyclable materials as substitutes for raw materials or commercial products. Massachusetts has also developed regulations that seek to simplify the permitting process for recycling facilities (19).

In Maryland, hazardous waste cannot be landfilled unless it has first been rejected by a treatment unit or a recycler. Since there are currently no commercially available landfills in Maryland, this legal requirement has had little effect. However, it does identify the context for the establishment of future landfills. In 1985, a bill was introduced in the Maryland Legislature (but not passed by both Houses) that would require generators to list with a waste exchange, and thus offer for recycling, any waste to be transported offsite (25).

The Ohio Environmental Protection Agency has legislative authority to review individual waste streams for their recycling potential. A technical reference document has been prepared to show the availability of appropriate management options for specific waste streams and is used by Ohio EPA staff during onsite inspections and during review of permit applications (26).

Section 39(h) of the Illinois Environmental Protection Act provides that hazardous waste cannot be disposed of in a landfill in Illinois unless the generator has demonstrated that, within the bounds of technological and economic feasibility, the waste cannot be recycled, incinerated, or chemically, physically, or biologically treated so as to neutralize and render it non-hazardous. In addition, the state operates a waste exchange clearinghouse, the Industrial Materials Exchange Program.

The New York State Environmental Facilities Corporation operates the Industrial Materials Recycling Program to assist industry in recycling industrial wastes, and partially funds the operation of the Northeast Industrial Waste Exchange. In addition, fees and taxes based on the amount of hazardous waste generated are reduced or waived for wastes that are recycled. Similarly, Minnesota Statutes, Section 115B.22, allows the tax that hazardous waste generators must pay, based on the volume and destination of waste generated, to be waived for wastes that are recycled.

STATE TECHNICAL ASSISTANCE PROGRAMS

A number of states have developed technical assistance programs to help generators reduce waste production and to manage properly that waste which is produced. Assistance may be provided through onsite inspection and pre-engineering consultation, literature searches, and referrals (27, 28, 29). As mentioned above, the California Department of Health Services may review generator manifests to identify waste streams that could be recycled. The New York State Environmental Facilities Corporation provides direct assistance to generators under a statutory mandate to help firms reduce waste production and to recycle industrial materials. Referrals may be made to the Northeast Industrial Waste Exchange for additional assistance.

The Minnesota Waste Management Board provides technical assistance and grants to encourage waste reduction and recycling. Grants may be used to develop waste management techniques or services, research waste reduction technologies, and study the need for new waste collection and processing facilities. The Minnesota Technical Assistance Program, funded by the State Legislature and operated by the University of Minnesota, offers technology transfer, evaluation of waste production and management practices, and an engineering intern program to implement onsite waste minimization practices.

The North Carolina Pollution Prevention Pays Programs help firms and communities reduce waste generation through technical assistance, research and education, and financial assistance. Staff members provide onsite technical assistance, prepare computer searches of literature databases, fund research on the application of pollution-prevention techniques, and conduct industry-specific workshops on the application of pollution-prevention techniques.

Several cooperative programs have been established to help small quantity generators (those producing less than 1,000 kilograms of hazardous waste in a calendar month) recycle their wastes. For example, in Houston, Texas, the Printing Industries of the Gulf Coast, a trade association, through their Silver/Plus program helps graphic arts firms reclaim silver and solvents. In Massachusetts, an association of drycleaners arranges for the collection and recycling of solvents from its member companies. In Ohio, the Greater Cincinnati Auto Dealership Association sponsors a program which coordinates the labeling, collection, and recycling of degreasing solvent (mineral spirits), lacquer thinner, waste gasoline, and waste oil from a large number of automobile dealerships for whom recycling is not economical on an individual basis (30). Industry-sponsored cooperative programs offer great potential for collecting small quantities of recyclable materials from widely scattered generators (31).

Cooperation among government-sponsored technical assistance programs, industry-sponsored cooperative programs, and industrial waste exchanges helps generators to identity waste reduction and recycling opportunities for a wide range of wastes. Working together, these programs can assist firms of all sizes and geographic locations, although small and medium sized firms benefit especially from such assistance.

IMPEDIMENTS TO OFFSITE RECYCLING

At present, the impediments or barriers to successful offsite recycling often outweigh the incentives. It is important to understand what these barriers are because they help to explain why recycling occurs less frequently than expected, given the cost savings that can be realized when recycling is successful. Treatment and disposal firms usually have aggressive marketing campaigns for their services, while recycling companies seldom advertise extensively, so generators may not realize that their waste streams can be recycled. It is, therefore, important for waste exchanges and technical assistance programs to share information and develop their educational and information transfer roles.

Closely related to the need for information about what material may be recyclable is what has been called "managerial inertia." Once production and disposal management procedures have been established within a firm, they are very difficult to change. If a company that uses a product that is 99.9 percent pure, company managers will usually resist using a product that is 95 percent pure even though it may perform just as adequately. There are, of course, valid reasons for adopting this conservative philosophy, however, it is another barrier to the use of wastes as raw material substitutes. Strong direction from corporate management is usually necessary before recycling and substitution are considered within the manufacturing facility (32). In fact, the major obstacles to waste reduction may not be economical or technical, but attitudinal, behavioral, and institutional (2, 33).

Most manufacturing processes and products are not designed to maximize recyclability. If disposal of waste material is assumed, care is usually not taken to assure that wastes meet the minimum requirements of potential users. For example, the mixture of two solvent waste streams may preclude their recovery and render them suitable only for an alternative fuels program or incineration disposal. In addition, good housekeeping practices by generators are a must to avoid contamination and can make the difference between a successful and unsuccessful recycling program (34).

Unfavorable economics are another barrier to successful offsite recycling. Since many wastes have a high volume but low economic value, long distance transport may not be cost-effective. Other costs that must be considered include the costs of finding a recycler, verifying the recycler's business reputation, negotiating a contract, material testing, and equipment or process modifications that may be necessary. These costs may become prohibitive when materials are available one-time-only, irregularly, or in small quantities. However, in comparing disposal to recycling, it is important to consider all present and future costs to the firm before an informed decision can be made.

Technology is usually available for the successful recycling of wastes (35). However, often it is not economical. Economical separation technology is needed for materials recovery from sludges, separation of close-boiling liquids, and separation of mixed plastic or fiber wastes (18, 36). In addition, many industrial processes result in the saturation of solids (such as catalysts and filter clays) by a variety of chemicals, including hydrocarbons. Technology is needed to allow the economic seperation of these chemicals and the subsequent recycling of the separated chemicals (37).

Two additional barriers to offsite recycling -- hazardous waste regulations and liability concerns -- are of such pervasive concern that they are discussed separately in the following two sections.

THE RESOURCE CONSERVATION AND RECOVERY ACT

In the United States, the management of hazardous wastes is regulated by the federal Resource Conservation and Recovery Act (RCRA). The RCRA regulations, administered by the U.S. EPA, establish standards and procedures for hazardous waste generators, transporters, storage facilities, and disposal operations. These regulations are among the most complex and costly ever developed. They affect offsite recycling both directly and indirectly. The regulations have developed piecemeal since 1980, and their changing requirements have caused some confusion, which may have deterred some companies from getting involved in recycling activities.

Confusion about the regulations and how they affect recycling opportunities is compounded by the unique variations many states have incorporated into their own regulations. This variation is permissible under RCRA and there may be good reasons for Congress to have allowed each state to choose its own regulatory path; however, since no state possesses the full range of recycling opportunities, interstate shipments are necessary but made more difficult by the lack of consistency among the states. As an example of the impact on recycling of the varying degrees of state

regulation, one consultant reported that a silver recycling client in one state was required to obtain a hazardous waste facility permit, while in a neighboring state silver recyclers need only comply with the federal regulations which do not require a permit for such activities. After assessing the environmental risks involved with the operations of these recyclers, it was concluded that a permit would not result in increased environmental protection, only increased costs (38).

A third problem with the RCRA regulations is that they focus on defining requirements for the proper storage, transport, and disposal of hazardous wastes rather than on establishing a framework that encourages resource conservation and recovery. In the original regulations, promulgated on 19 May 1980, recycling was treated as an exemption to disposal. For example, until 5 July 1985, characteristic wastes that were legitimately recycled, reclaimed, or reused were exempt from the regulatory requirements that pertained to listed hazardous wastes and hazardous sludges (39). The emphasis built into the regulations may help explain why recycling is not a priority with either the regulators or the regulated.

Underlying the RCRA regulations is the definition of what constitutes a solid waste. Only hazardous wastes which are solid wastes are regulated under RCRA. Recyclers of regulated hazardous waste must be permitted under RCRA and generators wishing to use their services must comply with the RCRA requirements. Like other portions of the RCRA regulations, the definition of solid wastes has changed through time. The trend has been to include more and more materials under the regulatory definition of solid and hazardous waste and the effect has been to increase the cost of and temper the interest in recycling many industrial wastes.

As more and more wastes are defined as hazardous and brought under regulatory control, companies that are now recycling these material may be reluctant to do so in the future since this would bring them officially into the hazardous waste management system, require them to be permitted, require increases in liability insurance, and force them into the public spotlight (especially during the permitting process).

A new definition of solid waste was promulgated by U.S. EPA on 4 January 1985 (40). The revised definition states that a solid waste is any material that is "thrown away" or abandoned by being disposed of, burned, or incinerated (or stored, treated, or accumulated before or in lieu of these activities). If it is not abandoned, it is not a solid waste. However, the recycling of certain types of materials in certain ways is also considered abandonment and, thus, is regulated under RCRA. Four types of recycling activities are within U.S. EPA jurisdiction: 1) use constituting disposal; 2) burning waste or waste fuels for energy recovery or using wastes to produce a fuel; 3) reclamation; and, 4) speculative accumulation. These four categories of recycling activities are further divided according to the type of material involved: spent material, sludge, byproducts, commercial chemical products, or scrap metal. It is necessary to know not only what the waste material is, but also how it is generated and how it will be recycled before a determination can be made as to whether it is regulated under RCRA. In general, only characteristic sludges, characteristic byproducts, and commercial chemical products that are reclaimed are not subject to regulation.

However, this seemingly straightforward scheme is permeated with a complex set of exceptions, qualifications, and undefined terms. U.S. EPA has attempted to relieve some of the confusion by publishing a guidance document explaining the definition and presenting some 120 examples of how specific wastes managed in specific ways

are regulated (41). Other commentators have explored the ambiguities in the definition of solid waste and observed that its complexity and restrictiveness probably act more as a constraint than as an incentive to recycling (42, 43, 44).

The definition of solid wastes and its underlying distinction between material that is discarded and material that is recycled has not gone unchallenged in the courts. On 31 July 1987, the U.S. Court of Appeals for the District of Columbia ruled that certain refining and mining wastes that are reclaimed and reinserted into the production process cannot be regulated as wastes because they were never discarded (45). U.S. EPA had argued that since these were listed wastes and were reclaimed before recycling, they were not exempt from regulatory control. The court disagreed and stated that "Congress defined 'solid waste' as 'discarded material.' The ordinary, plain-English meaning of the word 'discarded' is 'disposed of,' 'thrown away' or 'abandoned.' Encompassing materials retained for immediate reuse within the scope of 'discarded material,' strains, to say the least, the everyday usage of that term." The court concluded that "our analysis of the statute reveals clear congressional intent to extend EPA's authority only to materials that are truly discarded, disposed of, thrown away, or abandoned." Future court cases will likely be necessary to clarify whether this argument applies only to onsite immediate reuse operations or can be extended to apply to reuse in a different process within the same manufacturing facility, or even to offsite recovery and recycling. If the latter is the case, a major disincentive to offsite recycling will have been removed.

LIABILITY

Liability for the cleanup of pollution problems that are the result of hazardous waste or hazardous materials mismanagement is defined in the Comprehensive Environmental Response Compensation and Liability Act of 1980 (commonly known as "Superfund" or "CERCLA"). CERCLA applies not only to waste materials (as defined in RCRA) but also to any hazardous material or substance, including virgin and surplus materials.

CERCLA imposes a strict liability standard for cleanup costs and associated damages resulting from the disposal of hazardous waste or materials. Where liability is "strict," good faith or even compliance with state-of-the-art practices generally is not an acceptable legal defense nor is proof of negligence required. In addition, under CERCLA liability is joint and several (any one party may be liable for the full amount of cleanup costs), and retroactive (CERCLA applies to events that occurred before the passage of the Act). The effect of CERCLA has been to extend the scope of liability far beyond traditional common law limits and to insure that those who dispose of hazardous substances pay a share of the costs of correcting any problems that may occur as a result of such disposal, even if those parties were not directly responsible for the mismanagement.

CERCLA identifies several categories of "potentially responsible parties," including, in Section 107(a)(3): "Any person who by contract, agreement, or otherwise arranged for the disposal or treatment, or arranged with a transporter for disposal or treatment, of hazardous substances owned or possessed by such person, by any other party or entity, at any facility owned or operated by another party or entity and containing such hazardous substances. . . ." Thus, the strict liability imposed by CERCLA does not allow a generator to escape future cleanup costs by hiring someone

else to dispose of their wastes. Generators remains responsible for the fate of their wastes.

Although the extent of a generator's liability under CERCLA is difficult to define and is subject to differing court interpretation, one court case has established the principle that liability "ends with that party who both owned the hazardous waste and made the crucial decision how it would be disposed of or treated, and by whom" (36). Under this principle, it is clear that if a valuable waste material is sold by a generator to a recycler, who subsequently mismanages the material, the generator is potentially liable for cleanup costs under CERCLA. Since historically some hazardous waste recycling operations have been improperly managed (and some are now, in fact, Superfund cleanup sites), it is natural that some generators have reconsidered their decision to use the services of offsite recyclers (46). They realize, as one reviewer of recent court decisions has concluded, that "there is no insulation from the threat of strict liability if one sells spent or scrap materials which contain hazardous constituents." (47)

Firms wishing to minimize their exposure to future liability claims that may result from the action of others must maximize their own control over the ultimate fate of their waste materials. Such generators are likely to consider onsite disposal or recycling before considering offsite options (44). If offsite management is necessary, corporate waste managers may generally favor offsite disposal because they are better able to define their risks compared to the unknowns of dealing with a recycler. Complete destruction of organic waste streams through incineration (either onsite or offsite) is likely to be the preferred waste management strategy. Thus, the imposition of the strict liability standards of CERCLA on firms who use the services of offsite recyclers is a major disincentive to such recycling and a major incentive to disposal and may help account for the relatively rapid growth of incineration services during the 1980's, as opposed to the slow growth of offsite recycling services.

DISCUSSION

Well-organized markets exist to help industry buy and sell scrap materials and surplus chemicals with known reuse and recycling value. These markets typically only handle non-hazardous materials. Markets for the offsite recycling of hazardous materials are generally less well-organized and less visible. Obstacles to recycling are less technical than organizational and informational (33). Non-profit industrial waste exchanges assist industry in identifying offsite recycling opportunities. Exchanges publish and distribute catalogs, make telephone referrals, and use the National Waste Exchange Data Base to identify and create markets.

Despite the benefits to generators, recyclers and the nation as a whole, offsite recycling occurs much less frequently than desirable. Three major reasons for this situation have been identified: 1) the lack of economical recycling opportunities that result from the sparse distribution of recyclers and the small quanitity of material available from many generators; 2) the complex and restrictive RCRA recycling regulations; and 3) the fact that CERCLA-imposed liability favors the certainty of disposal and destruction of hazardous materials through treatment and incineration. Even with these disincentives, waste exchange programs have begun to receive increasing support from U.S. EPA and the states and are beginning to

achieve credible records of completed material transfers. Some changes could increase the effectiveness of waste exchanges.

The non-profit exchanges publish and distribute catalogs as their primary marketing tool. However, publishing ten catalogs in the United States is an extremely inefficient way of marketing waste materials. Both recyclers and generators are forced to list in many, if not all, of the catalogs in order to reach the broadest possible market. To keep up-to-date on the availability of materials, companies must review up to forty-nine catalogs per year (nearly one per week) from ten different exchanges. Considered purely from a marketing perspective, the existence of so many catalogs hinders, rather than promotes, the transfer of material from generators to offsite recyclers. To adequately serve industry's waste exchange information needs, four regional catalogs, published bimonthly to serve a major sector of the United States (Northeast, South, Midwest, and West), or one monthly catalog distributed nationally, would probable be sufficient.

Decreasing the number of published catalogs would not only be more cost-effective, but also would allow exchanges to concentrate on providing direct technical assistance to individual companies and to assist in the transfer of recyclable materials through problem-solving. Such a reorientation from publishing to problem-solving would have to be accompanied by an increase in the technical qualifications and skills of waste exchange staffs and a corresponding increase in funding. The relationship between the Northeast Industrial Waste Exchange, the New York State Environmental Facilities Corporation, and the New Hampshire Waste Exchange provides an excellent model of cooperation which minimizes the number of catalogs published and maximizes the provision of direct technical assistance to individual companies. The decision of the Alabama Waste Exchange not to publish a catalog, but rather to concentrate on providing technical assistance, is another excellent example, as are the decisions of the Ontario, Peel, and Waterloo exchanges in Canada.

With the exception of the California and Montana exchanges, all of the states that are served by single-state exchanges are also served by multi-state exchanges, and, to eliminate needless duplication they should merge their catalogs with those of the multi-state exchanges. These single-state exchanges would more effectively address waste management needs within their states by adopting the models provided by the New Hampshire, Alabama, and Ontario waste exchanges.

The service area of each multi-state exchange overlaps with that of another multi-state exchange. Industry would be more effectively served and competition among these non-profit exchanges reduced if they were to agree on mutually exclusive service territories.

Industry's reluctance to employ the services of brokers might be lessened if brokers handling hazardous substances were licensed or certified (such as the CHMM, Certified Hazardous Materials Manager, designation) and complied with national financial responsibility requirements.

It is paradoxical that waste exchanges exist primarily to serve the needs of industry, yet their funding is derived also exclusively from the public sector. A study prepared for U.S. EPA in 1976 concluded that the most appropriate sponsor for a waste exchange program would be a local or regional industry association (15). However, sponsorship by such groups has decreased rather than increased since publication of that study. Greater participation by industry in waste exchange programs is not

likely until the exchanges improve the technical capabilities of their staff and promote their services more effectively. Even with such improvements, plant engineers and managers will continue to be the primary source of the technical expertise needed to identify material substitution and recycling opportunities. Such participation by plant employees will not occur in the absence of strong leadership and commitment from corporate management. Exchanges can only act as catalysts; the real work of recycling must be done by industry. Even with encouragement and incentives, offsite recycling will not significantly increase until Congress releases generators from CERCLA liability at the time when recyclable material is delivered to a permitted recycler.

Opinions expressed are those of the author and do not necessarily reflect policy of the Southern Waste Information Exchange, its staff, or sponsors.

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47. D.B. Weinberg and D.D.K. Weiss, "Triggering Liability by the Sale of Reclaimable Materials," Pollution Engineering, February, 1986; quoting Chief Judge Foreman in *United States v. A & F Materials, Inc.* [582 F. Supp. 842 (S.D. Ill. 1984)].

LIST OF EXHIBITORS

George Boire	Metropolitan Environmental	101 Queensway West, Ste. 615 Mississauga, Ont. L5G 2J6 (416) 896-2100
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Bill Glenn	EcoLog Week	1450 Don Mills Rd., Toronto, Ont. M3B 2X7 (416) 445-6641
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Bob Laughlin	Ontario Research Foundation	Sheridan Park, Mississauga, Ont. L5K 1B3 (416) 822-4111
Earl Pifer	Finish Company Inc.	921 Greengarden Road, Erie, Penn. 16501 USA (814) 455-4487
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John Richmond	Ontario Waste Management Corporation	2 Bloor St. West, Toronto, Ont. M4W 3E2 (416) 923-2918
John Rocchi	Retek Resource Recovery	P.O. Box 1584, Brantford, Ont. N3T 5V6 (519) 756-9770
John Seldon	Tricil Environmental Management	155 Alvin Street, Waterloo, Ont. N2H 5M5 (519) 886-2029
Ken Wulff	Chemical Salvage Ltd.	32 Hastings Avenue, Toronto, Ont. M4L 2L2 (416) 465-9220

5th Annual Conference on Waste Exchange - Registrants List

Badge Name	Company	Address	City, Province	Postal code	Country\Phone
Mark Abbott	C.S.Mott Foundation	1200 Mott Foundation Bldg.	Flint Michigan	48502	U.S.A. 313 238 5651
Michael Agin	Agmet	PO.Box 39338	Solon Ohio	44139	U.S.A. 216 439 7400
Charlene Alston	Southeast Waste Exchange	Urban Institute UNCC	Charlotte North Carolina	28223	U.S.A. 704 547 2307
Randall Andrews	Industrial +Agric.Chemicals	Rt.2,Box 521C	Red Springs N.Carolina,	28377	U.S.A. 919 843 2121
Bruce Battaglia	Columbus McKinnon Corp.	140 Audubon Pkwy.	Amherst New York	14228	U.S.A. 716 689 5462
Karen Beliveau	Alberta Waste Exchange	250 Karl Clark Road	Edmonton Alberta	T6H 5X2	403 450 5408
John Bell	Shred Tech	201 Beverly Street	Cambridge Ontario	N1R 7G8	519 621 3560
Erica Belling	Dupont Canada Inc.	PO.Box 611	Maitland,Ontario	K0E 1P0	613 348 3611
Jeffrey Berman	Park Trading Co.	PO.Box 9521	Providence R.I.	02940	U.S.A. 401 467 3100
Ronald Blackmore	Earth Sciences Extraction Co	PO.Box 997 Postal Stn.T	Calgary Alberta	T2H2H4	403 279 8676
George Boire	Metropolitan Environmental	101 Queensway W.Suite 615	Mississauga Ontario	L5B 2P7	416 896 2100
Brent Bolger	Woodington Systems	PO.Box 140	Thorold Ontario	L2V 3Y8	416 262 4227
Carmine Bonacci	Huls Canada Inc	34 Industrial St.	Toronto Ontario	M4G 1Y9	416 421 3100
Ken Bradley	O.W.M.C.	2 Bloor St. West	Toronto Ontario	M4W 3E2	416 923 2918
Walter Brown	Walter Brown Assocs.	533 Arbor Road	Mississauga Ontario	L5G2J6	416 278 8848
Robert Brown	Eagle brook Environmental	2650 Royal Windsor Drive	Mississauga Ont.	L5J 1K7	416 822 5262
Steve Buck	General Super Plating	22 Celi Drive	East Syracuse New York	13057	U.S.A.
Sam Buggeln	Burlington Central High	1433 Baldwin St.	Burlington Ontario	L7S 1K4	416 634 7786
Richard Buggeln	Hamilton Autobody Repair Assn.	1366 Elgin St.	Burlington Ontario	L7S 1E5	416 637 3239
Dave Campbell	Environment Canada	351 St Joseph Blvd.	Hull Quebec	K1A0H3	819 953 1119
Phil Canning	Zenon Environmental Inc.	845 Harrington Court	Burlington Ontario	L7N3P3	416 639 6320
John Canning	Michelin Tire Canada Ltd.	1796 Victoria St.PO Box 399	New Glasgow Nova Scotia	B0K2A0	902 755 6040
Quentin Chapman	Chapman Research Ltd.	47 Ferndell Circle	Unionville Ontario	L3R 3Y7	416 475 9825
Chay Ching	BASF Corporation	108 Clarendon Drive	Anderson S.C.	29621	U.S.A 803 226 2023
Becky Chodzin	US DOD DRMR Columbus	926 Taylor Station Road	Columbus Ohio,	43004	U.S.A. 614 238 2171
Ed Ciepiela	Grow Rich Waste Recycling	51 Alamosa Drive	Willowdale Ontario	M2J 2N8	416 222 4138
Keith Coffin	Safety Clean Ltd.	1110 Sherbrooke St. W.	Montreal Quebec	H3A 1G8	514 282 1409
Joseph Cogswell	Valley Organics	RR#3	Waterville Nova Scotia	B0P 1V0	902 538 9978
Kenneth Cooper	Mercer Lime and Stone	348 New Castle St.	Slippery Rock Pa.	16057	U.S.A. 412 794 5434
John Cowan	Niagara Waste Systems	P0 Box 100	Thorold Ontario	L2V 3Y8	416 227 4142

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Judy Crow	B.P.I. Inc.	7425 Ben Hur Street	Pittsburg Pennsylvania	15208	U.S.A. 412 371 8554
Lewis Cutler	Northeast Waste Exchange	90 Presidential Plaza Ste.122	Syracuse New York	13202	U.S.A. 315 422 6572
Ron Daruwala	Union Carbide Canada Ltd	123 Eglinton Ave East	Toronto Ontario	M4P 1J3	416 488 1444
Harris Davis	Eagle brook Environmental	Royal Windsor Drive	Mississauga Ont.	L5J 1K7	416 822 5836
J.B.Derrick	Biochar Inc.	7729 Eighth Line S.	Hornby ,Ontario	L0P 1E0	416 875 4600
T.J.Desanti	Falconbridge Ltd.	P.O.Box 40 Commerce Ct.W.	Toronto Ont.	M5L1B4	416 863 7257
Michael Dombkowski	U.S.Dept.of Defence DRMS-HT	74 N.Washington	Battle Creek,Michigan	49017	U.S.A. 616 961 5799
William Donaldson	Metal\Koting	1430 Martin Grove Rd.	Rexdale Ontario	M9W 4Y1	416 743 7980
Patrick Douglas	Mosaic Chemical Corp.	5369 Maingate Drive	Mississauga Ontario	L4W 1G6	416 625 9436
Isobel Duncan	Canadian Waste Exchange	ORF,Sheridan Park	Mississauga Ontario	L5K 1B3	416 822 4111
Jean-Pierre Durocher	PPG Canada Ltd.	PO.Box 2010	Beauharnois Quebec	J6N3C3	514 429 4641
Paul Eisele	Masco Corporation	26855 Trolley Industrial Dr.	Taylor Michigan	48180	U.S.A. 313 291 3500
Jim Ferguson	Manitoba Waste Exchange	1329 Niakwa Road	Winnipeg Manitoba	R2J 3T4	204 257 3891
William Ferretti	N.Y.Dept.Economic Dvlpt.	1 Copmmerce Plaza Rm.920	Albany New York	12245	518 474 1131
Dusanka Filipovich	Union Carbide Canada	123 Eglinton Ave East	Toronto Ontario	M4P 1J3	416 488 1444
John Fletcher	Corundal Oil&Grease Inc	55 Vulcan St.	Rexdale Ontario	M9W 1L3	416 460 3076
Leonard Folkens	Meridian Chem.+Trading	2077 Mountain Grove Ave.	Burlington Ontario	L7P 2H8	416 335 0072
Allen Fracassi	Philip Enterprises Inc.	52 Imperial St.	Hamilton Ontario	L8L 7W2	416 544 6687
Gary Gardner	O.H.Materials Canada Ltd.	2192 Wyecroft Rd.	Oakville Ontario	L6J6L5	416 847 1700
Faith Gavin-Kuhn	Harris Beach Wilcox	130 East Main Street	Rochester New York	14604	U.S.A. 716 232 4440
Allison Gemmell	CH2M Hill	2510 Red Hill Suite A	Santa Ana California	92705	U.S.A. 714 250 5500
Lawrence Gemmell	GemChem,Inc.	PO.Box 116	Lititz Pennsylvania	17543	U.S.A. 717 627 0248
Marc-Aurele Gerard	Drainamar Inc	8600 Jarry East	Anjou Quebec	H1J1X7	514 352 2000
Barrie Gibbs	Carbose Corp.	100 Maple St.	Somerset Pennsylvania	15501	U.S.A. 814 443 1611
Carl Glas	Grow Rich Waste Recycling	51 Alamosa Drive	Willowdale,Ontario	M2J 2N8	416 222 4138
Bill Glenn	EcoLog Week	1450 Don Mills Rd	Toronto Ontario	M3B 2X7	416 445 6641
Beth Goodger	Region of Hamilton-Went.	71 Main Street W.	Hamilton Ontario	L8N 3T4	416 526 2671
Bill Gosse	SGS Plastics Recycling Inc.	125 Guelph Ave.	Cambridge Ontario	N3C 1A5	519 658 5165
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Badge Name	Company	Address	City, Province	Postal code	Country\Phone
Simon Grant-Rennick	Falconbridge Ltd.		Falconbridge Ontario	P0M 1S0	705 693 2761
John Guidolin	Fiberglas Canada	PO.Box 3049	Sarnia Ontario	N7T 7M6	519 336 5670
David Hall	Buyer	1 Gateway Center	Pittsburg Pennsylvania	15222	U.S.A. 412 562 6352
Christine Hart, M.P.P.	Parliamentary Assist., M.O.E.	135 St Clair Ave West	Toronto Ontario	M4V 1P5	416 323 4359
Barry Hayward	Atoma Intmational	521 Newpark Blvd.	Newmarket Ontario	L3Y 4X7	416 737 0796
Robin Henry	Burlington Central High	1433 Baldwin St.	Burlington Ontario	L7S 1K4	416 634 7786
Carolyn Hill	US DOD DRMR Columbus	926 Taylor Station Road	Columbus Ohio,	43004	U.S.A. 614 238 2171
John Hill	Motion Control Industries	Gillis Avenue	Ridgeway Pennsylvania	15853	U.S.A. 814 773 3185
Archie Hoevenaars	Timberbits Unlimited	55 Kenwood Cres.	Guelph Ont.	N1H6E4	519 763 1142
Bob Hollins	Heritage Env.Services Ltd	2728 Colonial AveSW Ste108	Roanoake Virginia	24015	U.S.A. 704 392 6276
Ron Horne	Pencco Inc.	PO.Box 2567	Corpus Christie Texas	78403	U.S.A. 512 881 9205
Martin Hotz	Hotz and Sons	166 Ferguson Ave N	Hamilton Ont.	L8L 4Y4	416 527 9266
Ai-Lun Huang	Taiwan Waste Exchange	321 Kuang Fu Rd.Sec.2	Hsinchu TAIWAN	30042	R.O.China 035 72132
Morris Ilyniak	Ont.Min of the Environment	135 St Clair Ave West	Toronto Ontario	M4V 1P5	416 323 4324
Patricia Inch	Min of the Environment	435 James St South	Thunder Bay Ontario	P7C 5G6	807 475 1215
Jay Jackson	Chem King Inc	Snow Valley Rd.RR#3	Barrie Ontario	L4M 4S5	705 737 1221
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Eugene Jones	Southern Waste Exchange	P.O.Box 6487	Tallahassee Florida	32313	U.S.A. 904 644 5516
Robert Joseph	Applied Specialties	PO.Box 777	Clairton Pennsylvania	15037	U.S.A. 412 384 4343
William Kay	Alberta Waste Exchange	250 Karl Clark Road	Edmonton Alberta	T6H 5X2	403 450 5408
Brian Kelleher	Waste Recycling Specialist	21316 Glen Place #11	Cupertino California	95014	U.S.A. 408 446 9792
Robert Kerr	Kerr & Associates,Inc.	2634 Wild Cherry Place	Reston Virginia	22091	U.S.A. 703 476 0710
Patrick Kitchin	Air Products+Chemicals Inc.	Box 351,R.D.1	Tamaqua Pennsylvania	18252	U.S.A. 717 467 2981
Sol Koplowitz	Spider Maple Lift	421A Bowes Rd.	Concord Ontario	L4K 1J5	416 738 4008
Bill Kowalchuk	Varnicolor Chemical Ltd	62 Union St.	Elmira Ontario	N3N 2Z6	519 669 5491
Les Kuczynski	O.W.M.C.	2 Bloor St. West	Toronto Ontario	M4W 3E2	416 923 2918
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Phillipe LaRoche	Canadian Chemical Exchange	P.O.Box 1135 900 Blondin	Ste-Adele Quebec	J0R 1L0	514 229 6511
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Bob Laughlin	Canadian Waste Exchange	Sheridan Park	Mississauga, Ontario	L5K 1B3	416 822 4111
Earl Lavelle	Ontario Hydro	800 Kipling Ave.	Toronto Ontario	M8Z 5S4	416 231 4111
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Jerry Lefson	Sharper Alloys Inc.	PO.Box 231	St.Jean sur Richelieu Que.	J3B 6Z4	514 658 9223
J.F.Lesko	O.W.M.C.	845 Harrington Court	Burlington Ontario	L7N 3P3	416 637 2452
Jack Lieberman	Hamilton Iron +Metal Co.Ltd.	239 Caroline St. N.	Hamilton Ontario	L8R 2S3	416 529 2229
Barb Loida	University of Minnesota	420 Delaware St.S.E.	Minneapolis Minnesota	55455	U.S.A. 612 626 4850
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Jack Lonsinger	Chem Agro	PO.Box 4913	Kansas City Missouri	64120	U.S.A. 816 242 2464
Frank MacGillvary	Global Recycling	PO.Box 164	Centreville Kings N.S.	B0P 1J0	902 538 9978
Chris Madden	A.C.T.Canada Inc.	PO.Box 174	Carlisle Ontario	L0R 1H0	416 689 5485
Erin Mahoney	Proctor and Redfern	45 Greenbelt Drive	Don Mills Ontario	M3C3K3	416 445 3600
Steve Mandich	Retico Rubber Inc	Melair Drive	Ayr,Ontario	N0B 1E0	519 632 7883
Gary Mann	Hevmet Recovery Ltd.	PO.Box 278	Pt.Colborne,Ontario	L3K 5W1	416 834 0034
Steve Martindale	Ont.Min of the Environment	119 King St.W.	Hamilton Ontario	L8M 3Z9	416 521 7640
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Ken Maynard	Schomberg Dehy Inc.	102 Herbcain Ave.	Newmarket Ont.	L3Y 6X5	416 939 2931
David McCallum	Township of West Lincoln	PO.Box 400	Smithville Ontario	L0R 2A0	
Robert McCormick	California Waste Exchange	714 P Street	Sacramento California	95814	U.S.A. 916 324 1807
Mary McDaniel	Southeast Waste Exchange	Urban Institute UNCC	Charlotte North Carolina	28223	U.S.A. 704 547 2307
Frank McGovern	Mowhawk Oil	130 Forester Street	N.Vancouver B.C.	V7H2M9	604 929 1284
Ellen Meadd	Resource Integration Systems	Suite 2 400 Mt.Pleasant Rd.	Toronto Ontario	M4S 2L6	416 480 2420
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Glenn Milbury	Region of Peel	10 Peel Centre Drive	Brampton Ontario	L6T4B9	416 791 9400
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Thomas Norton	Turtle Plastics	10955 Shaker Blvd.	Cleveland Ohio	44104	U.S.A. 216 791 2100
Brian O'Sullivan	Prime Polymers Inc.	5925 Airport Rd.	Mississauga Ontario	L4V1C9	416 672 2470
Hillo Paar	Min.of the Environment Ont.	7 Overlea Blvd 4th Floor	Toronto Ontario	M4H 1A8	416 467 3015
Romeo Palombella	Region of Hamilton Wentworth	71 Main St. W.,5th Floor	Hamilton Ontario	L8N 3T4	416 526 4454
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Bob Pojasek	ChemCycle Corporation	129 South Street	Boston Massachutsetts	02111	U.S.A. 617 451 0922
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Daniel Reddington	Commodity Improvisors Inc.	3366 Hillside Ave	New Hyde Park,New York	11040	U.S.A. 516 248 9714
Robert Redhead	Tricil(Sarnia)Limited	89 Queensway West	Mississauga Ontario	L5B 2V2	416 270 8280
Archie Reynolds	Woodington Systems	P.O.Box 100	Thorold Ont.	L2V3Y8	416 262 4227
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John Schilstra	Township of West Lincoln	PO.Box 400	Smithville Ontario	L0R 2A0	
Bill Searfoss	Motion Control Industries	Gillis Avenue	Ridgeway Pennsylvania	15853	U.S.A. 814 773 3185
John Seldon	Tricil Environmental Mgmt.	155 Alvin St.	Waterloo Ontario	N2H 5M5	519 886 2029
Jack Shaw	Mosaic Chemical Corp.	5369 Maingate Drive	Mississauga Ontario	L4W 1G6	416 625 9436
Margo Siekerka	Ind.Materials Exch.Service	11 Boulder Point	Springfield,Illinois	62702	U.S.A. 217 787 4058
Portia Sinnott	Micro Services Plus	2524 Benvenue #35	Berkeley California	94704	U.S.A. 415 548 6659
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Frank Trembacki	Da Trex Enterprises	6401 W,65th Street	Chicago Illinois	60638	U.S.A. 312 496 3353
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Angela Wilkes	U.S. Env. Protection Agency	401 M Street S.W.	Washington D.C.	20460	U.S.A. 202 382 7917
Frank Wills	Reclamation Assocs	609 West 114 Street	New York New York	10025	U.S.A. 212 666 4699
Cheryl Wilson	Texas Water Commission	PO.Box 13087	Austin Texas	78711	U.S.A. 512 463 7773
Kirk Woodworth	U.S.Dept.of Defence DRMS-HT	74 N.Washington	Battle Creek,Michigan	49017	U.S.A. 616 961 7306
Kenneth Wulff	Chemical Salvage Ltd.	32 Hastings Ave.	Toronto Ontario	M4L 2L2	416 465 9220
Raymond Yong	McGill University	817 Sherbrooke St.W.	Montreal Quebec	H3A 2K6	514 398 6672
Harland Young	Wainfleet Wood Products	PO.Box 464	Fonthill Ontario	L0S1E0	416 892 3813