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OPPORTUNITIES FOR INTERNATIONAL COLLABORATION IN INDUSTRIAL POLLUTION PREVENTION

J. K. Young
K. M. Fowler

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Pacific Northwest Laboratory
Richland, Washington 99352

Opportunities for International Collaboration in Industrial Pollution Prevention[a]

J. K. Young and K. M. Fowler
Pacific Northwest Laboratory
P.O. Box 999, MS K6-54
Richland, Washington 99352

Abstract: The goal of this paper is to describe international research opportunities for in-process reduction of wastes from industrial processes. Written responses from 52 researchers were obtained from 15 different countries in mid-1992. Each researcher provided information about projects to reduce waste in industrial processes and recommended joint activities and mechanisms for working collaboratively with the United States.

Survey responses are tabulated by country in Table 1. About 85% of the respondents are from government environmental agencies including multi-country organizations such as the United Nations, the Organization for Economic Cooperation and Development (OECD), and the European Economic Community (EEC). The remaining 15% are from industry. These companies include waste management firms, environmental engineering services, automotive manufacturing, electronics manufacturing, textile manufacturing, chemical production, and metal reclaiming companies.

Geiser, Fischer, and Beecher[1] and Rappaport[2] report that Austria, the Netherlands, Germany, Denmark, Japan, and Sweden are leaders in implementing waste management and pollution prevention. Clean technology has been adopted as a national priority for over a decade in these countries. Strong programs are in place in the area of solid waste reduction. Survey participants report concerns about the generation of specific types of these wastes. Concerns specifically mentioned include: chlorofluorocarbons (CFCs), dumped appliances, lacquer, sludge, waste oils and fats, reverse osmosis

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Table 1. Survey Responses by Country

Country	Number of Respondents
Australia	1
Austria	4
Belgium	2
Canada	6
Denmark	4
Finland	1
France	5
Germany	8
Holland	1
Italy	1
Japan	2
Mexico	2
Saipan	1
Sweden	1
Switzerland	2
Thailand	1
The Netherlands	8
United Kingdom	1
West Indies	1
Total	52

(R/O) brine, waste plastics, and waste acids.

Highly developed countries such as the Netherlands, Germany, and Denmark report problems exist with reducing wastes from the following industries: metal finishing, steel production, industrial organic chemical manufacture, and pulp and paper production. Problems result from both production and use of the products of these industries. End-of-pipe technologies still dominate solutions rather than true source reduction; however, end-of-pipe constitutes recycling and reuse rather than release or disposal. The need source reduction and recycling strategies are shared between the U.S. and these nations. This offers many immediate and longer-term opportunities for collaboration.

COOPERATIVE ACTIVITIES

Nineteen respondents indicated an interest in cooperative activities with the U.S. Department of Energy (DOE) and presumably other U.S. industries and agencies. Proposed activities are shown in Table 2. These projects are appropriate topics for joint R&D and innovative funding mechanisms are necessary. While all types of cooperative mechanisms elicited interest, a Finnish respondent felt joint research projects were preferred because there would be less potential to compromise proprietary information. Technical staff exchanges were favored by 47% of respondents presumably because costs would be low. A researcher from Mexico suggested joint fund-raising activities to support the development of clean technology.

Respondents from lesser-developed countries report concerns with agricultural, municipal, and food wastes. Low cost technologies are needed to reduce the following: contaminants from petroleum refining, gases from transportation equipment manufacture, residuals from coffee production, and stillage from alcohol production. Efforts to transfer pollution prevention technology and knowledge from more to lesser developed countries were requested.

OPPORTUNITIES FOR ACQUIRING TECHNOLOGY

Viable technology is available from European countries for

Table 2. Joint R&D Opportunities		Cooperative Mechanisms						
Survey Participants	Project Opportunity	Joint Research	Field Study/ Plant Demo	Staff Exchange	Advisory Group	Conference	Joint Data Collection	Commercialize Technology
Confidential Al Deventer, The Netherlands	Metal separation and recovery systems	X	X			X		
Public Works Agency of Flanders Mechelen, Belgium	Anaerobic composting	X						
ORTECH International Canadian Waste Material Exchange Mississauga, Ontario, Canada	No activities specified	X	X		X	X	X	
Confidential Fredriustad, Norway	Zinc hydroxide, Recovery in electroplating	X		X				
Commonwealth Utilities Corp. Saipan, Commonwealth of Northern Marianas Islands	Adapt available technologies to recover waste heat		X		X	X	X	
Wastewater Technology Centre Burlington, Ontario, Canada	Oil from sludge, Electrodialysis membranes for oil and gas industry	X	X	X	X	X	X	X
Confidential Alberta, Canada	Deploy process to refine waste gas treating chemicals		X					
Product Life Cycle Institute Geneva, Switzerland	Product life cycle analysis	X						
Asian Institute of Technology Bangkok, Thailand	Alkaline digestion of tannery wastes	X	X	X	X	X	X	
Danish Technical Institute Taastrup, Denmark	Powder coating of wood, Water-borne degreasing low-VOC coatings	X	X	X				
United Nations Industrial Development Organization Vienna, Austria	Open to existing projects in black liquor recycling and biogas energy		X	X	X			
Confidential participant Helsinki, Finland	Pulping processes, Biodegradable polymers	X		X			X	
Water Agency Douai Cedex, France	Low waste products and processes; high-value products from wastes	X		X				
Confidential Paris, France	No activities specified							

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Survey Participants	Project Opportunity	Joint Research	Field Study/ Plant Demo	Staff Exchange	Advisory Group	Conference	Joint Data Collection	Commercialize Technology
Confidential Augsburg, Germany	Technology to reduce combustion emissions	X		X		X	X	
University of Hannover Hannover, Germany	CFC substitutes/ Ammonia vapor compression	X						
Confidential participant Osaka, Japan	No activities specified					X	X	
Confidential participant Kusatau Shigaken, Japan	Recycle plastic products					X	X	
Institute of Ecology Xalapa, Mexico	Cultivation of algae grown using agriwastes to reduce CO_2	X	X	X	X	X	X	X

Note: The author of this paper may be able to provide confidential information upon request after obtaining requested approvals.

sorting, collecting, and recycling a number of waste products. Literature from these countries describes bottle collection and sorting machines from the Netherlands, sorting systems for industrial, construction, and commercial waste from Sweden[3], and plastic recycling factories from Austria[4]. Use of such technology in the U.S. could quickly result in reuse of waste products. Federal, state, and local agencies in the U.S. may want to explore acquiring these technologies for their facilities. Turnkey plastic recycling plants seem to be especially promising, provided they can be supported with an infrastructure for collecting and using recycled goods. Demonstration projects would be useful to prove the performance of these recycled materials in actual applications.

ENERGY-RELATED OPPORTUNITIES

Recycling is considered a solution to industrial waste reduction (due to a lack of source reduction options), but recycling can mean increased energy consumption. Developing clean, energy-efficient technology is of mutual interest to all nations. Japan and the United Kingdom reportedly have formally recognized the need to include energy conservation objectives in waste minimization goals. Use of renewables is frequently cited as a waste minimization technology in the Netherlands because there is no net CO_2 generation. The organizations sponsoring these programs represent likely targets for joint R&D with U.S. agencies such as the Department of Energy (DOE).

NEXT GENERATION TECHNOLOGY DEVELOPMENT

The Federal Ministry for Research and Technology of Germany[5] sponsors comprehensive, innovative technology development efforts for in-process industrial waste reduction. Many of their efforts can be considered "next generation." For example, programs to recycle non-halogenated solvents and to recover metals from mixed electroplating wastes are under development. Such technologies would have broad application in the United States and joint R&D is an option.

OTHER OPPORTUNITIES

Various responses suggested the following technology developments topics for joint R&D:

- design tools
- bioreactors
- sensors
- incinerators
- automation
- selective separations
- conversion of wastes to usable products
- substitutes for hazardous chemicals
- processes and equipment that produce less waste.

CONCLUSIONS

The responses indicate that there is considerable activity in Scandinavia, Germany, and Japan to develop technologies to recycle waste in industries. A number of turnkey recycling systems are available for solvent recovery, vapor recovery, and recovery of consumer waste.

In addition, the U.S. and countries demonstrating leadership in pollution prevention need to seriously consider the role of providing technical assistance to Mexico and developing countries. By providing educated experts, developing countries can be prevented from repeating past mistakes. Solutions that are turnkey, low maintenance, and supported with minimal infrastructure are highly desired.

The future for source reduction in industrialized countries is likely to be driven by consumer preference, voluntary industry actions and government regulations. Source reduction continues to be a strong need in the U.S. as well as other countries, even those demonstrating leadership in pollution prevention. International cooperation in technology development can lead to quicker solutions. This includes redesigning both products and processes.

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