

Illinois' program to promote industrial waste reduction

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Abstract

In 1984 the State of Illinois established the Hazardous Waste Research and Information Center (HWRIC) to become a focal point for the states non-regulatory hazardous waste activities. HWRIC established a formal waste reduction program in 1986 as a long term approach to helping solve the state's future waste management problems. This paper describes the Center's multifaceted approach to encourage and support industrial waste reduction efforts in Illinois. We also discuss outside contracts received from U.S. Environmental Protection Agency (EPA) to further promote the reduction of industrial waste and to enhance long term environmental protection.

Introduction

Governor James R. Thompson and the Illinois legislature created the Hazardous Waste Research and Information Center (HWRIC) in 1984 with a well-defined mission in mind. The new Center would combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities in a multidisciplinary effort to solve Illinois' hazardous waste problems. The Center was created within the Department of Energy and Natural Resources (ENR), a non-regulatory state agency, and was initially administered by the State Water Survey Division. In 1989, HWRIC was made a separate Division within ENR. Like the Survey it has maintained its affiliate status with the University of Illinois, Urbana-Champaign campus.

The Center was invested with specific objectives in its enabling legislation:

- (1) Characterizing and assessing the extent of Illinois' hazardous waste problems;
- (2) Reducing the volume of hazardous wastes generated and the threat they pose to human health and the environment;
- (3) Assembling, analyzing, and disseminating hazardous waste-related information and making it available to various users;
- (4) Providing waste management assistance to industry, agriculture, and communities; and

(5) Helping develop and implement a comprehensive hazardous waste management program for Illinois.

Waste reduction has been a priority program for HWRIC since its enabling legislation was passed in 1984. The Center's mandate was to promote waste reduction and improved waste management through direct technical assistance to industry, education programs, and research. In September 1989, Governor James R. Thompson signed Senate Bill 1044, The Toxic Pollution Prevention Act. This Act formalizes HWRIC's efforts to promote pollution prevention in the state of Illinois and is discussed further in this chapter.

Pollution prevention/waste reduction is a true win-win endeavor. It can help an industry increase productivity while simultaneously offering environmental protection. Despite almost certain cost savings, however, industries have often resisted adopting pollution prevention strategies. In response, HWRIC has developed a multifaceted approach to overcome the hurdle of industrial inertia. Aspects of our program have been published in a series of reports and papers [1-3].

Below we discuss some of our program activities and accomplishments in the area of waste reduction. We also discuss some U.S. Environmental Protection Agency (U.S. EPA) contracts the Center has received to further promote its waste reduction activities in Illinois.

HWRIC defines waste reduction to include all measures that can be taken within a facility to reduce the quantity and/or the toxicity of a waste. However, we do not consider simply dewatering a waste as waste reduction. Our definition includes on-site recycling but not off-site recycling which is usually the less preferred management option because of the risk incurred in transporting wastes. If on-site waste reduction is not feasible, however, off-site recycling is usually the preferred waste management method.

We have defined waste as any material that is no longer useful at a particular facility and must be recycled or released to the environment (e.g. air, water, or land). We consider hazardous waste in a broad sense to include any waste which poses a potential threat the human health and the environment. Although the focus of our Center's activities are on waste that are legally classified as hazardous, our experience with Illinois industry has shown that companies with successful waste reduction programs have taken into consideration the flow of all materials through their plants and the generation of all wastes released to all media. Thus, throughout this chapter we focus on the reduction of all waste generated within an industrial facility and releases to all environmental media.

Waste reduction program components

It is clear that a strong multimedia waste reduction program must be supported by aggressive research, information, and technical assistance programs.

In addition, for states to insure future capacity for waste treatment, storage, and disposal they must encourage industry to adopt active waste reduction programs. Ultimately these programs will lead to more efficient and competitive industries and better use of our resources.

HWRIC has promoted waste reduction in the state through the following four major program activities:

- Providing industrial and technical assistance,
- Encouraging waste reduction through the use of the Governor's Pollution Prevention Awards,
- Encouraging waste reduction through our Recycling and Reduction Techniques (RRT) matching fund and research programs, and
- Information dissemination and technology transfer through our library and clearinghouse, and computerized bibliographic information system.

Each of these four activities is described in more detail below.

Industrial and technical assistance

Our Industrial and Technical Assistance (ITA) Program provides direct technical assistance to Illinois industries, communities, and citizens with hazardous waste management problems. The Center emphasizes source reduction, recycling, and other methods of reducing the amounts and toxicity of hazardous wastes generated within a given plant.

ITA personnel provided technical assistance on 211 occasions in 1988 and on 323 occasions in 1989. In 1989 our ITA staff also presented seminars or gave talks to 39 different groups. The types of technical assistance given included:

- (1) Helping resolve waste problems by developing suggestions regarding waste management, process changes, and regulatory compliance;
- (2) Making site visits to help evaluate waste management practices and identify opportunities for overall improvement;
- (3) Providing information and help in applying waste reduction programs;
- (4) Conducting seminars, workshops, and talks to laymen, trade, and industrial groups interested in better waste management;
- (5) Helping generators comply with all applicable regulations by answering their questions, providing easy to understand analyses of the regulations, and by providing appropriate contacts within the regulatory agencies for further information;
- (6) Assisting users to find a variety of waste-related services including vendors, consultants, laboratories, waste haulers and waste disposers; and
- (7) Funding firms interested in developing applicable methods or technologies for the recycling or reduction of hazardous wastes.

The ITA Program's focus on helping individual industries develop waste reduction programs is a particularly important component of the Center's strategy for promoting waste reduction. We have found that once a company makes a commitment (from the top down) to waste reduction and develops a

waste reduction team and a well-thought-out plan, that it will usually achieve its waste reduction goals. The Center is thus encouraging companies to undertake waste reduction programs through on-site visits, information dissemination, seminars and workshops, and production of a waste reduction brochure.

Governor's Pollution Prevention Awards

Since 1987, HWRIC has also promoted waste reduction in Illinois by presentation of the annual Governor's "Pollution Prevention Awards" (formerly Innovative Waste Reduction Awards). The awards are given to recognize successful efforts of industry and others toward reducing their hazardous and non-hazardous waste. In April 1989 four awards were presented:

- Moline Paint Manufacturing Company (small business category — less than 100 employees) for reducing their wastes by training employees in waste management and giving them rewards based on the success of their efforts. Moline Paint further reduced its waste generation by reusing waste materials.
- Johnson and Johnson Health Care Company (large business category) for its management and manufacturing strategies that reduced the company's hazardous waste generation by more than 97%. Johnson and Johnson chemists developed water-based instead of solvent-based formulas for use in their adhesive coatings as one method of reducing waste.
- Illinois Agricultural Association-Employee Recreation Association (community association category) for their "Waste Not Recycling Program" in which they estimated they saved 19,228 trees through paper recycling.
- Industrial Waste Elimination Research Center of the Illinois Institute of Technology (educational institution category) for their eight years of achievements in waste management/reduction research. The IIT Center's research has focused on reducing wastes that are released to all media and is directed toward in-plant control of waste.

The awards program has been a success, not only by recognizing industries and other organizations for their waste reduction efforts, but also by encouraging companies to implement waste reduction programs and helping us learn what waste reduction techniques and technologies are presently working. We hope that publicity about this program will encourage others to further examine their own waste management needs and look for waste reduction opportunities. The awards program has also allowed us to work further with the award winners to expand upon their present successful efforts.

The awards program is now in its fourth year. Ten new winners were announced on April 20, 1990: 3 in the large business category, 3 in the medium category, 3 small businesses, and 1 not-for-profit group.

Waste reduction research

We also encourage waste reduction through the use of state-appropriated research funds. Our goal is to document what industry has done to reduce their

wastes and to encourage them to evaluate waste reduction technologies and techniques applicable to their specific facilities. Towards this goal, we have allocated \$200,000 per year of state research funds, of which \$100,000 is designated for projects that are matched by the recipient.

The matching fund program provides up to \$50,000 for any single project to demonstrate or develop specific techniques or technologies relating to the reduction of the amount and toxicity of waste streams within an industrial facility. Although this program started out slowly, in 1989 close to 30 companies responded with proposals requesting some \$2.4 million in funds. HWRIC has also expanded its waste reduction research efforts through a three year contract with U.S. EPA called the Waste Reduction Innovative Technology Evaluation (WRITE) program (a description follows later).

Three types of waste reduction projects have been sponsored. The objective of most has been to evaluate or develop a waste reduction technology or technique. The 15 projects of this type that have been sponsored are listed in Table 1. These projects have addressed a wide range of industries and waste types from electroplating sludges to laboratory chemicals to electric arc furnace dust from steel making. Technologies studied include metal reduction, ion exchange and electro dialysis. In two projects, several technologies are being screened before pilot scale evaluations are undertaken.

Research funds have also been used to sponsor two legislatively mandated studies on waste reduction. The first was a study of industrial waste reduction practices in Illinois, which included an assessment of techniques and approaches that are available to industry and development of various policy options to encourage additional waste reduction [4]. The second study, to be completed in the fall of 1991, is focused on waste reduction practices and policies for the production, use and reprocessing of paints.

A third type of waste reduction research project has been to facilitate technology transfer through the collection, organization and distribution of waste reduction information. A major project has been to develop the Waste Reduction Advisory System (WRAS) which consists of a survey questionnaire of industrial waste reduction practices and also contains a bibliography of case studies and other literature information. (The WRAS is described below in more detail in a separate section.) Another project has been to analyze Illinois-specific waste reduction information contained in the *U.S. EPA National Survey of Hazardous Waste Generators* and the *National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities*. This study is being done by Research Triangle Institute of Raleigh, North Carolina. Finally, we have developed a method to evaluate the "degree-of-hazard" of waste streams based on toxicity and other data [5-7]. This methodology is being applied to waste reduction techniques and technologies to account for changes in toxicity and other waste characteristics that result from waste reduction.

TABLE 1

Waste reduction technology/technique development research projects sponsored by HWRIC

Waste type	Technology/ technique	Industry
Carbon disulfide emissions	To be determined	Synthetic food wrapping
Electric arc furnace dust (zinc and lead recovery)	Metal reduction with hydrogen	Steel making
	Metal reduction with carbon	Steel making
Electroplating sludge	Chemical substitution and reuse	Zinc electroplating
	Ion exchange	Copper, nickel and chromium electroplating
	Vacuum evaporation	Various electroplating
Foundry waste molding sand	Hydrometallurgic extraction and recovery	Non-ferrous foundry
	To be determined	Investment casting
Laboratory chemicals	Microtechniques and training	Teaching and research laboratories
Laundry wastewater	Stripping tower and adsorption	Industrial laundries
Pickling acid	Electrodialysis	Electroplating
Plastics	Solvent blending	Plastics
Public works	Manual and training	Municipalities
Spent nickel bath solution	Ion exchange with electrolytic recovery	Nickel plating
Solvents	Fractional distillation	Hospital laboratories

Information dissemination

A fourth approach for promoting waste reduction is through our library and clearinghouse of hazardous waste reports, newsletters, fact sheets, and books. The library also provides access to several on-line information systems, including U.S. EPA's Electronic Information Exchange System. HWRIC's clearinghouse contains materials for distribution, including HWRIC's research reports and other publications and brochures. Waste reduction is one of the major topic areas of our clearinghouse and library collection.

HWRIC also has an active data management program which utilizes a PRIME minicomputer and a network of PC's. The three main objectives of the Data Management Program are to develop a hazardous waste data base for

Illinois, to apply the data base information to environmental issues in Illinois, and to provide support of HWRIC's electronic data processing needs. Data base research projects supported in Fiscal Year 1989 (FY'89) included development of a data base on hazardous waste activities in the Lake Calumet (southeast Chicago) area; assessment of the risk of spills to Illinois waterways; and the review of waste minimization data for Illinois' hazardous waste generators, treaters, storers, transporters and waste disposers. To date, HWRIC has obtained hazardous waste-related information from about 30 sources, projects and reports.

Education and training

Our educational and training activities have been in the form of sponsoring seminars and workshops on various topics of interest to waste generators. The Center has sponsored a number of regulatory compliance and waste reduction seminars around the state for small quantity generators. In 1987, HWRIC sponsored a two day state-wide conference on industrial waste reduction in which a number of Illinois generators participated and shared their success stories. In 1989, we sponsored our first series of training seminars on waste reduction to inspectors and permit writers within the Illinois Environmental Protection Agency (IEPA).

The Illinois Toxic Pollution Prevention Act (TPPA) calls on HWRIC to establish courses and provide curriculum and training for students and faculty. We have begun our efforts here by working with an engineering professor at the University of Illinois, Champaign-Urbana to add a module on waste reduction into an existing hazardous waste management course. In the future we will be greatly expanding on these efforts and will make resources for curriculum development available through our clearinghouse and library.

Waste Reduction Advisory System (WRAS)

Description of the WRAS

The WRAS was created to provide a systematic means for generators of regulated and non-regulated wastes to find ways to reduce the volume and toxicity of wastes they generate. For two years HWRIC has worked with several other states and the U.S. EPA under the auspices of the National Roundtable of State Waste Reduction Programs to develop the WRAS [8]. The WRAS is an IBM compatible, interactive waste management tool, designed to increase a generator's knowledge of the wide range of options for reducing and recycling their waste. It consists of two components:

- The Waste Reduction Audit Checklist (WRAC), contains groups of questions on eleven waste reduction techniques and strategies. The twelfth topic contains a description of technical assistance services and information available to help generators evaluate specific waste reduction techniques.

- **The Waste Reduction Information Bibliography (WRIB)**, which contains an annotated bibliography of articles and case studies about waste reduction that pertain to a particular industry, waste type, process, or waste reduction approach. Some of the case studies were compiled with the assistance of other state technical assistance programs and are only available in the WRIB.

Both components of the WRAS, the Audit Checklist and the Information Bibliography, can be used as tools to provide tailor-made technical assistance to generators to help identify waste reduction technologies that may meet their specific needs. The WRAS can also be used to identify technology research needs where there are currently no proven or adequate techniques for particular industrial processes or waste sources. Field testing has been conducted and the system has been found to be functional and contain valuable reference information. It has also been successfully tested as a training tool for regulators, technical assistance personnel, and generators. The WRAS is now available for purchase through HWRIC.

Waste Reduction Audit Checklist

By using the Waste Reduction Audit Checklist (WRAC), generators can: (1) assess what waste reduction activities are being used at their facilities; (2) identify potential waste reduction techniques for each of their waste-generating processes or job operations; and (3) determine how to obtain waste reduction assistance.

The eleven waste reduction techniques and strategies available in the Checklist are displayed in Table 2. The techniques range from low capital investment approaches (e.g. management strategies) to those that are more costly (e.g. equipment or technology modification). The user of the checklist (WRAC) can choose which techniques to review that are of interest. For each chosen waste reduction technique, a definition is provided along with an industrial example of the technique in use. A series of questions follow which explore the generator's use of that technique.

The waste reduction technique questions are designed to motivate generators to: (1) systematically evaluate their current waste reduction activities; (2) consider how they currently plan or envision waste management; and (3) develop on-going waste reduction programs. By responding to questions, the users are shown in full range of waste reduction strategies that they could implement in their facilities, what barriers may exist to implementing these strategies, and what to include in an evaluation of waste reduction opportunities. These questions can be used by generators as a framework or outline for developing organization-wide waste reduction programs.

After generators have completed the Checklist, they can use the twelfth topic to request technical assistance and information on each of these waste reduction strategies. Some of the types of information that can be requested in this section are shown in Table 3. For generators in the State of Illinois, HWRIC

TABLE 2

Question topics for waste reduction techniques

Topic	Question
Management strategies	(1) Establishment of corporate policy (2) Employee training and incentives (3) Inventory control and purchasing procedures
Waste reduction audits	(1) Have you performed or had a waste reduction audit performed?
Better housekeeping	(1) Spill prevention (2) Routine maintenance (3) Preventative maintenance (4) Storage requirements
Waste stream segregation	(1) Regulated from non-required wastes (2) Treatability (3) Toxicity (4) Organic from metal-bearing wastes (5) Chlorinated solvents from non-chlorinated solvents
Process raw materials modification or substitution	(1) Which solvents, paints, cyanides could be replaced to reduce toxicity or volume (2) What raw materials have been substituted
Product reformulation or redesign	(1) Could your products be reformulated or redesigned (2) Have products been reformulated to reduce waste by-products
Equipment or technology modification	(1) Purchased new equipment to reduce waste (e.g. equipment that needs less maintenance or clean-up) (2) Modified equipment to reduce wastes
Process modification or substitution	
Wastewater reduction	(1) Flow controls (2) Rinsewater reuse (3) Mechanical cleaning (4) Operations scheduling (5) Excess water reuse
On-site recycling or recovery for reuse	(1) Which wastes can be recycled (2) What wastes are being recycled (3) Is there potential to reduce wastes in-process (4) Reuse of "wastes" into products
Off-site recycling or recovery for reuse (materials exchange)	(1) Do you participate in materials exchange (2) Would you participate in materials exchange (3) What types of wastes could you sell or give (4) What types of wastes could you buy or receive

will provide additional waste reduction information, and, at the request of a generator, visit on-site.

The Checklist summarizes what particular industries have tried or could try

TABLE 3

Types of technical assistance information and services that may be requested

Information available for each technique

- How to establish policies
- Audit/opportunity assessment manuals
- Suitable consultants
- Case studies
- Equipment vendors
- List of materials exchanges
- List of recyclers
- On-site consultation
- Materials compatibility

to reduce waste generation. An aggregate count of the responses (in which the generator cannot be identified) are stored to provide state technical assistance agencies with general feedback on what generators are doing about waste reduction and what problem they may encounter in the implementation of waste management strategies. The results of each session with the Audit Checklist can be printed or stored for future reference.

Waste Reduction Information Bibliography

The Waste Reduction Information Bibliography (WRIB) is a collection of information on the published literature and unpublished case studies on waste reduction. At this time there are 300 references and case studies in the Bibliography. By using the WRIB, generators can learn about waste reduction strategies used at other facilities. The WRIB contains bibliographic citations for case studies and brief descriptions of the strategies.

Information in the Bibliography can be accessed by five types of keywords and keyphrases: (1) standard industrial classification (SIC) code; (2) waste type; (3) process or waste source; (4) waste reduction technique (identified in the WRAC); and (5) economic information (costs and benefits). There are 1,330 total keywords in the five categories that can be used to identify specific waste reduction information in the Information Bibliography.

The unique feature of the WRIB is that for each article and case study the waste reduction related key words have been identified and entered into the computer. They key words are then used to select specific waste reduction information. For each article the type of industry (SIC) that it pertains to, the industrial process or activity that produced the waste, the type of waste, the techniques that were used, and the costs and benefits are identified. By using combinations of these keywords generators can identify waste reduction information specific to their needs. Previous to the WRIB there was no other electronic bibliography with literature abstracted and keywords identified that fo-

cused on waste reduction. The identification of these keywords for each reference in the WRIB makes it a powerful tool for waste reduction technology transfer and training.

For each case study, the WRIB provides the following information: bibliographic citation including title, author, and publication, and an abstract of the article. An example print out of a reference is shown in Fig. 1. The abstract discusses the advantages and disadvantages of the waste reduction technology,

**WASTE REDUCTION INFORMATION BIBLIOGRAPHY
DETAILED PRINTOUT Reference ID # 87**

Headline: "Countercurrent rinsing of work pieces can reduce rinsewater requirements 90-99%"

Industry/SIC Code: 3471 Plating, and Polishing
3479 Metal Coating and Allied Services
3400 FABRICATED METAL PRODUCTS

Process or waste sources: Rinse baths, spray, etc.; Rinsing; Drag-out, bath; Cleaning; Electroplating; Metal finishing; Metals, cleaning

Wastes: Aqueous waste with low toxic organics content; Spent mineral acid with dissolved heavy metals; Alkaline solution with metals but no cyanides; Alkaline solution with metals and cyanides

Waste Reduction Technique: Equipment or Technology Modification; Process Modification or Substitution; Better Housekeeping; Onsite Recycling or Recovery for Reuse; Wastewater Reduction

Economic and Other Keywords: ECONOMIC EVALUATION; Payback period

Abstract: Counter-current rinsing of plated work pieces can reduce rinse water requirements by 90 - 99%. In a multistage counter-current rinse system, fresh rinse water enters the last rinse tank compartment via a submerged pipe distributor. It flows over and under partitions into the preceding rinse tank compartment, and so forth. Air sparging is provided in all rinse tank compartments via submerged pipe distributors. Drawbacks are the capital cost associated with the installation of additional tanks, pumps, piping, etc., as well as the additional space requirements. Payback in a two-tank system studied was 70 weeks.

Citation: Hunt, G. Water Conservation for Electroplaters; Countercurrent Rinsing. N.C. Dept. of Natural Resources and Community Development, 1985: 5p

Contact: Company: Don't know
Address: Don't know

Fig. 1. WRIB detailed print format.

the costs associated with implementation of a waste reduction strategy, the amount of waste reduced, and the cost savings to the industry.

Integration of the WRAS and EPA's Pollution Prevention Information Exchange System (PPIES)

Distribution of the WRAS diskettes and User Guide began in January 1990. HWRIC will be expanding the number of references by developing a network of contributors. This network will primarily consist of state waste reduction programs and the U.S. EPA.

HWRIC and the U.S. EPA are collaborating to incorporate the WRIB into the PPIES which is a part of their Pollution Prevention Information Clearinghouse. This coordinated approach provides the most flexibility for the users of both systems, better utilization of resources, and will enhance future integration of both systems.

U.S. EPA Contract to support training, technical assistance and research

HWRIC has received two outside contract to expand our present waste reduction program and to provide greater service to Illinois industry and others with waste management problems. One contract, the RCRA Integrated Training and Technical Assistance (RITTA) program, has also allowed us to better coordinate our efforts with those of the Illinois EPA. HWRIC will continue to explore outside funding to enhance the services it provides.

The RCRA Integrated Training and Technical Assistance (RITTA) Project

Project objectives

HWRIC has joined in a cooperative effort with IEPA to expand the existing Resource Conservation and Recovery Act (RCRA) program in the state by implementing waste reduction training of personnel from the regulatory, technical assistance, and business/industry communities, and by sponsoring demonstration programs to promote and document waste reduction. IEPA's Land Pollution Control Division, which has responsibility for the state's RCRA program, is the Agency's primary division involved in RITTA.

The project has three goals: (1) to develop and implement a five-year State Training Action Plan (STAP), (2) to expand the RCRA hazardous waste training for IEPA personnel, for others providing technical assistance, and for generators, and (3) to develop and implement pilot technical assistance projects focusing on waste reduction.

Through this project, HWRIC has worked cooperatively with IEPA, other Illinois technical assistance providers, and Illinois business to promote and implement reduction of air, water, solid, and hazardous wastes.

State Training Action Plan (STAP)

Congress and U.S. EPA have identified state program development, training, and technical assistance as keys to RCRA implementation. The transfer of technical and regulatory information from U.S. EPA to state and local personnel and the regulated community are essential to the successful control of hazardous waste. The goal of the STAP is to institutionalize training by establishing in-state training capabilities with a corresponding commitment to support and integrate training and technical assistance into the overall compliance system. The results of such an integrated compliance strategy include the following:

- (1) Improved environmental quality through better management of hazardous waste as directed by RCRA.
- (2) Integration of regulatory approaches for achieving compliance by use of appropriate technical assistance, training, and enforcement actions for each non-complying generator and treatment, storage, and disposal (TSD) facility.
- (3) Incorporation of technical assistance and training, whether delivered by the regulatory agency or others, into the hazardous waste regulatory control program for consideration as one of the potential responses to noncompliance.

The five-year STAP is being developed by IEPA with assistance from HWRIC. It is designed to achieve an integrated compliance strategy and will include the following components:

- An evaluation of the existing state RCRA program,
- An assessment of training and technical assistance needs, and a projection of resources required for the next five years,
- A statement of goals and objectives for future training and technical assistance activities,
- Identification of potential funding sources, and
- A plan to improve environmental programs and achieve RCRA program goals by developing and implementing state training and technical assistance programs.

Waste reduction training

Before May 1989, RCRA training programs for IEPA personnel were limited to regulatory, safety, and inspection procedures. HWRIC developed and provided waste reduction training across the state for most IEPA permit writers and inspectors. The training program included a brief introduction and an overview of waste reduction as a national and state environmental priority, a review of waste reduction techniques through the use of the WRAS (see above), identification of waste reduction strategies, and identification of waste reduction opportunities in some common industrial processes: machining, cleaning

and degreasing, paint coatings and formulation, electroplating, and paint stripping.

IEPA personnel, including permit writers and inspectors, make frequent contact with Illinois businesses and industries to enforce RCRA program goals. HWRIC has trained IEPA personnel to recognize waste reduction opportunities in the course of their contacts with businesses and, where appropriate, to direct industries to HWRIC and other waste reduction training and technical assistance providers in Illinois.

To encourage industry to look for waste reduction opportunities, HWRIC and IEPA prepared a brochure, "Waste Reduction of Illinois: Information and Services". The brochure identifies those agencies and groups that can provide detailed waste reduction assistance. The brochure defines waste reduction terminology and describes the types of waste reduction assistance provided by various groups in the state. It also identifies sources for answers to questions on specific topics (such as used tires and spent oil).

Demonstration projects

The pilot demonstration projects focus on waste reduction at the plant level. Four groups have received training from HWRIC staff to provide plant operators and managers with waste reduction information and/or assistance: IEPA's student intern program, Center for Neighborhood Technology (CNT), Community Contacts, Inc. (CCI), and IEPA inspectors and permit writers (described above).

The IEPA's student intern program began in the spring of 1989. Two engineering students from the Illinois Institute of Technology (IIT) are helping two Chicago electroplating companies implement waste reduction technologies, such as reverse osmosis to recover cadmium plating solution from the wastewater of a cadmium plating line.

The Center for Neighborhood Technology (CNT) has had several years of experience in providing engineering consultation to metal finishers. They provide on-site engineering assistance and help in implementing waste reduction alternatives to Chicago-area metal finishers. Under the RITTA project CNT has quantified hazardous waste reduction at 10 companies they assisted; they have also initiated 10 new contacts for waste reduction.

The Community Contacts Inc. (CCI) which is part of the Illinois Community Action Agency and the Great Lakes Rural Network, is providing an outreach program to encourage waste reduction in Kane County (west of Chicago). They have been focusing their early efforts on the printing and electroplating businesses located in that county. Their goals are to survey all printing and electroplating businesses in Kane County and to develop waste reduction assistance based on the survey results.

Illinois/U.S. EPA WRITE Program

Illinois was one of six states selected by U.S. EPA to implement a national research demonstration program called the Waste Reduction Innovative Technology Evaluation (WRITE) Program. HWRIC began the three-year research project, funded at \$100,000 per year, in June 1989.

The WRITE Program is designed to evaluate the use of innovative engineering and scientific technologies to reduce the volume and/or toxicology of wastes produced from the manufacture, processing and use of materials. Under this project, HWRIC will work with industries to demonstrate and evaluate at least five innovative production and recycling options for reducing waste generation. The scope of the technology evaluations will include both engineering effectiveness and economic return or payback. Technologies and techniques to reduce pollution to all environmental media are included in the scope of the WRITE Program.

The objectives of the WRITE Program are

- to establish reliable performance and cost information on pollution prevention techniques by conducting evaluations or demonstrations of the more promising innovative technologies;
- to encourage an early introduction of pollution prevention techniques into broad commercial practice;
- to encourage active participation of small and medium-sized companies in evaluating and adopting pollution prevention concepts by providing support to these companies through state and local government agencies; and
- to encourage the transfer of knowledge and technology concerning pollution prevention practices among large, medium-sized, and small industries.

To accomplish these objectives, staff from HWRIC and from the Institute for Environmental Studies (IES) at the University of Illinois will be involved. They will work with industry to identify and select projects and to conduct in-plant sampling and data gathering. Chemists in HWRIC's Laboratory Services Program will perform analysis of the samples and be responsible for the quality assurance aspects of the projects. The IES participants will have responsibility for determining the degree-of toxic hazard reduction that is achieved by the technologies.

A number of industries have already been contacted to explore their interest in the program. Technologies under consideration for the WRITE Project include substituting soybean oil links for solvent-based links in offset printing, substituting water-based inks for solvent-based inks in flexigraphic printing, changing from zinc cyanide to zinc hydroxide combined with total wastewater reuse in zinc electroplating, using evaporation along with condensation and recycling in an integrated electroplating shop to eliminate wastewaters and sludges, and recovery of metals and zircon sand in the investment foundry industry.

Illinois' pollution prevention initiatives

Illinois' Toxic Pollution Prevention Act (SB 1044)

In June 1989, the Illinois General Assembly passed the Toxic Pollution Prevention Act whose purpose was

"... to reduce the disposal and release of toxic substances which may have adverse and serious health and environmental effects, to promote toxic pollution prevention as the preferred means for achieving compliance with environmental laws and regulations, to establish State programs that provide high-level attention to toxic pollution prevention policy initiatives, to integrate existing regulatory programs to promote toxic pollution prevention, and to stimulate toxic pollution prevention strategies by industry."

Section 5 of this Act established a Toxic Pollution Prevention Assistance Program at the Hazardous Waste Research and Information Center. As part of this assistance program, the Center was asked to

- (1) provide general information about the advantages of and developments in toxic pollution prevention;
- (2) establish courses, seminars, etc., and other means of providing technical information to industries, governments, and citizens concerning toxic pollution prevention;
- (3) develop and provide curricula and training for students and faculty;
- (4) provide on-site technical consultation to help industries and businesses identify opportunities for toxic pollution prevention and develop toxic pollution prevention plans;
- (5) engage in research on toxic pollution prevention methods;
- (6) sponsor pilot projects in cooperation with the IEPA to develop and demonstrate innovative technologies for toxic pollution prevention; and
- (7) publish a biennial report on its toxic pollution prevention activities, achievements, identified problems, and future goals.

The Act provides for a natural expansion of HWRIC's present waste reduction activities and is consistent with the expanded efforts envisioned for our new facility, the Hazardous Materials Laboratory (HML), which is located on the University of Illinois, Urbana-Champaign (UIUC) campus. For example, with the HML conference facilities and expanded library and clearinghouse on pollution prevention, HWRIC can expand its training programs and other outreach activities. With a significantly increased mandate for IEPA to promote pollution prevention to Illinois industry, this Act institutionalizes pollution prevention as a state priority and gives greater emphasis to HWRIC's waste reduction activities.

Pollution prevention incentives for states program

HWRIC and the IEPA were recently awarded a U.S. EPA contract to help more rapidly implement the state's Toxic Pollution Prevention Act (TPPA).

Specifically, HWRIC's TPPA Program will be achieved through the following program objectives:

- (1) Develop and pilot test an Illinois guidance document to encourage corporate toxic pollution prevention planning for large, medium and small facilities.
- (2) Develop pollution prevention curriculum for educational facilities at the university level.
- (3) Identify priority industry groups in the Greater Metropolitan Chicago area in order to
 - Document past waste reduction activities of selected facilities in the Chicago area;
 - Select two industry groups for further toxic pollution prevention technical assistance;
 - Gather technological data on pollution prevention alternatives using the Waste Reduction Advisory System (WRAS) and literature review for these two industry groups;
 - Prepare fact sheets and other information needed for two industry specific workshops; and
 - Conduct two industry pollution prevention training workshops.
- (4) Implement general toxic pollution prevention assistance activities by expanding technical assistance onsite, and by developing research needs, an agenda on toxic pollution prevention methods, and soliciting proposals.
- (5) Publish a biennial report on HWRIC's pollution prevention activities.
- (6) Integrate the Toxic Pollution Prevention Act project activities by
 - Assisting Illinois industry in preparing toxic pollution prevention plans,
 - Assisting IEPA with a toxic pollution prevention training manual, and
 - Assisting IEPA with two promotional pollution prevention conferences.

This project is designed to last for two years and began July 1, 1990. It will further the cooperative efforts between HWRIC and the IEPA to promote waste reduction/pollution prevention among Illinois industries.

Future activities

Illinois is examining legislation that will further promote pollution prevention in the state. In the meantime the IEPA and HWRIC are cooperating, through funding from two EPA grants, to encourage industry to develop pollution prevention programs, including facility planning and the education and training of personnel. Various non-regulatory approaches are being explored to stimulate industry to adopt pollution prevention strategies.

Education and training programs will become the keystone to non-regulatory programs promoting pollution prevention. Some of these programs will be utilized to help leaders within facilities first sell and then implement pollution prevention programs. We are presently working with a number of facility and

corporate environmental managers to help them develop programs for their facilities. Often our assistance includes helping to find ways to overcome hurdles to change within the facility or corporate structure.

A future research area that will receive more attention is in the area of life cycle analyses. We have generally dealt with waste generated in only one part of the life cycle without considering the consequences elsewhere in the cycle. For example, we may design a product to be more readily recycled but not consider the implications of the waste that will be generated in making this new product. Or a company may modify a product to reduce the waste generated within the industrial facility, but not consider the disposal problems that may occur once the product has been used. Future considerations of pollution prevention options will have to assure that human health and the environment are protected over the life cycle of a product.

HWRIC will be coordinating the data entry of pollution prevention case studies from other states. These studies will be entered into the Waste Reduction Advisory System (WRAS) described earlier, and will also become available on EPA's Pollution Prevention Information Exchange System (PPIES).

We will continue, through the National Roundtable of State Waste Reduction programs, to coordinate our efforts with those of other states. Activities of the Roundtable are now coordinated by the Waste Reduction Institute for Training and Applications Research, Inc. (WRITAR), Terry Foecke President, 1313 5th Street, SE, Minneapolis, MN 55414 (phone 612-379-5995). For the address of contacts for various pollution prevention programs within the states see Appendix 1.

Discussion

In dealing with industrial waste reduction problems we have found it necessary to define waste very broadly to include any solid, liquid or gas removed for disposal or released from an industrial facility. Unfortunately, our societies present pollution control strategy often shifts pollutants from one media to another, and although the volume of waste may be reduced (such as with incineration) toxicity often remains the same or increases. Although our past pollution control strategies have helped to reduce air and water releases there has been an ever decreasing return in environmental improvement for each dollar spent on pollution control.

U.S. EPA recently announced a new Pollution Prevention Policy Statement (Federal Register, Jan. 23, 1989, Vol. 54, No. 16). They admitted that:

“notwithstanding the substantial gains that have been made in limiting environmental pollution, media specific programs have some inherent limitations. Efforts to control or treat pollutants subsequent to their generation or production can sometimes result in transfers of these pollutants from one environmental medium to another, where they may continue to present a hazard.”

Their new policy focuses primarily on the prevention of pollution through the multimedia reduction of pollutants at the source. The belief was that this policy offers enormous promise for improvements in human health protection and environmental quality.

Even more recently, EPA Administrator William K. Reilly called for a new debate on U.S. environmental policy that would emphasize a radically different way of controlling pollution than had been the norm over the past two decades (Environment Reporter, Dec. 1, 1989, p. 1351). He stated that we should begin moving away from a pollution control strategy (where pollutants are transferred from one part of the environment to another) to a more effective strategy of pollution prevention. He went on to comment that:

“the mechanisms for formulating policy are so diffuse that we are bound to have gaps in our programs and laws, in some instances, gaps so large that human health and natural resources may needlessly be put at risk.”

His conclusion was that we should drive for a single new environmental law that would encompass the existing nine major statutes and emphasize pollution prevention and risk reduction as a solution to the United States increasingly complex environmental challenges in the next decade.

The program HWRIC has developed utilizes a variety of approaches and techniques to encourage waste reduction as illustrated in Fig. 2. Also shown are the specific activities HWRIC has undertaken to promote waste reduction. To identify information and technology needs of industry, four main activities have been undertaken. This includes information obtained while providing technical assistance to industry and conducting workshops, review of surveys such as the *National Survey of Hazardous Waste Generators*, and through use of the Audit Checklist (WRAC) contained in the WRAS.

Identify Information and Technology Needs	Develop and Evaluate Technologies and Techniques	Assemble and Analyze Information	Encourage Adoption of Waste Reduction Practices
Technical Assistance	Basic and Applied Research	Library and Clearing-house	Technical Assistance
Workshops	Documentation and Evaluation of Case Studies	WRAS	Governor's Awards
Surveys/Needs Assessments		Fact Sheets	Technology Demonstration Projects
Audits/Questionnaires		Training Materials	Conferences, Workshops and Seminars
		Policy Studies	Brochures
			Training
			Reports, Papers and Other Publications

Fig. 2. Four main aspects of HWRIC's approach to waste reduction assistance.

From these identified needs various research projects are funded to collect the necessary information or to develop and evaluate technologies. The information obtained is analyzed and assembled in our library, clearinghouse, and Information Bibliography (WRIB) in the WRAS. Information is also provided through developing fact sheets, training materials and policy studies.

The goal is that waste reduction practices will be encouraged through many activities. Most significant are technical assistance, the annual Governor's Pollution Prevention Awards, funding for technology demonstration projects, training classes, seminars, and various publications.

Information dissemination and technology transfer are essential components of this program. For example, our goal in developing and distributing the Waste Reduction Advisory System (WRAS) is to foster more rapid adoption of waste reduction techniques by generators. It has often been shown that when industry adopts a waste reduction program then productivity and competitiveness is enhanced. Also, with a reduction in the amount and toxicity of wastes that are generated, existing capacity for waste management is better utilized and the environment is better protected. While this may seem like an idealistic and long-term goal, some companies have already made remarkable progress in reducing their wastes. With increased cooperation and information sharing by all parties involved, the widespread implementation of waste reduction may occur in a surprisingly short period of time. State government programs can play a vital role in this process.

It has been shown by a number of sources [9-11] that companies can often recover the costs of implementing waste reduction projects within a short period of time. Because these projects can be profitable for companies in the short-term and because it is difficult to regulate what are often proprietary aspects of a production process, an effective approach for state government is to encourage and promote the adoption of waste reduction rather than to require or regulate specific waste reduction programs. Where the government and industry cooperative approach is not successful, then direct regulation such as requiring waste audits, the development of waste reduction plans, specific production process technologies, or specifying waste production limits may be necessary.

To encourage better industrial waste management we believe that states need to look more comprehensively at waste generation and the multimedia release of waste. The IEPA is beginning to do this through some efforts at facility-wide permitting, where all regulatory programs (air, water and land) work together. Also, the Toxic Pollution Prevention Innovation Plan (Section 6 of the Toxic Pollution Prevention Act) allows the IEPA to provide temporary variances from some environmental regulations to enable a company to institute and complete a pollution prevention project. Both of the above examples represent the types of innovations that will be needed to overcome some of the present hurdles to waste reduction.

There is a need at both state and federal level to develop a comprehensive framework to promote industrial waste reduction. In a recent report exploring policy options for the State of Illinois, Thomas et al. [4] recommended that requiring waste audits and waste reduction plans might be important early regulatory steps to further promote waste reduction. In addition, it was determined that the state needed better data on the flow of chemicals through facilities, the wastes that are generated, and the degree of reduction that is taking place through various waste reduction strategies to be able to assess progress being made.

The advantage of a comprehensive industrial waste reduction program is that it encourages a facility to evaluate the reduction or better management of all to its waste, and releases to all environmental media. As policymakers develop better reporting requirements and more data become available, then the state can institute more specific requirements to further reduce or recycle specific wastes. In the meantime, HWRIC will continue to utilize its non-regulatory program to look for ways of encouraging and promoting industrial waste reduction in Illinois.

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Appendix

National Roundtable of State Waste Reduction Programs

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