EPAX EPA
9701 500
0010 1988
US EPA Headquarters Library
401 M St
(3404)

PROCEEDINGS OF THE WORKSHOP ON MUNICIPAL SOLID WASTE TECHNOLOGY

OCTOBER 3 - 4, 1988

WASHINGTON, D.C.

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENVIRONMENTAL ENGINEERING
AND TECHNOLOGY DEMONSTRATION

36221036

PROCEEDINGS OF THE WORKSHOP ON MUNICIPAL SOLID WASTE TECHNOLOGY

OCTOBER 3 - 4, 1988

WASHINGTON, DC

Prepared for:

U.S. Environmental Protection Agency
Office of Environmental Engineering
and Technology Demonstration

Prepared by:

Joesph M. Greenblott
Channah Springer
Theodora Radcliffe
Beverly Campbell
Ky Ostergaard
Mel Knapp
Gerald Filbin

Technical Resources, Inc.
3202 Monroe Street
Rockville, Maryland 20852

DISCLAIMER

Mention of trade names or commercial products does not constitute endorsement or recommendation for use. Statements made or ideas expressed in these Proceedings are those of the identified authors and are not to be construed as positions or policies of the agencies or institutions which may employ the authors or of the sponsors who provided support for publication of these Proceedings.

PREFACE

The United States is facing a garbage crisis. The crisis is the result of a number of factors, including increased waste production, limited capacity of existing landfills, and difficulty in implementing new municipal solid waste (MSW) management technologies and siting new MSW facilities. Local and state waste managers and planners in many regions of the country are already faced with the dilemma of how to safely and economically dispose of MSW.

A workshop on Municipal Solid Waste Technology was held in Washington, DC, on October 3 - 4, 1988. It was sponsored by the United States Environmental Protection Agency, Office of Environmental Engineering and Technology Demonstration (U.S. EPA--OEETD). The workshop indicated a recommitment by the U.S. EPA to provide a leadership role in finding technical solutions and approaches to resolving the MSW dilemma. The purpose of the workshop was to receive feedback from representatives of local and state governments, industry, and academia in order to develop a national research agenda for MSW based on an integrated management plan that was developed by an EPA task force on MSW. In addition, the Agency sought guidance on the appropriate role of the Federal government, specifically the EPA, in the MSW arena.

The following document contains the proceedings of the workshop. Every attempt was made to preserve content, although the actual transcripts were edited for readability. Presentations and discussions from plenary sessions are presented in section I, in the order in which they were presented at the workshop. Summaries and conclusions of individual workgroups are presented in section II. Each workgroup dealt with different aspects of MSW management, and is presented in the order of its importance vis-a-vis integrated solid waste management, i.e., waste reduction and recycling, municipal waste combustion, municipal waste combustor ash management, and land disposal. An additional workgroup, presented last, discussed research, development, and demonstration needs in the general area of municipal planning and waste management.

CONTENTS

Page

I. PLENARY SESSIONS 1

1. Introduction 3
Fred Lindsey, Acting Director, U.S. EPA--OEETD

2. Overview of Current Municipal Waste Research Programs 5

2.1 RCRA - Subtitle D (Municipal Solid Waste Program) 5
Robert Landreth, U.S. EPA--OEETD, Risk Reduction Environmental Laboratory, Cincinnati, Ohio

2.2 Municipal Waste Combustion Program 10
James Kilgroe, U.S. EPA--OEETD, Air and Energy Engineering Research Laboratory, Research Triangle Park, North Carolina

2.3 Municipal Waste Combustion Ash Stabilization Program 42
Carlton Wiles, U.S. EPA--OEETD, Risk Reduction Environmental Laboratory, Cincinnati, Ohio

3. Description of MITE Program 47
Fred Lindsey, Acting Director, U.S. EPA--OEETD

4. "Strawman" Municipal Solid Waste National Research Agenda. 63

5. Presentations by Workgroup Facilitators 75

5.1 Source Reduction and Recycling 75
Conrad Simon, U.S. EPA--Region II

5.2 Municipal Waste Combustion 83
James Kilgroe, U.S. EPA--OEETD

5.3 Municipal Waste Combustion Residuals Management 89
Carlton Wiles, U.S. EPA--OEETD/RREL

5.4 Land Disposal 92
Robert Landreth, U.S. EPA--OEETD/RREL

5.5 Municipal Planning and Waste Management 98
Truett DeGeare, U.S. EPA--OSW

6. General Discussion 101

7. Concluding Remarks 107
John Skinner, Acting Deputy Assistant Administrator
U.S. EPA--ORD

8. Concluding Discussion. 109

CONTENTS (Continued)

II. SUMMARY OF WORKGROUP CONCLUSIONS/RECOMMENDATIONS . . . 111

Source Reduction and Recycling 113

Municipal Waste Combustion 125

Municipal Waste Combustion Residuals Management 131

Land Disposal 135

Municipal Planning and Waste Management 139

III. LIST OF PARTICIPANTS 143

APPENDIX. COMMENTS TO DRAFT WORKSHOP PROCEEDINGS 151

I. PLENARY SESSIONS

1. INTRODUCTION

Fred Lindsey, Acting Director, U.S. EPA--OEETD

We are all familiar with the garbage barge incident and with the furor caused by hauling the Philadelphia ash around the Caribbean. This furor contributed toward renewing the EPA's interest in the whole area of municipal solid waste (MSW). Under the Resource Recovery Act of 1970, we had a rather major demonstration program in the resource recovery area, and then when the Resource Conservation Recovery Act (RCRA) was passed in 1976, we developed some rules under subtitle D of that Act which laid out requirements for land disposal of MSW. Since then there has not been much activity. However, within the last 2 years or so there has been a great deal more activity: a task force on MSW was headed by Ed Kline, and the Office of Solid Waste's (OSW's) report on MSW resulted in publishing an Agenda for Action. OSW also sponsored an exploratory conference in March. The work that surrounded the development of the Agenda for Action and the conference concentrated on municipal waste in general, but did not focus in detail on the technology and the state of the art of the technology.

The purpose of this workshop is to explore what is the state of the art, where is it adequate, where is it inadequate; what more research, development, and demonstration needs to be done; and particularly, what is the role of the Federal government in doing that kind of work. We seek three objectives to this workshop. First, we would like to see this group act as a forum for information exchange between the people who develop and provide technology and equipment in this area and the users of this technology, equipment and technical support services. Second, we are doing some work in the area of municipal waste combustion as well as in other areas, and we are looking for some advice and guidance on where we are and where we are going. Third, and perhaps most importantly, we are looking for a consensus on what the nation's research development and demonstration (RD&D) agenda should be. Specifically, I would like to come away from this meeting with a consensus if possible, or at least an airing of views, on what the RD&D agenda should be for EPA; that is, what kind of work should we be doing, and where should we be going. We have some ideas we will lay out for you, and we will be interested in hearing what you have to say about them.

A draft research agenda will come out of this workshop which we will be distributing after we distribute the proceedings of the workshop. We will be putting that together based on this meeting and on further work which we will do with the program offices within EPA. Our outreach program in the technology area is going to begin in earnest in January when we will be hosting a MSW technology conference in San Diego.

2. OVERVIEW OF CURRENT MUNICIPAL WASTE RESEARCH PROGRAMS

2.1 RCRA - Subtitle D (Municipal Solid Waste Program)

Robert Landreth, U.S. EPA--OEETD, Risk Reduction Environmental Laboratory, Cincinnati, Ohio

We have been actively involved in landfill research since approximately 1976. Our research until just recently has focused on hazardous waste. Subtitle C is our hazardous waste program, and subtitle D is the MSW program.

We traditionally look at the landfill in terms of what the layers are. Let me start by saying that the first system we looked at is the cover system, and we have information now on the vegetative system. We have a standardized procedure for doing this. We put out information on composite covers, and look at settlement and subsidence in areas of subtitle C. We started to collect information on subtitle D. In our modelling area we feel very good. We have the help of a computerized model that allows one to look at the route of the moisture through the cover system of the landfill down to the leachate collection system.

Within the next 4 or 5 months we will be looking at what is going on out there, whether the designs are adequate, and if they are, why; if they are not, why they are not. We hope to be able to answer some of the questions. One of the things that we are interested in is the freeze-thaw question that comes up in New York all the time. They have challenged us with some of their information. We are trying to take a look at that to see if we can give them some appropriate answers. Gas emissions are another problem with municipal landfills, but not extensively with subtitle C. Our design manuals have addressed emission control systems. In addition, we have some field-validation work, so we think that we are at least halfway home.

The next area we want to talk about is waste leaching. Here is a weak area for us because our program goes back to the mid to late 1970s when it was a completely different type of leaching problem than what we have with our subtitle C program. We do have waste and leachate characteristics that probably need to be updated, especially if the ideas and thoughts are put into practice. We probably need to continue that type of work in the future so that we understand what will be going into the landfill if it is different from what is going in there now. We understand that some recent information has made us change some of our thinking. We will talk about that when we get to liners.

As for leachate collection design manuals, I can think of two of them right away. One has been out a year. It is directed more to the subtitle C area, but it would work for our subtitle D. We have another one that will be out probably within another month or so, and we think that one will also fit very well.

One of the things that we are interested in is the use of geosynthetics in the area of drainage, and the potential for biological clogging. We find that this is, in fact, the problem and we are looking into it. We have a research program ongoing and it is about halfway through right now. They have identified the problem while talking with the owner-operators of field systems. We are in the process now of working with some of the biologicals before they build up, unless we have to redo something in the design phase.

Leachate treatment is an area we have to look at very strongly in the subtitle C area. We have individual systems that we have looked at, like rotating biological contractors. That system is well understood now. It works on a variety of wastes. There are a variety of leachate treatment schemes throughout the country and several sites around the eastern part of the country that are doing some type of biological treatment. We are not completely familiar with all of those systems. We think that they need to be updated based on the characteristics of the leachate that is coming out of today's landfills. The whole question of using the landfill as a bioreactor needs to be addressed, and we have just recently entered into an agreement, or will enter into an agreement soon with one of the local states here, where they are offering us a very large test facility--two 1-acre cells. We are going to be recirculating leachate there to look at the potential for rapid stabilization of that particular facility. The other cell will be used as a control vent, and we think that is a benefit. We have much lab data on that, although there are still some questions that need to be answered. We will look at the field validation and the upscaling of that particular system.

In the area of liners, we of course put out a 5-year study program on geosynthetics back in the mid-1970s. That program was a very good 5-year study. We had good quality leachate, and we had the commercially available geosynthetics in the system. We think we had a very good handle on it and then something happened; we looked at the leachate characteristics again and found that they were a little bit different from what we had used in that particular study. So that needs to be addressed. The current method for looking at compatibility, whether the geosynthetic is compatible with the leachate, also has to be addressed because the current technique, method 9090, looks at a sampling or testing device that is really not amenable to landfill leachate.

Landfill leachate tends to oxidize very quickly when it is exposed to the air, and it is something for which the current test procedures would not allow. We have a report that is looking at that particular issue, not only at the test procedures, but whether there is even a need for it. In looking at the characteristics of the leachate, we find that there are some organics in there. There are some other things that give us some problems too, and we want to make sure that we cannot just give somebody a blanket approval. So we are looking at that, and we should have a report out within the next 6 to 8 weeks.

Compatibility is not so much of a problem with our clay liner. We have two major reports this year: one is a clay liner technical resource document, and the other is our flexible liner technical resource document. These two reports should handle a majority of the questions. There are specific issues that need to be addressed. We did a lot of work looking at clay liners back in the early days of landfill research. We realize that is going to be a major factor in any type of control technology we use, and we need to update it based on the current leachate characteristics. We found in our subtitle C that quality assurance/quality control, in designing and building these landfills, plays a major role in getting into the field. There is a somewhat outdated document out there, a year or two old, that we need to update. We have some information that we might be able to put out. We will probably be initiating some new studies. On the area of closure, I want to reiterate that we have talked about our expert system there. We think that is very worthwhile. It has a total of six month-modules in it, only three of which are completed. We anticipate completing the remainder in the next year or so.

We need to look at vertical expansion. I think some of the people here on the East Coast will look at that as a means of expanding their landfill capacity. We want to look at it because it is necessary to insure that we are not just doubling the problem if we build vertically. So we want to look at that, and we have a little bit of information on how you stabilize a cover system in order to build vertically on existing sites. If I look at the sludge problem, we are still interpreting the data of a recent report. What we did was to look at the paint-filter test to see if it was a way of correlating to the percent solids which are more familiar to the people in the sludge industry. We are still reviewing some data that are coming out of our co-disposal situation, where we might look at sewage sludge disposed of in a municipal sector. From there, there might be some benefits that we had not thought of before. Data are very preliminary at this point. In the area of corrective action, we feel we can gain a lot of information from our Comprehensive Environmental Response, Compensation, and Reliability Act (CERCLA) side of the house, that is, the Superfund, because that is basically what they have been doing. This needs to be transferred back into new terminology that the subtitle D or the owner-operators in the municipal sector understand. It is a language that is different from what they use on the other side.

In the area of risk, we have not done a lot. It is one of the things we will probably be talking about in the overall meeting. In the area of new starts, the program offices asked us to look at the degradation of plastic, and specifically, what the products are, what the sizes are, how long they will last, and so on. We realize that the industry is moving very quickly in that area, looking at adding starch and like substances to the various polymers.

In recycling technologies, they are asking us to do an update of the information. This is another program area that we left back in the mid-1970s. We need to back up and look primarily at the economics, at what works, why, and so on.

Discussion

Question:

Is there any specific research planned for long-term program studies to evaluate groundwater and leachate monitoring programs?

Response:

We are involved in some aspects of monitoring research, both from laboratory studies of groundwater and from dealings with individual states. I wonder if there is a plan, a coordinated plan, and I think the answer to that is no. That is one of the things we hope will come out of this. This is technology in the broad sense, which I think would include monitor control.

The monitoring lab is doing research on indicators, looking at a wide range of indicators as well as looking at a series of different ways to monitor others that are using an indicator. Much of that work is being done under the subtitle C program, the hazardous waste program, and of course some of the technology could be used for both hazardous waste and MSW.

Question:

Are you doing any work on methods to develop emissions testing?

Response:

I know there has been work on it. We looked at air emissions from hazardous waste sites to the sea, but we have not had new study sites for a long time.

They are doing some work in looking at where they are purposely collecting gas out of landfills through some type of collection system. They are doing some analyses of that and determining what might be hazardous, and that is probably in the private sector. I do not know of anything that we are doing from an Agency standpoint.

Question:

What is the level of funding available for research at this point?

Response:

In the municipal waste combustion area, the current funding is a little less than $2.1 million. In landfills, it is $650,000 extra annually. In the air part of this, there is a total of $100,000 this year. Sort of a monitory sampling analysis. We know that area is completely underfunded.

Question:

What is the long-term funding projection?

Response:

The research agenda we will be putting together will lay out the needs in the whole area of municipal funding, and then we will identify the priorities. How much money will then be ultimately available depends on a variety of things. The money that we now have has been redistributed among the program areas. Based on what we come out with in this program, we might do some more restructuring of funding, independent of what Congress or other parts of the Agency would direct us to do. I cannot give you figures, as I do not know what the long-term funding will be. That is anybody's guess.

Question:

How are you defining waste for your future concepts of leaching and settlement and so forth? From my perspective, how do you define waste if it is going to be changing continually as more recycling programs start up and more people get incinerators in places where least production takes place? How are you ever going to know when you are developing information, that it is really going to be useful to people who are dealing with all of these other approaches to solid waste management? Waste is a by-product of something that is recycled and used. You have to define the questions you are asking.

In other words, are you going to be doing a special landfill program for each conceivable waste? What kind of waste material do you mean? As you talk about MSW you may be thinking about it as landfill in the 1970s, and I do not see that happening anymore. I mean people are not going to be putting MSW in the landfills anymore.

Response:

One of the things involved is that you are going to have to take a look at what is in MSW treatment, how it is changing, and how it is going to continue to change. It may be that regionally that is exactly what a private sector or the state is going to support. One of the objectives of this workshop is to come out with a national research plan. We know it is going to take a little effort as far as looking at a national waste stream on several levels. We have the capability to do that, but what you may be driving at is one of the areas where states and localities are going to have to step in and do some work. Regionally, we will look at things like source reductions, source separation, and recycling affecting our work on the landfill.

2.2 Municipal Waste Combustion Program

James Kilgroe, U.S. EPA--OEETD,
Air and Energy Engineering Research Laboratory, Research Triangle Park, North Carolina

I have arbitrarily broken the program down into two different components for this briefing. One is environmental engineering activities, and the other is health and environmental sciences activities. The environmental engineering activities have about 1.2 million dollars this year and the other program is about $900,000. So, they are roughly equal in size as far as resources are concerned.

There was a lot of arguing going on even before the Agency was formed back in the days of the Health Education and Welfare (HEW) Department. They did some pioneering work at that time on incineration and found that things such as benzo(a)pyrene were emitted from the incinerators. There was a continuation of that type of work up through about 1975. There was a shift of focus to the hazardous waste area. In modern times, after it became apparent that incineration and municipal waste were a substantial problem, we started the Municipal Waste Combustion (MWC) study within the Agency. That was the Office of Air Quality Planning and Standards (OAQPS) and the Office of Research and Development (ORD). Out of that study came a Report to Congress and a decision to regulate or develop new and improved regulations for incinerators. Our current MWC Program really flows from this study (Figure 1).

The current objectives of our MWC Program are obviously to evaluate the health and environmental risk of incineration; to look at and evaluate different types of co-technologies for controlling pollution from incineration; and then to provide technical information to back up the development of regulations (Figure 2). In actuality, most of the activities we have on the engineering technology program are an early technology assessment which constitutes essentially a cooperative effort between OAQPS and OEETD to develop the kind of technology information needed to set new standards.

This is the current air regulatory schedule that was announced in the Federal Register in June of 1987 (Figure 3). The Agency's schedule is to propose new source performance standards in November of 1989 and at the same time issue draft guidelines for existing units. The difference is that the new performance standards will be set under Section 111B of the Clean Air Act, and the guidelines for existing units will be under 111D. The regulations and the guidelines will be promulgated in December of 1990 after being reviewed by industry and other concerned parties. The states will have until about September of 1991 to come forward with a plan on how they will comply with the EPA guidelines on existing incinerators.

BACKGROUND: PREVIOUS MWC RESEARCH AT EPA

- ASSESSMENT OF INCINERATOR AIR POLLUTION (1965 - 1975)
- DEMONSTRATION OF RESOURCE RECOVERY TECHNOLOGY (1971 - 1976)
- FOCUS SHIFTED TO HAZARDOUS WASTE (1967 - 1986)
- MUNICIPAL WASTE COMBUSTION STUDY (1986 - 1987)
- PRESENT MWC PROGRAM (1987 - Present)
- NEW SOLID WASTE INITIATIVES (1988)

Figure 1

OBJECTIVES

- EVALUATE HEALTH AND ENVIRONMENTAL RISKS
- EVALUATE AND DEVELOP POLLUTION CONTROL TECHNOLOGY
- PROVIDE TECHNICAL INFORMATION TO SUPPORT REGULATORY ACTIVITIES

Figure 2

AIR REGULATORY SCHEDULE

• PROPOSAL OF NEW SOURCE PERFORMANCE STANDARDS (NSPS)	NOV. 1989
• ISSUANCE OF DRAFT GUIDELINES FOR EXISTING UNITS	NOV. 1989
• PROMULGATION OF NSPS	DEC. 1990
• ISSUANCE OF FINAL GUIDELINES	DEC. 1990
• STATE PLANS FOR EXISTING SOURCES DUE	SEP. 1991

Figure 3

Here is a little background about our MWC study (Figure 4). It actually was about a seven- or eight-volume study, and it featured a Report to Congress which included assessments of the combustion, flue gas cleaning (FGC), sampling, and analysis we developed, and an emissions database. There was also some risk assessment work done. Essentially it was a fairly comprehensive study, and it took about a year and a half and about $500,000 to $600,000 of Agency resources. The major outcome of the study was the decision by the Agency to set standards for new and existing municipal waste sources and combustion sources. Prior to the time new source standards were set on prevention of significant deterioration areas, there were certain recommendations regarding control technology. The recommendation was that they should use good combustion practices. They should also use adequate FGC technology, and we defined adequate as a spray dryer in fabric filter or spray dryer in electrostatic precipitator (ESP) or equivalent technology. At the same time that we came out with the decision to regulate, we had also been developing a research plan for ORD. We came out with a research plan about that time, and the work we are really talking about now was the outcome of that research plan.

During the MWC study, we looked at a wide range of pollutants and they included organic compounds, metals, and acid gases (Figure 5). The decision to regulate was largely driven by the potential risk associated with dioxins and furans. While metals did pose some risk, theirs was somewhat lower. In our current programs, we are attempting to look at this and other pollutants, but our technology assessments are largely limited by the amount of data on different types of pollutants. There is just not much information out there.

During the technology assessment phase we looked at basically three different types of technologies. We looked at conventional mass-burn incinerators (Figure 6), where essentially what you do is bring the solid waste in and dump it into a pit. It is then fed through the incinerator. The gases go out through a waste boiler, an economizer, and into an ESP which is used for controlling the air particulate matter. In this system you see an HCl removal device that is really a dry injection system. This is not typically used in the United States. I believe there is one place in the United States where they are now using dry injection. Generally speaking, it is a fairly low-performance device, perhaps getting only about 30 percent capture of the HCl. This is what is fairly typical of a modern mass-burn incinerator.

There is another general class of incinerators--the module incinerator (Figure 7). The particulate emission zones are fairly low because it is a two-chamber design and in fact they can meet what used to be, or what is, the Federal particulate emission regulation, which is .08 grains per dry standard cubic feet. Many of the units can meet the old Federal regulations without any air pollution control device whatsoever just by controlling the combustion process.

BACKGROUND: MWC STUDY (1986 - 1987)

- ENVIRONMENTAL ENGINEERING AND SCIENCE ASSESSMENTS
  - COMB, FGC, S&A TECHNOLOGIES
  - EMISSION DATA BASE
  - RISK ASSESSMENTS
- MAJOR RESULTS
  - DECISION TO REGULATE
  - COMBUSTION AND FGD TECHNOLOGY RECOMMENDATIONS
  - REGULATORY AND RESEARCH PLANS

Figure 4

POLLUTANTS OF CONCERN

	INORGANIC COMPOUNDS	
ORGANIC COMPOUNDS	METALS	ACID GASES
CHLOROBENZENES	CADMIUM	HYDROGEN CHLORIDE
PHENOL	BERYLLIUM	SULFUR DIOXIDE
BENZO(a)PYRENE (BaP)	LEAD	HYDROGEN FLUORIDE
NAPHTHALENE	CHROMIUM	
PERCHLOROETHYLENE	MERCURY	
CHLORODIBENZODIOXINS	ARSENIC	
CHLORODIBENZOFURANS	SELENIUM	
BENZENE	NICKEL	
FORMALDEHYDE	COPPER	
CARBON TETRACHLORIDE		
CHLOROFORM		
POLYCHLORINATED BIPHENYLS		
CHLOROPHENOLS		

Figure 5

CONVENTIONAL MASS BURN INCINERATOR

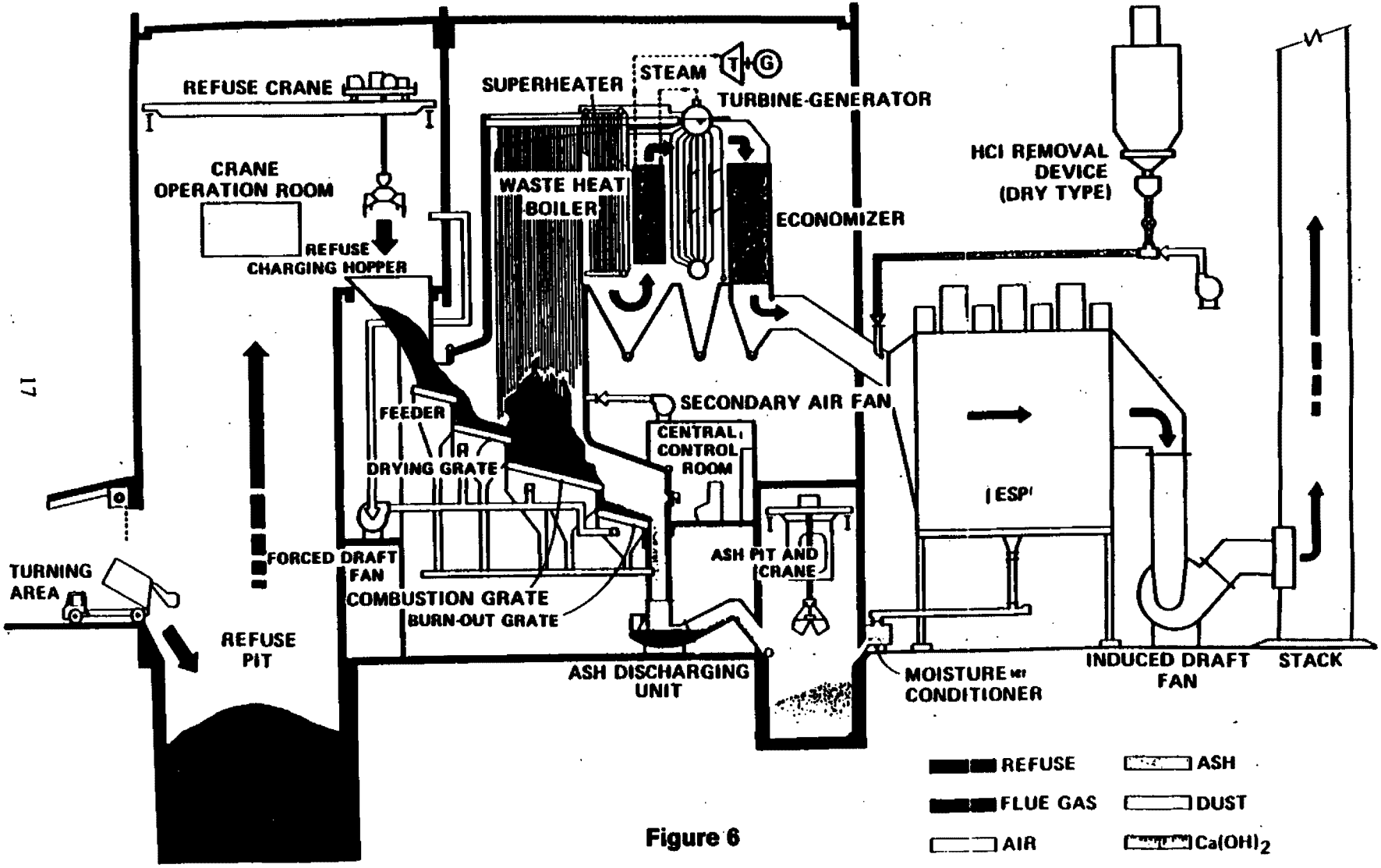


Figure 6

CONSUMAT STARVED - AIR INCINERATOR

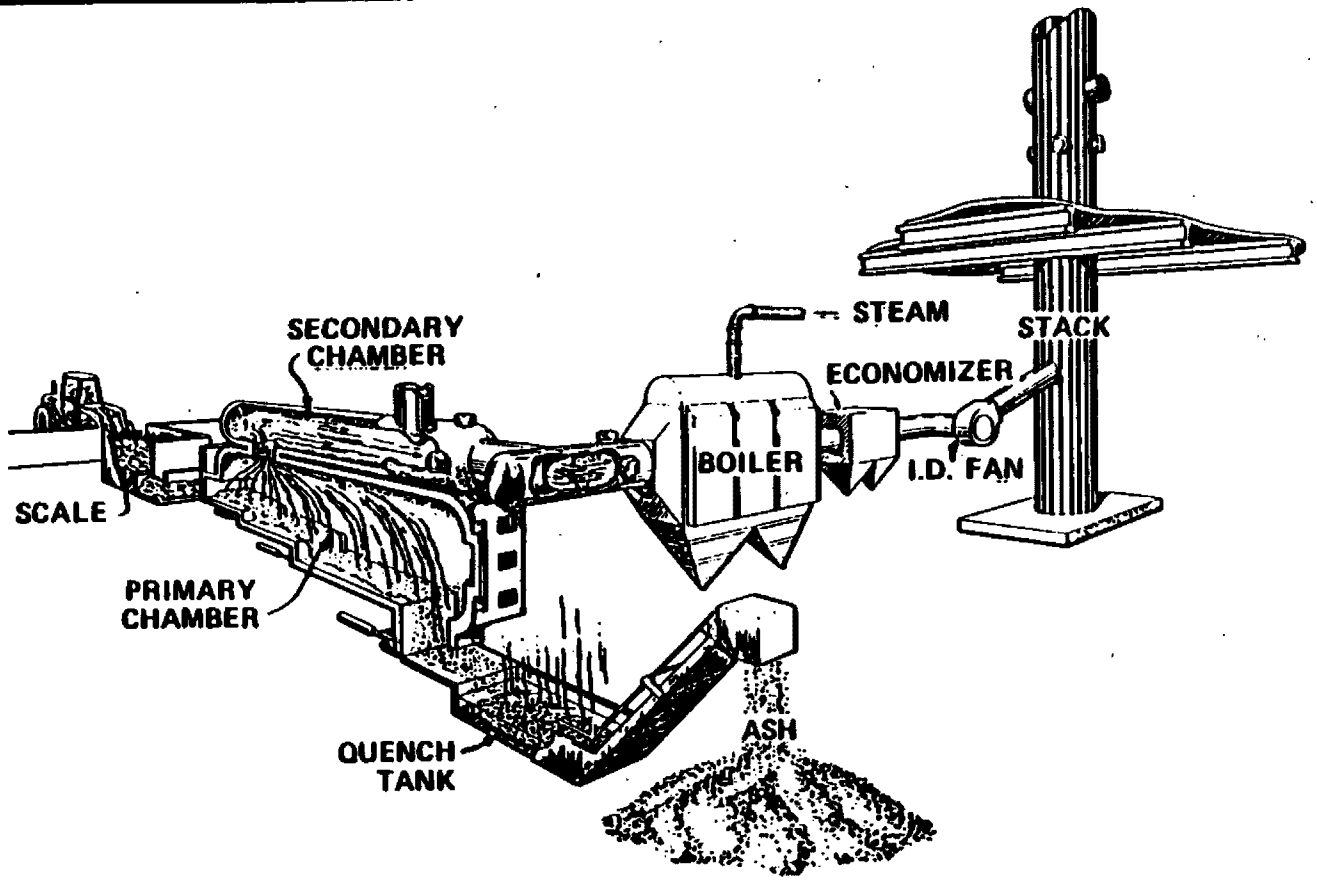


Figure 7

There is another general class of municipal waste combustors which is refuse-derived fuel (RDF) combustors (Figure 8). With these types of systems the solid waste is prepared before it is burned in a boiler. Here we have a process which includes a primary shredder, an air classifier, storage, and some degree of recovery of materials. More typically now, they have a sort of primary shredder which is a flare mill followed by something like a rotary screen or trawl mill. Maybe a second degree of shredding and various metal recovery is generally practiced, but there is not a lot of recovery of other materials, primarily because there is no market out there. Typically, in the modern systems the boiler they use is a spreader-stoker boiler, which is really an adaptation from coal or wood firing.

The Agency decided to regulate municipal waste combustors because of the emission of dioxins and furans (Figure 9). Initially there was much controversy about where the dioxins originated from. It could be in the waste that is fed to the incinerator; it could be formed from certain precursor materials in the combustion process; or it could be formed downstream at a low temperature from an ESP in the air pollution control device. We now think dioxins probably come from all of the regions and zones. It is important to control the combustion process, to eliminate all the types of material coming out of the furnace which could form dioxins later on. The later temperature formation occurs between about 250 and 400 degrees centigrade with a maximum formation at 300 degrees centigrade. Others have pretty much demonstrated that there is a low-temperature formation reaction which is catalyzed by the surfaces of the fly-ash particles, and one of the Agency activities right now is to look at ways to avoid that low-temperature formation.

When we did our initial Report to Congress, we felt that in some ways we could control the formation of dioxins. Also, we thought there was a very good correlation between the types of combustion used or the quality of the combustion and the amount of dioxins that would be coming out of the incinerator. Essentially, we identified different criteria for achieving good combustion practices and three types of incinerators: the mass burn, the modular, and the RDF system. These criteria included design criteria, operational criteria, and monitoring criteria (Figure 10). One of our current key activities is trying to update those good combustion practices for other classes of incinerators.

The air pollution control devices that we identified could control trace elements, acid gases, and organics with a wet-dry scrubber with a fabric filter (Figure 11). This type of technology is capable of getting over 99 percent removal efficiency of most pollutants of concern (Figure 12). Only the sulfur dioxide (SO_2) and the HCl have somewhat of a reduced removal efficiency.

The budget is $1.25 million for environmental engineering technologies, $200,000 for health effects research, $600,000 for risk assessment, and $100,000 for the sampling analysis. The current program, the 1987 through 1989 program of environmental engineering technology, includes environmental engineering studies, demonstration evaluation of commercial technology, and the R&D activities that we talked about previously.

RDF PLANT SCHEMATIC

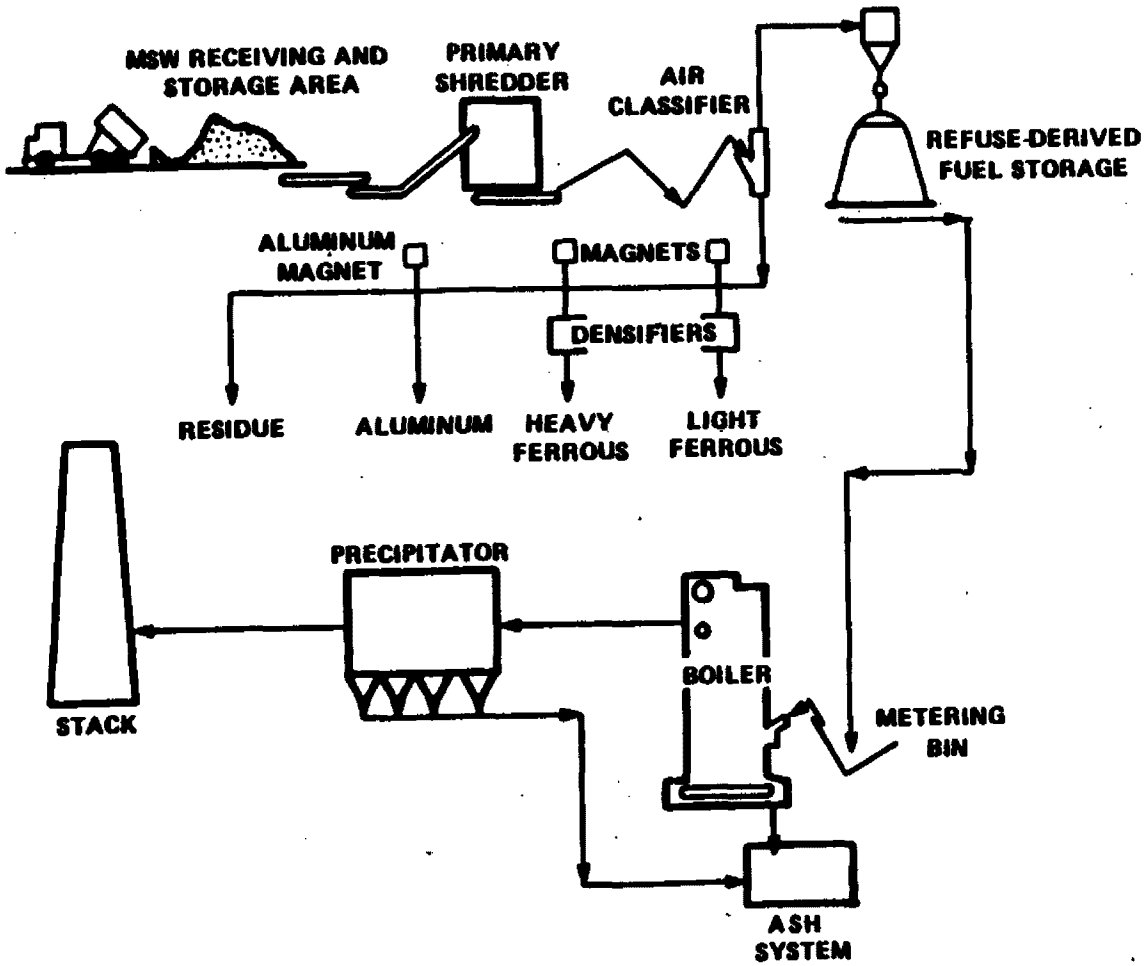


Figure 8

DIOXIN FORMATION MECHANISMS

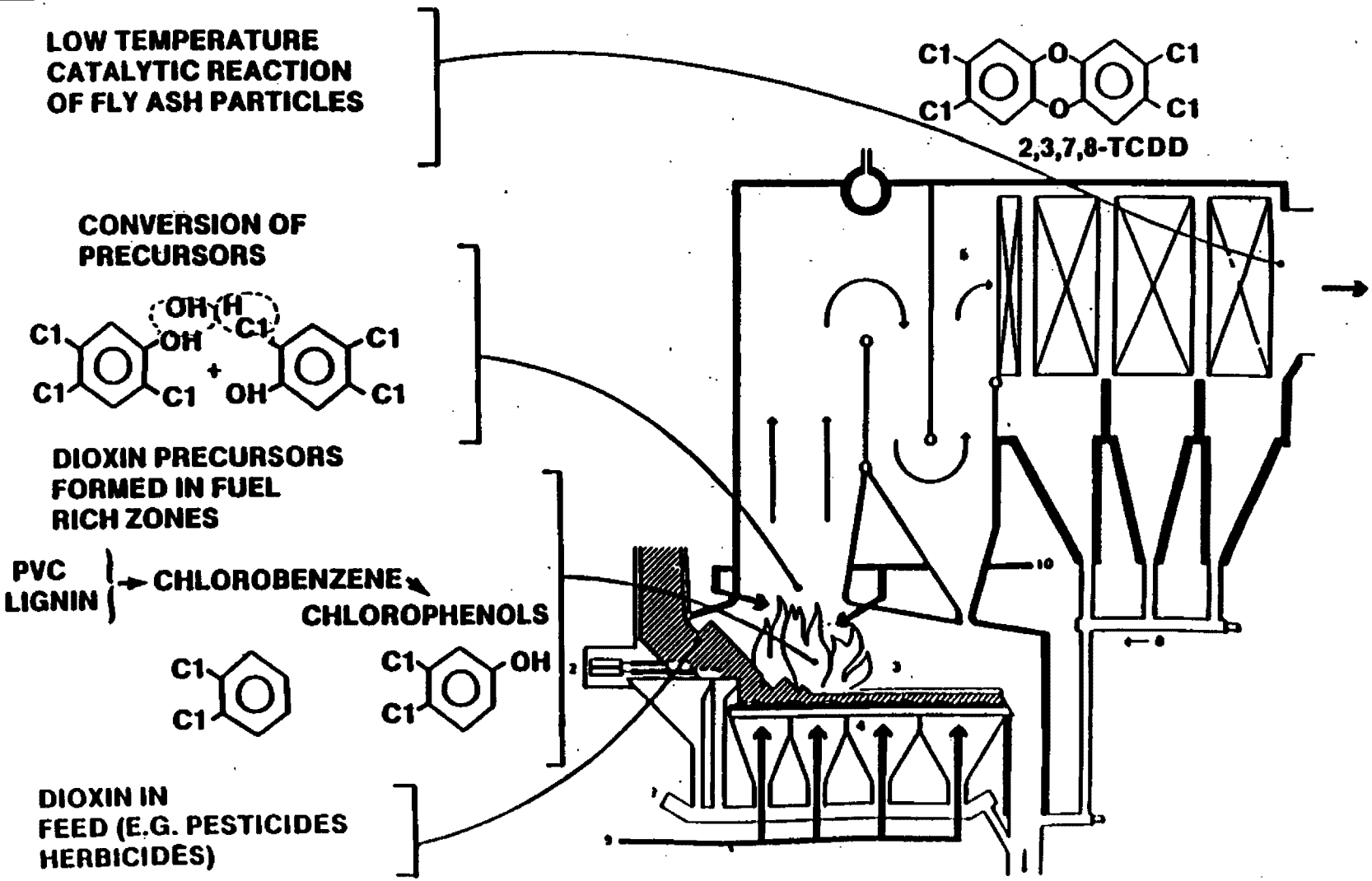


Figure 9

GOOD COMBUSTION PRACTICE

- DESIGN
  - COMBUSTION AIR
  - FURNACE TEMPERATURE
  - AUXILIARY FUEL CAPACITY

- OPERATIONAL DESIGN VALIDATION
  - AMOUNT/DISTRIBUTION OF COMBUSTION AIR
  - FURNACE TEMPERATURE
  - LOAD LIMITATIONS
  - AUXILIARY FUEL USE

- COMBUSTION CONTROL AND MONITORING
  - OXYGEN AND CO IN FLUE GAS
  - TEMPERATURE CONTROL

Figure 10

WET-DRY SCRUBBER

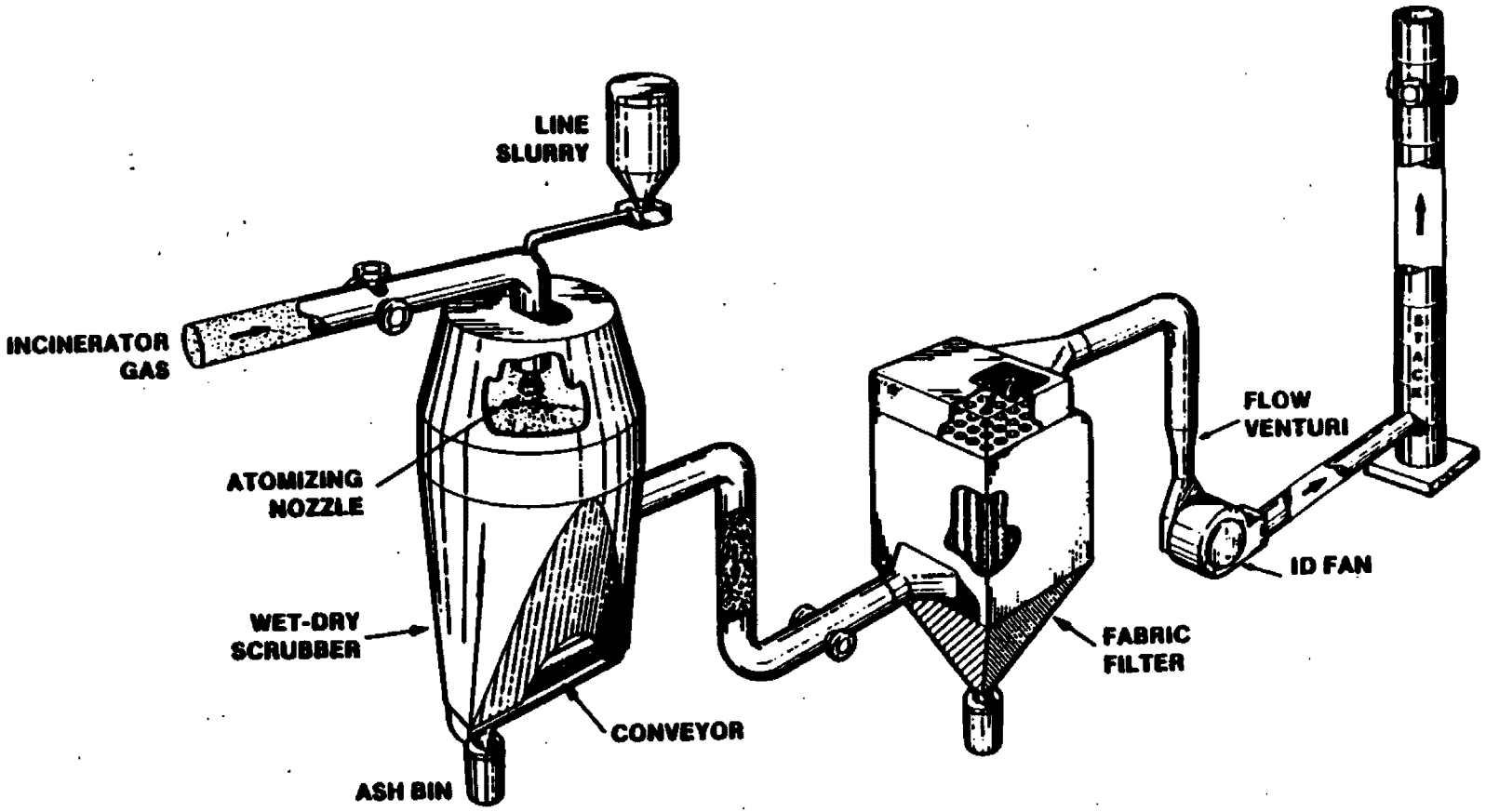


Figure 11

WET - DRY SCRUBBER PILOT PLANT DATA

POLLUTANT	RANGE OF REMOVAL EFFICIENCIES MEASURED (%)
TOTAL PARTICULATE	> 99.9
SO_2	60 to 67
HCl	91 to 92
PCDD	> 99.9
PCDF	≥ 99.9
CHLOROBENZENES	≥ 99
POLYCHLORINATED BIPHENYLS	> 99
POLYCYCLIC AROMATIC HYDROCARBONS	79 to > 99
CHLOROPHENOLS	96 to 99
Zn, Cd, Pb, Cr, Ni, As, Sb	> 99
MERCURY	95

TESTS AT 140° INLET TEMPERATURE WITH AND WITHOUT RECYCLE

Figure 12

These technology assessments provide information that we need to set regulations. Initially we had a MWC study and a Report to Congress. Then we started an assessment of existing technologies, performance, the cost of upgrading the combustion systems, and the FGC technology on existing systems. That is what we call a retroset study. We are also looking at the best commercially available technology, and then we are going to be looking at the kinds of advanced technology that can be used for municipal waste incineration.

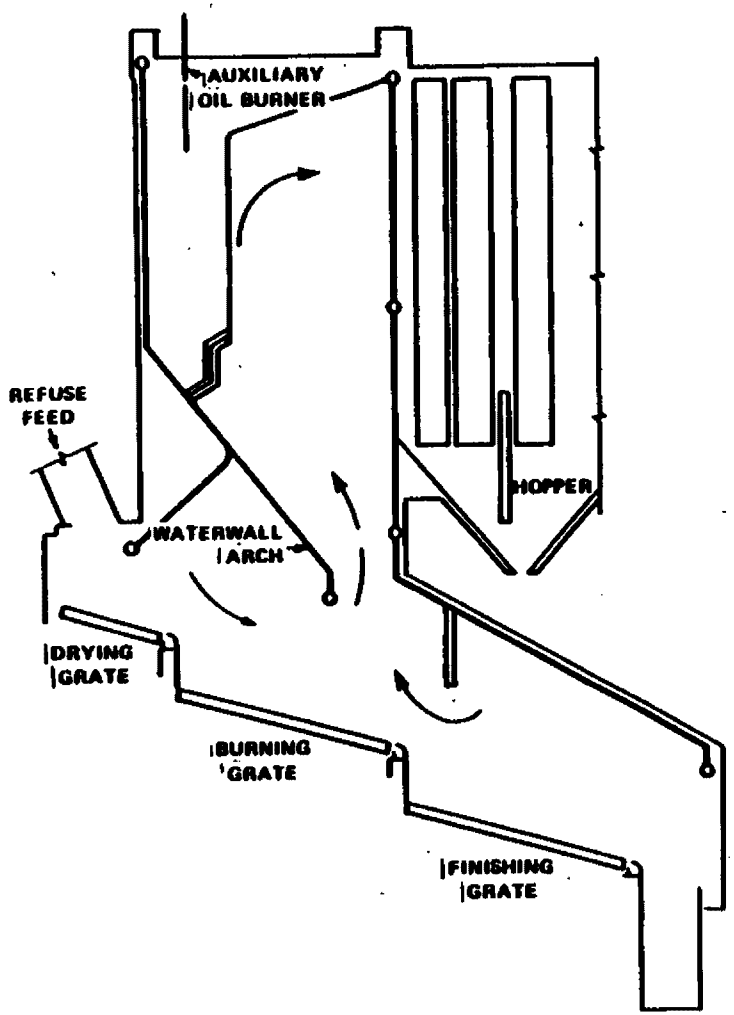
The combustion technology assessments have included a wider range of technologies than we looked at in the Report to Congress. There is a refractory system that we classify into a monoflow or a split-flow type of design. A split flow is typified by a manufacturer called Volund. There is a conventional water-wall design, and also a rotary waterwall which is manufactured by Westinghouse. A refuge fuel system may be a suspension-fired system, which is taking municipal waste and turning it into a boiler which was originally designed for coal firing (that can be a pulverized coal firing wall, or a fired system which can include a cyclone fired boiler, also a semi-suspension system) which is a general practice. A new advanced technology is fluidized bed combustion.

The Agency has two strategies to control emissions from MWC. One is good combustion, and the other is FGC technology. The fact that good combustion will work is largely predicted on work done by Environment Canada in Quebec City. It took an old incinerator modified to some degree to look like modern-type technology which included provisions for better distribution of the under- and over-fire air, computerizing the control for the system, and having a better upper furnace (Figure 13).

After this modification, they tested the incinerator and it had dramatically improved the emission of dioxin/furans (Figure 14). Before modification of the incinerator, the total dioxin emission ranged from about 800 to 4,000 ng/Nm^3. After they modified the incinerator, the combustion conditions dropped the emissions clear down to about 200 ng/Nm^3. Under good combustion conditions with that particular modified design, the emissions were less than 50 nanograms per normal cubic meter. The Agency is faced with a number of typical problems. There are many ancient incinerators in the United States. The archaic design is very difficult to try and modify as far as a combustion process is concerned.

At the other extreme, there is what one calls an advanced technology. It is a fluidized bed combustor (Figure 15). There are only about two of them in the United States in operation, and they were designed primarily for incineration of either wood waste or sewage sludge. They also burn RDF. The Japanese, I understand, have over 90 fluidized bed combustors in operation in Japan. The Europeans are also starting to employ this technology, and Gotoverken and others from Europe are actively marketing their technology in the United States. One of the advantages of this technology is that basically you put a sorbent into the bed of the incinerator and it will capture your acid gases, that is your SO_2 and your HCl, in the bed and you do not have to have a scrubber on the back end. This advanced technology is probably no more advanced or more modern than some of the mass-burn incinerators we have now.

QUEBEC CITY INCINERATOR BEFORE MODIFICATION



QUEBEC CITY INCINERATOR AFTER MODIFICATION

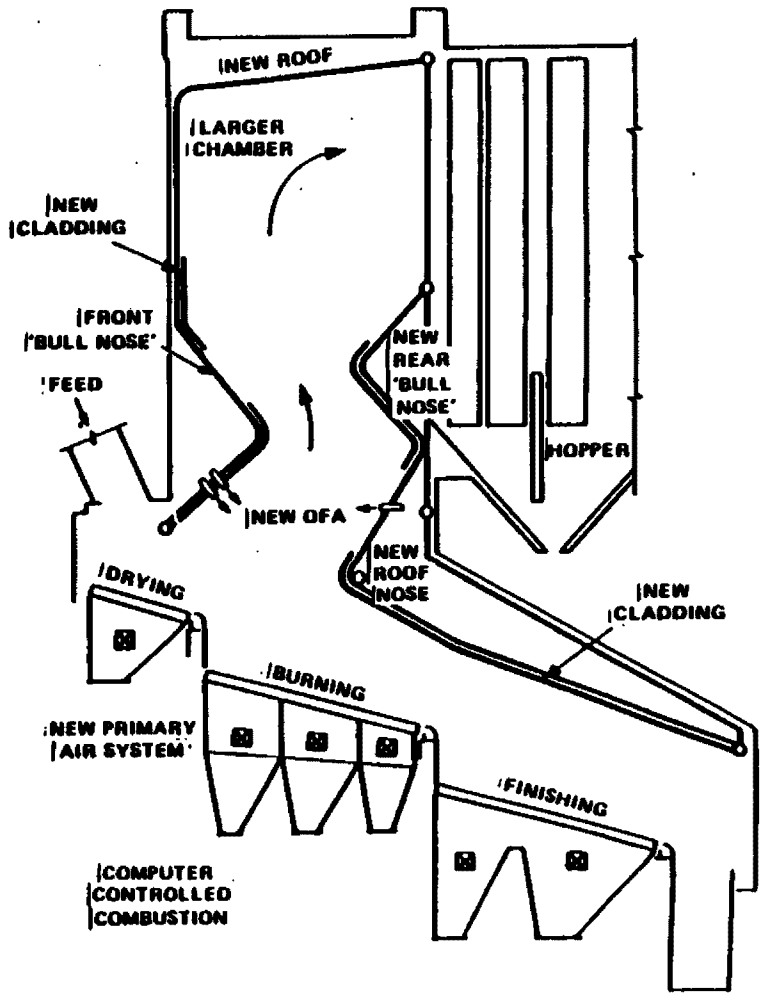


Figure 13

QUEBEC CITY COMPARATIVE DIOXIN RESULTS

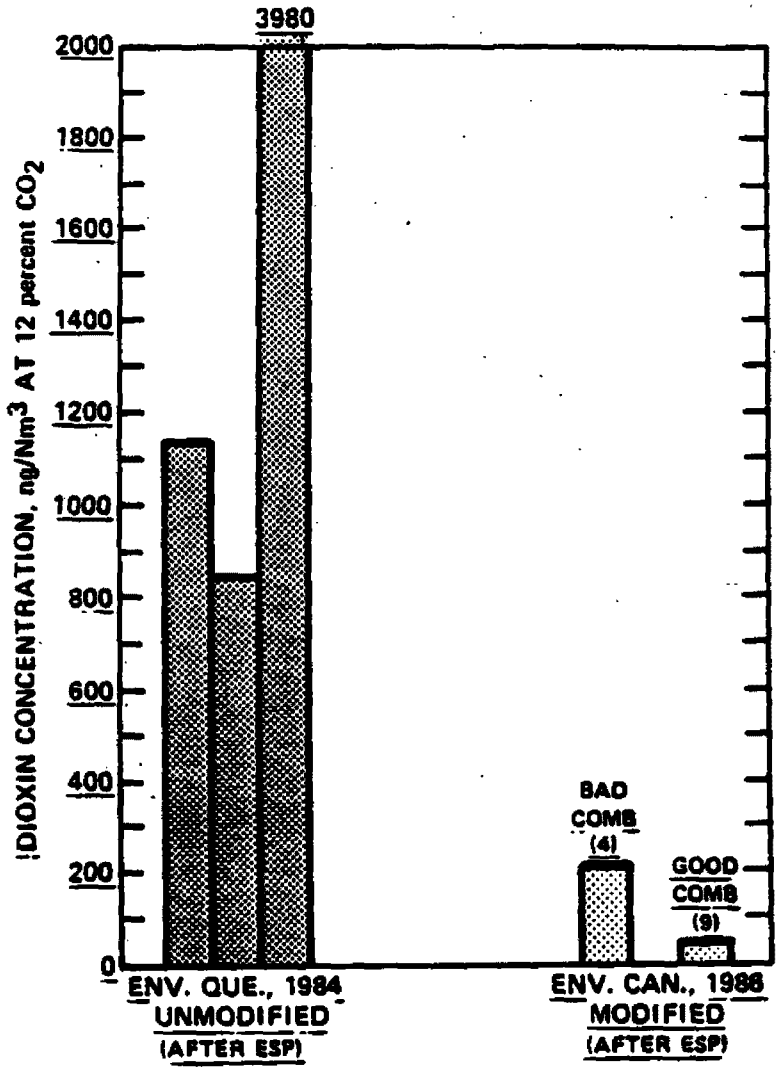


Figure 14

IHI FLUID BED COMBUSTOR

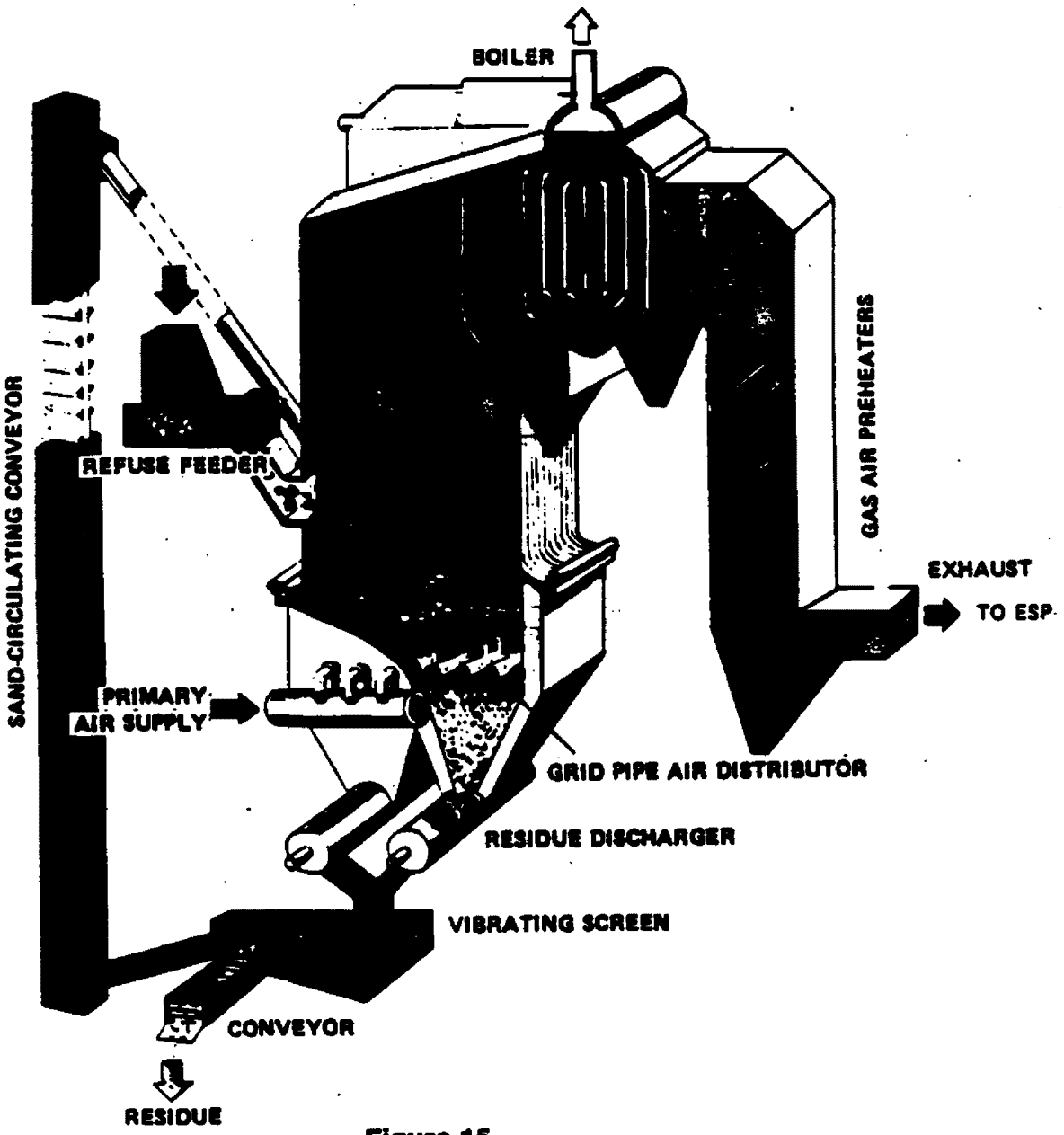


Figure 15

In our FGC technology assessment, we looked at the effect of controlling the downstream temperature on mitigating the effects of dioxin formation and structure (Figure 16). We also looked at particulate control with ESPs and fabric filters, as well as at different types of acid gas control, including in-furnace sorbent injection or spray dryers.

Our field evaluation program consists largely of collecting information on different types of combustors and FGC technology to monitor control of dioxins, trace elements, and other emissions from the combustion of municipal waste. Our current program includes tests from Marion County, Oregon; Biddeford, Maine; Millbury, Massachusetts; Hartford, Connecticut; and Dayton, Ohio (Figure 17).

The best combustion technology within the United States is able to destroy dioxins and furans (Figure 18). It has very low furnace emission and the system, even on a spray dryer and fabric filter, operates on controlling dioxins. We looked at this because we considered it to be the best available combustion technology, and it had the best available FGC technology with a spray dryer fabric filter on it. This is a sort of teller-type reaction system which is in essence a spray dryer with a bag house for clean up. At Biddeford, Maine, we tested a Babock & Wilcox (B&W) control combustion zone furnace (Figure 19). Most of the B&W's older systems had a straight furnace wall. We were initially concerned about the mixing of the over-fire air and the waste and the fact that you probably could not get good combustion because there was not enough provision for mixing. The mass burner tested in Millbury, Massachusetts, is very similar to the Ogden Martin System, but it has an ESP and fabric filter (Figure 20). The test in Hartford, Connecticut, and joint test with Environment Canada are to be very extensive in that we are going to look at process parametric changes within the combustion and FGC technology to see how those processes change the emissions and the residues from the combustion and FGC devices. The Combustion Engineering system at Hartford is somewhat different from the B&W you saw, and it has a greater degree of under-fire air control but it has over-fire air range. All these things impact the type of combustion you get within the boiler.

Lastly, we come to the refractory mass-burn system which is really very similar to what we call a Volund design (Figures 21 and 22). This is a brand new unit that was designed and used about 10 years ago. I would call it really sort of an arcade technology, but we are going to test this system and attempt to see what we can do as far as lowering the downstream temperature and measure how that is going to affect the formation of the dioxin and furan in an ESP. We are going to be doing some in-duct or in-furnace injection of sorbent to see how that controls the acid gases and dioxins and furans. Our research plan had called for some combustion research and FGC research. Essentially that program is starting out this year because all the money in previous years has gone to the field test program.

For our 1989 plans, basically we are going to be using all of our 1989 resources to continue work at the Dayton facility, and do engineering analysis work which is really needed to support the setting of regulations as standards. As I mentioned earlier, we are going to really start our combustion and FGC R&D this year.

FGD TECHNOLOGY ASSESSMENTS

- EXHAUST GAS TEMPERATURE CONTROL
- PARTICULATE CONTROL
  - ELECTROSTATIC PRECIPITATORS (ESP)
  - FABRIC FILTERS (FF)
- ACID GAS AND ORGANIC EMISSION CONTROL
  - IN-FURNACE SORBENT INJECTION (ISI)
  - DUCT SORBENT INJECTION (DSI)
  - SPRAY DRY SCRUBBER (SD)

Figure 16

FIELD EVALUATION OF COMMERCIAL TECHNOLOGY

SITE	OBJECTIVES	COMBUSTOR	FGC TECH.
MARION COUNTY, OR	S	WMB	SD/FF
BIDDEFORD, ME	S	RDF	SD/FF
MILLBURY, MA	S	WMB	SD/ESP
MID-CONN., CT	R	RDF	SD/FF
DAYTON, OH	R	RMB	FSI/DSI/ESP

S = Supports Standards Development
R = R&D and Standards Development
WMB = Waterwall Mass Burn
RMB = Refractory Mass Burn

Figure 17

Marion County

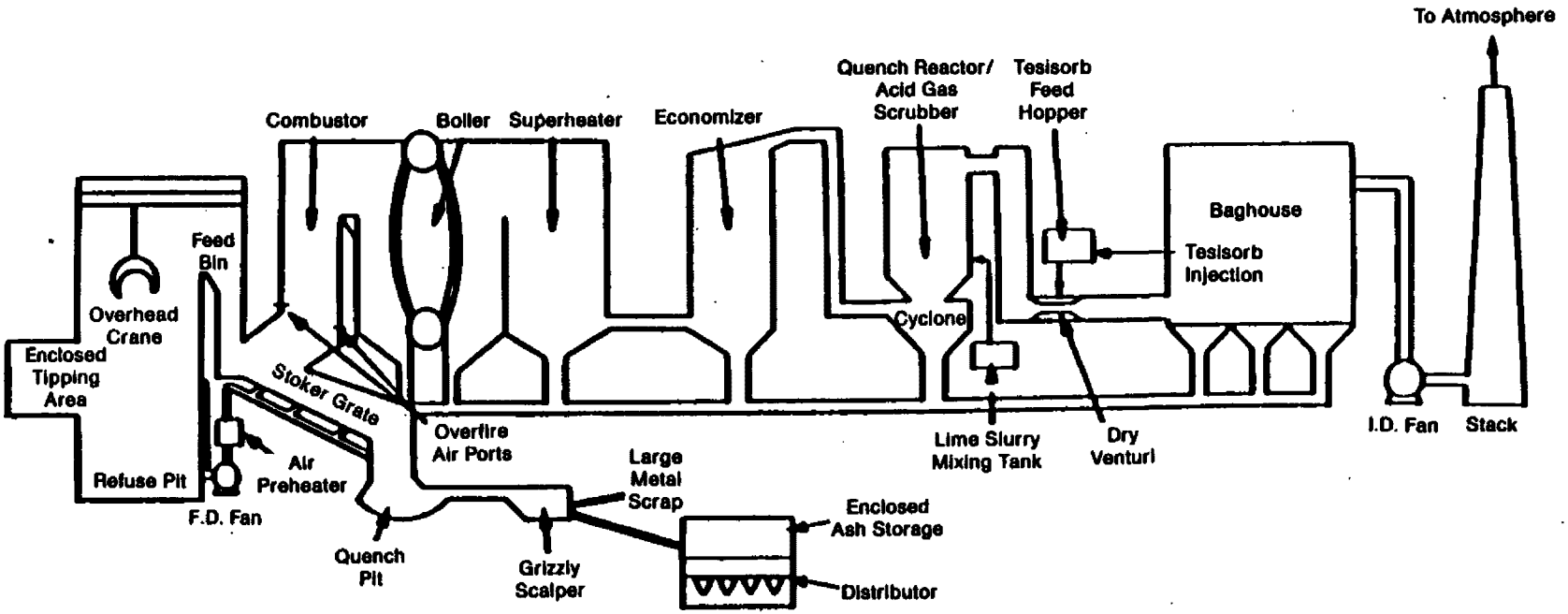
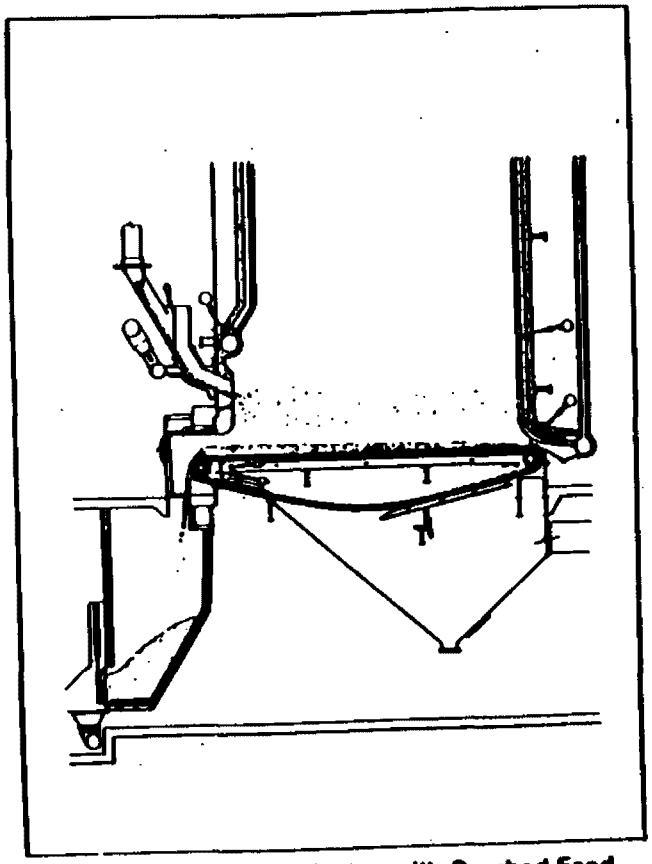
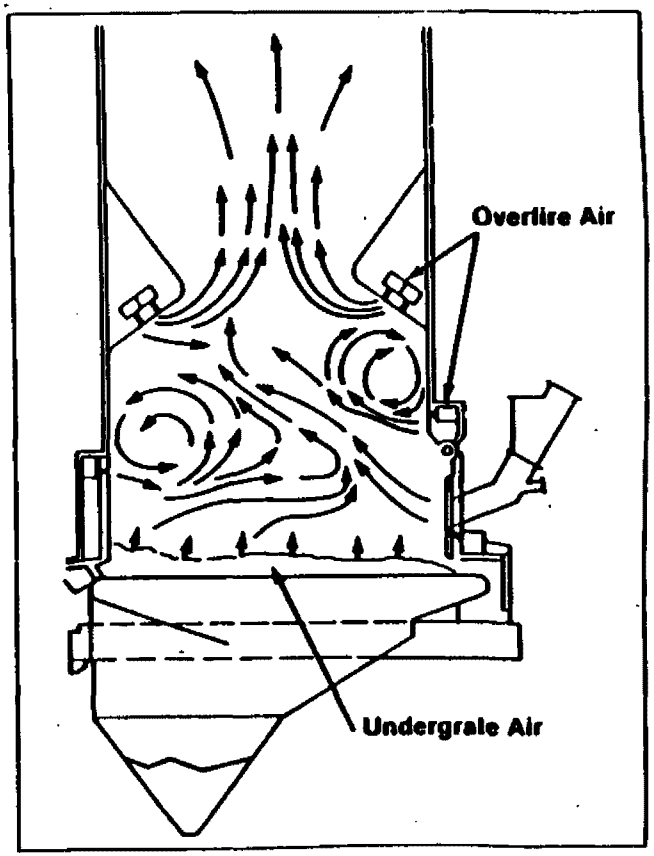


Figure 18

BABOCK AND WILCOX RDF STOKER BOILERS



RDF Traveling Grate Stoker with Overbed Feed



Controlled Combustion Zone (CCZ™) Lower Furnace

Figure 19

Millbury, Massachusetts

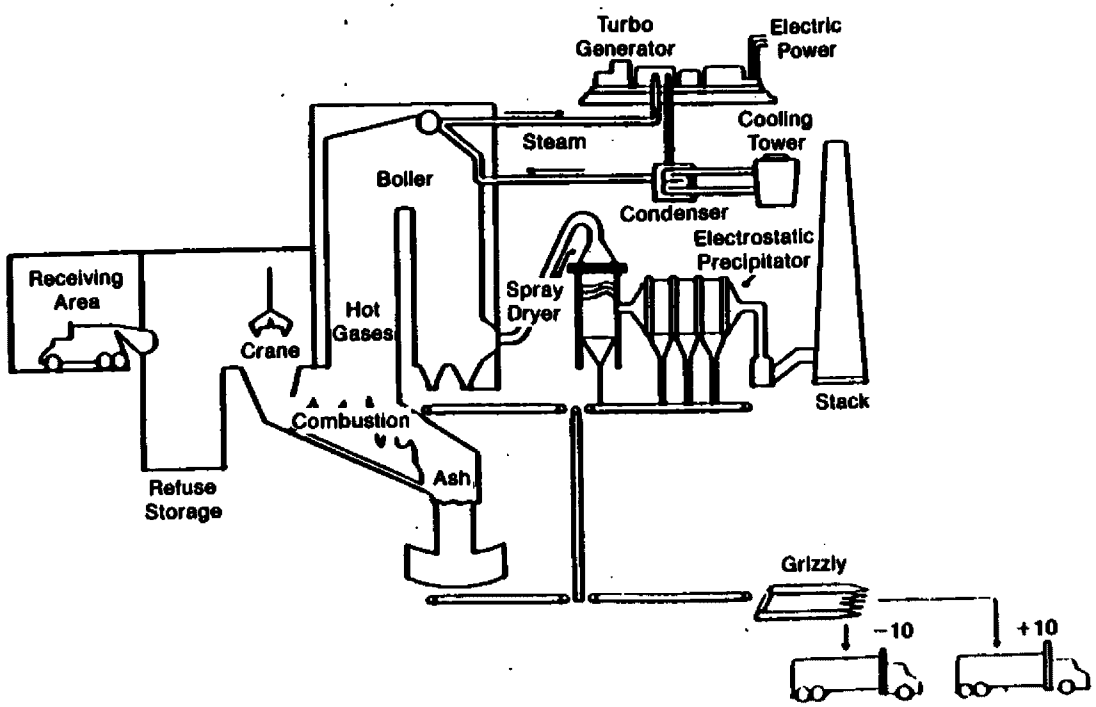


Figure 20

PHILADELPHIA NORTHWEST
MASS BURN REFRACTORY INCINERATOR

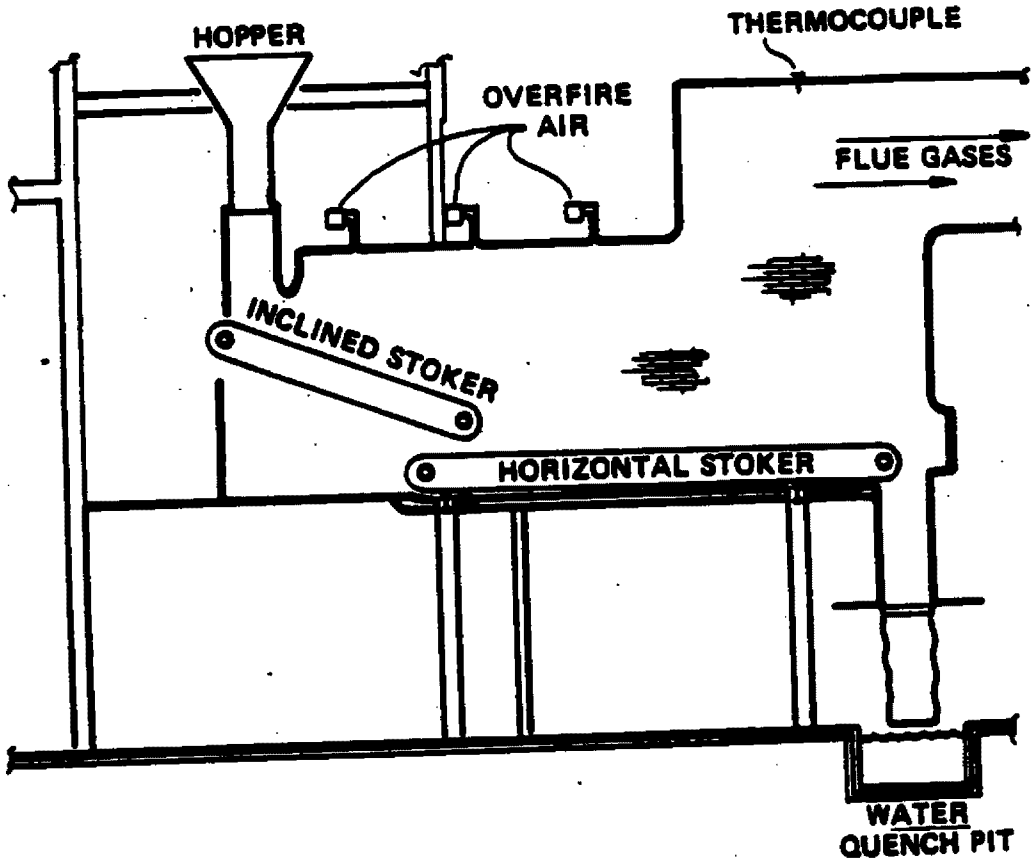
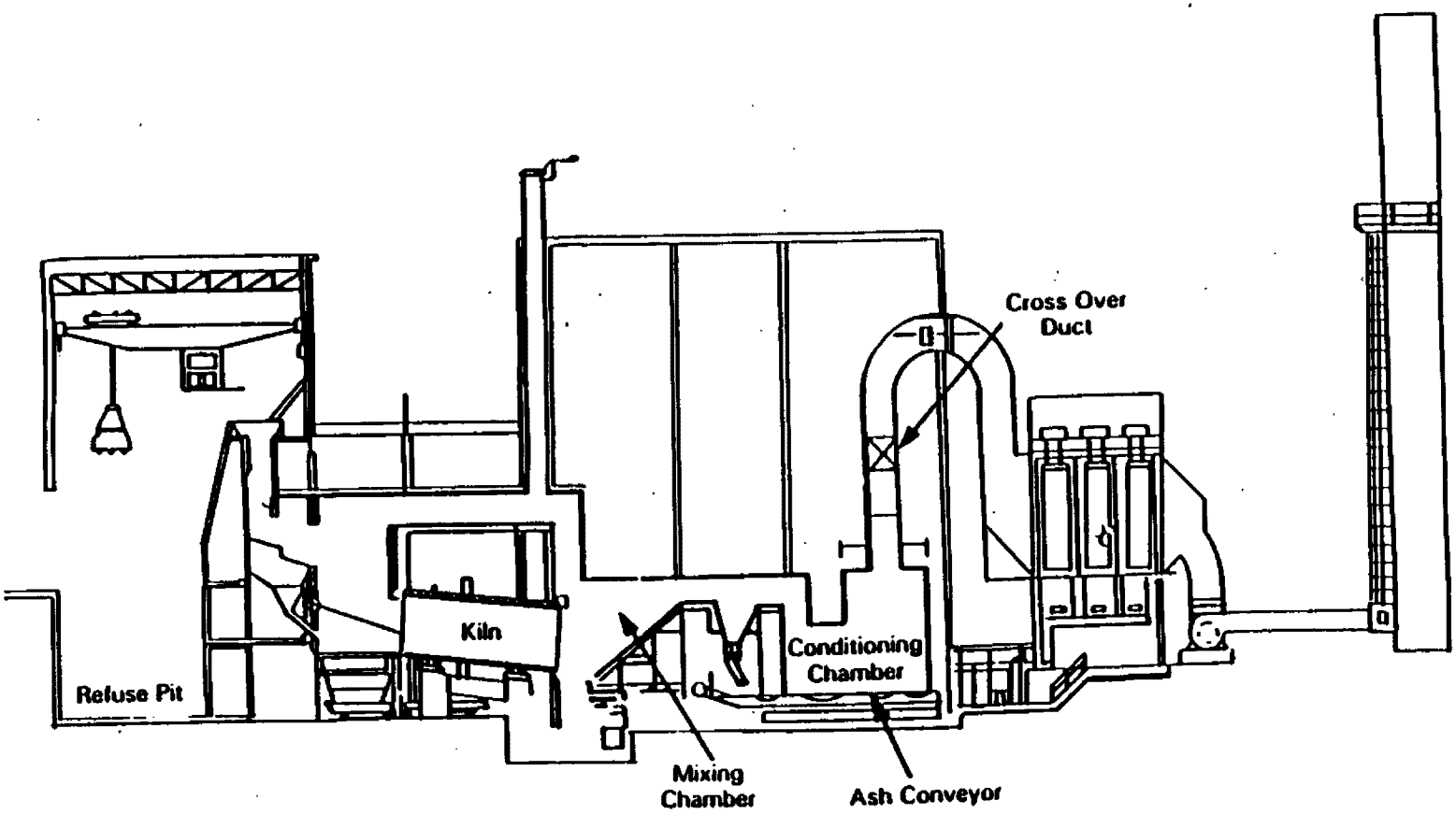


Figure 21



Schematic of MWC Unit #3 at the Montgomery County, Ohio
South MWC Facility

Figure 22

The Health and Environmental Sciences part of the program includes health effects research, risk assessments, and of course, the sampling analysis activities. The objective of the health effects research is to determine the effects of municipal waste emissions on human health. The approach is to take a mixture of pollutants rather than one individual pollutant. There is an empirical risk assessment looking at MWC versus hazardous incineration versus wood stove versus a bunch of other combustion technologies. It is broken down into three different phases. There is hazard identification, hazard characterization, and hazard quantification (Figure 23).

We are really in phase one right now. We have had problems getting samples for our health effects people. Not everybody wants you to come to their incinerator and take a sample so you can bring it back and see whether or not you have any problem with bioassays. Therefore, we are not moving on it as fast as we would like, but we are getting some samples this year. The program is starting to move along.

The health effects end-points for cancer in rats include mutagenicity and carcinogenicity and of course the noncancer pulmonary, reproductive, immunological, and neurological end-points; interpretation of all the evidence we have; and risk assessment to develop multipollutant, multimedia pathway protocols and demonstrate those protocols on the existing site. The major products this year are an improvement of the risk methodologies used when studying municipal waste incineration.

Site-specific assessment really looks at pollutant levels before and after operation and includes environmental sampling, air, soil, crops, and dairy products. We are going to analyze them for organics.

Sampling and analysis is mostly to validate techniques or develop improved techniques for measuring emissions from incineration. We finished a sampling analysis (a methods manual) and are in the process of validating the dioxin furan methodology while doing some work on a dilution sampler. The dilution sampler is basically used to get samples for the health effects research people. A modified method 5 train is a train used to collect dioxin samples (Figure 24). It comes through a probe and through a filter to an absorption trap and out through a series of infringers. A major problem with researching dioxin emissions and setting standards has been the sampling methodology; it raises a lot of questions and we found that one must use the right kind of solvent in a sampling train. Some people use methylene chloride in the sampling train. We found that if you have basically zero amount of carbon in a particulate matter, then you get a very good recovery from the train. However, if there is carbon in the particulate matter, then you get a very low recovery. If you go to toluene as a solvent, then you can get good recovery of the dioxins and furans.

Discussion

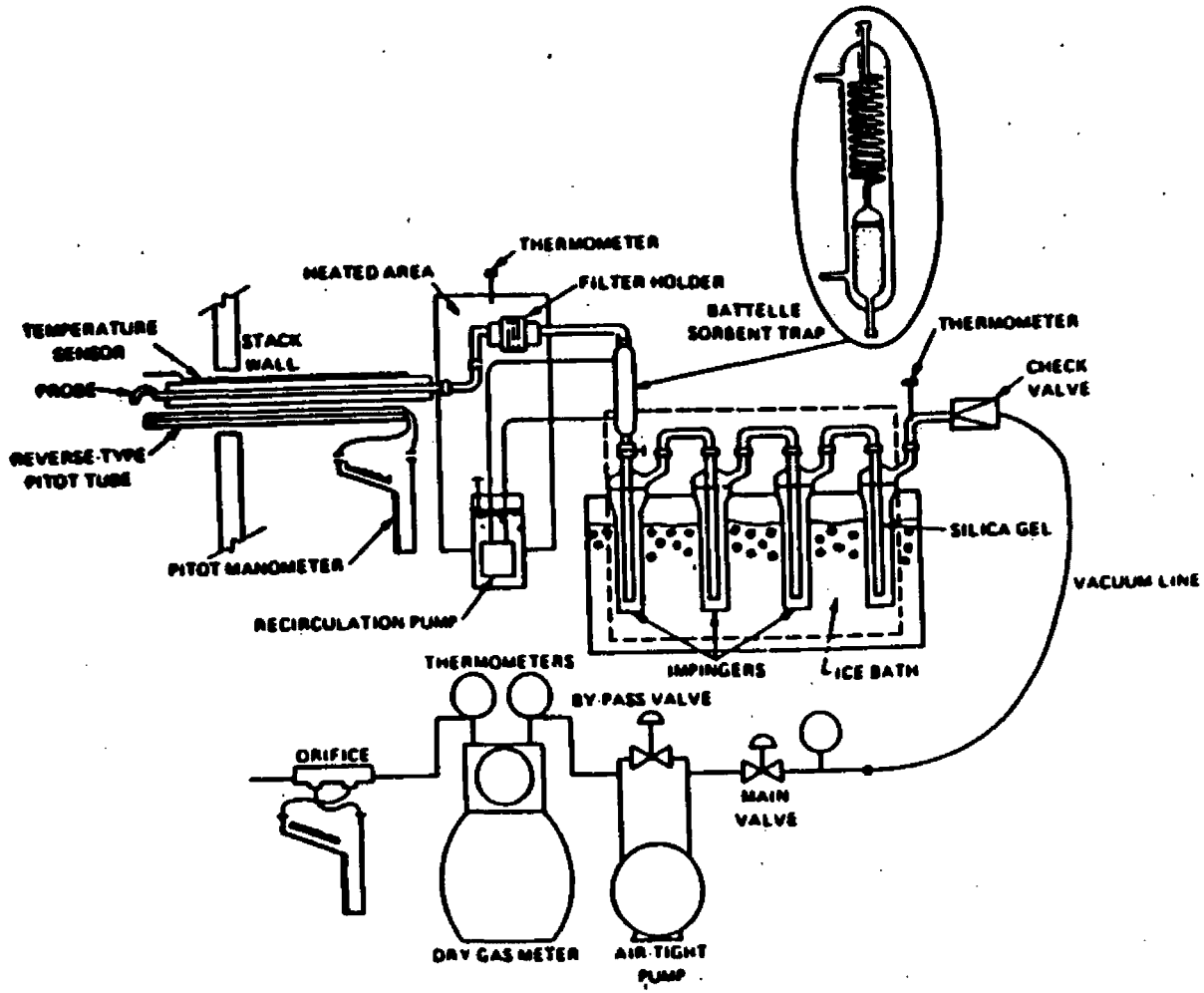
Question:

What is the current state of knowledge regarding control technology?

HEALTH RESEARCH PHASED APPROACH

PHASE I: HAZARD IDENTIFICATION	SHORT-TERM BIOASSAY SCREENING TESTS
PHASE II: HAZARD CHARACTERIZATION	DOSE-RESPONSE MECHANISTIC AND DOSIMETRY STUDIES
PHASE III: HAZARD QUANTIFICATION	CHRONIC STUDIES HUMAN STUDIES CANCER AND NON-CANCER

Figure 23



MODIFIED METHOD 5 TRAIN

Figure 24

Response:

Our knowledge obviously is improving substantially in control technology. In the past, there was not very much emission data from various sources. I think we are starting to understand where the dioxins and furans are coming from and how to control them. There are certain unresolved questions in our minds such as: how to best control substances like mercury? What is really the collection mechanism for dioxins and furans? If you are trying to collect something in the downstream air pollution device, is it a condensation phenomenon or is it an absorption phenomenon?

These are questions that have some bearing and impact on how you design your pollution control technology. In Europe, they have largely been more concerned about mercury than we are. They have gone to the wet scrubber system which we are not really using in this country. The idea there is to drop the temperature down in the air pollution device to the extent where you can condense most of the mercury. There is also one thing that we have not really looked at, which is, what do you do about the residues as far as the organics are concerned. We do not appear to be concerned about the residues, but there is a great deal of concern in Europe over the dioxins and the furans and other organics in the residues themselves. They are actually developing processes for postcombustion treatment of the residues to get the organics out. As far as we can see, there does not appear to be any environmental hazard.

Question:

Is there any plan to study emissions of oxides of nitrogen and their control?

Response:

I think the Agency is looking at oxides of nitrogen control technologies, but as far as the amount of waste that comes from emission waste sources, from a national perspective, it does not appear to be a major contributor to the dioxide of nitrogen. We are looking at existing technology for controlling oxides from nitrogen: selected noncatalytic, selective and nonselective combustion, and furnace modifications.

In incineration systems it is largely fuel nitrogen, and one does not normally operate at high enough temperatures to have really elevated levels of NO_x. So it is more or less a problem of dealing with a fuel nitrogen rather than with a nitrogen fixation.

Last July OAQPS issued a guidance document. It is minimum guidance and is basically directed to people involved in writing permits. It is presumptive to tell permitters that good combustion is an important component of their permit.

Question:

Is the current level of funding for R&D monitoring methodologies adequate?

Response:

This year there is $100,000 in the area of developing monitoring methodologies. The other hazardous waste programs do support some monitoring work. We do feel that it is underfunded.

Question:

Will emissions control technologies differ for new and old incinerators?

Response:

A mere compliance test, just inlet and outlet of an air pollution control device, doing acid gases, metals, and organics, is probably going to cost $300,000 to $400,000. R&D costs approximately a million dollars or more. One of the biggest problems, from a regulatory and a technical point of view, is what do you do about the old incinerators? We know we could go out there and put very costly FGC devices on them, but is there an intermediate ground? We have some ideas about the combustion process. A less expensive FGC technology is the spray-dryer fabric filter, but we do not have much data which would show the performance of the devices.

2.3 Municipal Waste Combustion Ash Stabilization Program

Carlton Wiles, U.S. EPA--OEETD, Risk Reduction Environmental Laboratory, Cincinnati, Ohio

The other side of the combustion issue has to do with the quality of the ash, what we do with it and its contents, and its controversial aspects. Our work includes some work in conjunction with the Municipal Waste Combustion Program, as well as other work. The program is not that large. In the 1987 budget we took some money, around $150,000, from other sources and initiated activities to assist OSW in preparing the Report to Congress. In 1988 we had about $200,000 that went to the program. In 1989 approximately $325,000 went to the base Residuals Program.

Another program is the Ash Solidification/Stabilization Program, funded at approximately $500,000. In the 1960s and 1970s, we were doing a lot of work with resource recovery and waste-to-energy projects. We did not do very much with the residues at that time. Most of the studies that were done during that period attempted to provide the engineers with design and operating information for designing their facilities, such as sagging characteristics and other information. There was some work done in the late 1970s that looked at the potential for recovering certain components from the ash or residues, and the Bureau of Mines process for recovering metals.

The issue became controversial again in the past couple of years. Whether it is a perceived problem by the public or a technical problem is moot at this time. It is a problem.

I will highlight some studies that the OSW did at the same time. In support of the OSW's responsibility for producing a Report to Congress, we did the ash characterization study that was in the report and looked at the physical and the chemical characteristics of the ash from four different facilities. A preliminary study was done on solidification for treating the residues in support of OSW. Some of this information went into the guidance document produced by the OSW.

The preliminary guidance on transportation, handling, and management of the ash was in the document that OSW developed. It dealt with land disposal and monofills. (This document has been distributed to several states.) Legislation is pending in Congress that would essentially tell us what we should or should not do in that area.

In conjunction with this, OSW did some studies to look at the potential sources of cadmium and lead in the municipal waste stream (or in consumer products that might end up in the municipal waste stream) that could potentially be combusted and affect the characteristics of the ash. The report from the project may be available in November.

There was also a study initiated by OSW that is a cooperative effort between the Coalition on Resource Recovery and the Environment (CORRE) and EPA to look at the characteristics of ashes from six or seven different combustors. It has not started yet, but we hope that it will before the end of the year. That study will include some sampling and analysis of the leachate from several disposal facilities at the sites.

Last year we provided support for the continuation and improvement of an ash data base at the University of Massachusetts which primarily deals with the residuals from resource recovery facilities. The project is on-line now, and hopefully EPA will continue support for the coming year.

We provided some money in conjunction with another organization from our Cincinnati laboratory to develop a resource document on the different options for managing or treating the ash. The main emphasis of this document is to provide information on the different alternatives, such as vitrification, solidification/stabilization, monofills, etc., and to give information as to where the potential user of that document could get more details.

With regard to the field combustion tests, we can do sampling of the ash, take the residues from different points in the plant, and do a complete chemical and physical characterization of those residues. We are doing this project in conjunction with Environment Canada.

We had two projects scheduled for last year that were not started because of budget reallocations at the end of the year. The first one was to look at the potential migration of contaminants or the potential attenuation of those materials in clay liners. The University of New Hampshire is doing some work in this area.

One thing that we were concerned about is data that have come across our office show that the chloride complexes of some of the metals will move rather rapidly through some clay liners. We are concerned about that since clay liners are an intricate component of most of the monofill designs.

We also wanted to provide some support to look at the reuse of ash in the ocean environment and to look at the organic components of that material. There has been a lot of work done on the metals, but little work done on the organic components, and we wanted to provide some support for doing that. Whether or not we do this depends on the input that I would like from my workgroup.

Activities planned for 1989 include continuing the activities of the base Combustion Program. We will do some additional work in the control technology area for the residues. I mentioned that we have another program that was initiated this past year and that is going to go into full swing next month. We are attempting to evaluate solidification/stabilization technologies for treating the ash with an emphasis on the long-term utilization of that material.

Solidification/stabilization technology has been studied for treating the ashes. From a technical point of view, we know that it can be done. One big issue that remains is the long-term effectiveness of that technology if we are looking at utilization of the residues.

Whether it is a public perception problem or a technical problem, the Agency has a test based on toxicity that classifies the ash or materials as hazardous or nonhazardous. The ash will fail that test. In some cases, tests with fly ash may have a 50 percent failure rate. The public is saying that if a test classifies an ash as hazardous or nonhazardous, and the material fails the test, then it is hazardous. We believe that it would behoove us to evaluate the technology for treating the ashes, so we can obtain some credible results. The emphasis is for the long-term, safe utilization of that material.

The first phase of this program will rely upon the developers or the vendors of that technology to do the solidification/stabilization at their own expense. This is very similar to the SITE Program. EPA then will pay for the cost of evaluating each of these processes or treatment techniques. I have established an advisory panel that will look at this plan. This is the basic outline for purposes of planning. We hope to have a meeting in a couple of weeks, at which time the advisory panel will start making recommendations that will make this a very credible and worthwhile effort.

The basic design is to emphasize the treatment processes, rather than the different characteristics of the ash. If we had tried to get all of the different characteristics of the ash or residues from many different facilities, the cost would be way more than we could bear. We are, therefore, trying to emphasize in the design the evaluation of the different processes. Initially, I estimated approximately 18 months to complete the program from start to final report phase, at an estimated cost of around $650,000. Field demonstrations were not considered, but I estimated somewhere between $200,000 and $400,000 if we decide to do demonstrations at an actual facility with a full-scale process.

I believe that the big question we are going to have to satisfy for the public is what are the long-term environmental effects of the products. We are going to need to assure those people that this material can be used safely. Another issue is what is the potential liability situation.

To give you an example of the potential problem--and I want to emphasize "potential"--the Netherlands has used ash from both coal-firing and from refuse-firing as roadbed construction material for a number of years. The Netherlands is also in the process of developing criteria for the amount of pollutants that they will allow in the soil. Some people are concerned that hazardous levels of pollutants are coming out of the material, such that they may have to go back into an existing roadbed that has used this material and remove or treat it.

Discussion

Question:

I am assuming that you meant mixed bottom ash and residue when you were using the word "ash?"

Response:

Combined. The real term is "residue." We are looking at both the fly ash or the fly residue and the combined ash. They are being looked at separately.

Question:

Assuming a worst case that the ash is initially considered hazardous prior to treatment, how does this impact your listing decisions or any of your work?

Response:

I know that there have been several delistings in the hazardous waste area using solidification/stabilization. If this material is ever declared hazardous and requires treatment, and if you can delist some of the hazardous waste with solidification, then you might have a good chance of doing the same thing with this. As you probably know, there are some advantages and disadvantages with solidification, such as volume increases.

Question:

Do you think that delisting would be associated with the plant, and therefore be waste specific or site dependent?

Response:

Delisting is always dependent. It has been that way in the hazardous waste area. I do not know if it will be any different. It depends on how the regulations are put together.

Question:

Is leaching from the plant the main concern?

Response:

Cadmium and lead appear to be the main concern. However, there are technical people who are concerned about soluble salts from the ash.

Question:

If you are using a roadbed, how do you know that the lead did not come from the automobile itself?

Response:

You can characterize the ash before it ever goes into a roadbed, and you know that lead and cadmium are going to be there. The material may leach, but with the rapid increased use of nonleaded gasoline, I do not know how much of a problem it might be in the future.

Comment:

This is one of the difficult technical aspects in evaluating these ashes in roadbeds from an environmental perspective. So the environmental margin scheme is going to have to be the ashes. This reuse scenario is going to be a problem, but we are going to look at it.

Comment:

I failed to mention one thing in some planned 1989 activities. We are hoping to provide some support next year to some demonstrations that would look at those kinds of issues. Of course, we are helping to provide some monetary support, but we are going to follow those demonstrations and hopefully get some of that type of information.

Question:

Are you saying that in Phase I you are going to evaluate all of these conclusions of the 18-month objective? On what basis are you going to evaluate the performance standards for reuse of ash?

Response:

That is an excellent question. I have been asking for a number of years that the Agency move toward some kind of performance criteria for solidification/ stabilization of hazardous waste. The Nuclear Regulatory Commission has this type of criteria. This is a topic that I am going to raise for the advisory panel. However, the first emphasis is on evaluating the technologies. We will establish criteria to make that evaluation and to select those technologies that will be initially involved in the program, given limited resources. Determining long-term criteria is an area of research. We have the same problem in the hazardous waste area. The lack of good techniques to characterize the chemical and physical performance of those materials over a long term is an area that needs more work.

Comment:

I would hope that we are going to try to look at reasonable environmental criteria as well.

Response:

From a technical point of view, we will do the best job we can, develop a good set of criteria that makes sense, and give it to the people who make the policy decisions. We need to get that information together in a packet and then present it in a way that the public will have confidence that, "We have answers to the problems" or "We have solutions to the problems."

3. DESCRIPTION OF MITE PROGRAM

Fred Lindsey, Acting Director, U.S. EPA--OEETD

I want to discuss the Municipal Innovative Technology Evaluation (MITE) Program. This is not an existing program, it is a concept. I am interested in presenting the layout to you and getting feedback from you as to whether this kind of a program might be useful.

The purpose of the MITE Program is to spur development in the use of innovative technology in managing municipal waste. I am not going to present an exhaustive list of what I consider to be municipal waste for this program, but I am going to give you some ideas. It includes household, yard, and commercial wastes, but not industrial process wastes. I think it should also include hospital waste and sewage sludge. In other words, wastes or waste materials that are typically handled by the municipal sector.

What is the problem that we are trying to solve? Is there a problem that we are trying to solve? That is an open question. We obviously think that there is a problem or we would not have suggested this as a possibility.

I would like to describe a scenario which you can comment on. It is my view and the view of others that, with the exception of combustion, there has not been a lot of innovation in the MSW technology area, and that most recent innovation in the area has come from Europe. Is that statement true, and if so, why?

Another possible scenario is that the decision-makers in this area are largely local government people, city managers, and architecture and engineering firms that work with the local governments' utility authority, decision-makers, and so forth. Generally speaking, my view is that there has been a tendency in that group of people not to be thrilled about trying new things. Some of you who represent that part of our economy may take issue with this statement.

First of all, when we start to talk about the need to do something different with regard to MSW, there are a couple reasons why you might not want to experiment with new and innovative technologies. One reason is that it is a big ticket item, and the rate payers and/or taxpayers, or whoever is footing the bill for all of this, are going to be very interested in what gets done.

Second, the decision-makers in this area tend not to make these decisions very often, unless the landfill fills up and no other alternatives are available.

Third, there is a lack of expertise in the associated technologies. Thus, the decision-makers at the local level are reluctant to try new, unproven technologies. Therefore, I think that in this scenario the private sector does not respond with a lot of R&D for development of innovative technologies, because there is an uncertain market for those technologies. People are reluctant to try anything that is not "tried and true," or that has been used in other places.

The MITE Program is designed to try to overcome what we perceive as a barrier, given the previous scenario and our perception that there has not been a great deal of innovation recently, except for what has been imported or has been

forthcoming in the combustion area. I am interested in hearing whether you think there is a barrier, and the way in which the MITE Program can provide a pathway to demonstrate these technologies and innovative approaches where credible information can be developed for local decision-makers. These innovative technologies could then facilitate the potential inclusion of newer technologies into their decision-making process.

What will we be doing in that regard? We are talking about demonstrations, or maybe a better term is an "evaluation." It would not be unlike the Superfund Innovative Technology Evaluation (SITE) Program, which is a program we have ongoing in the Superfund area for demonstrating innovative technologies and cleanup technologies. We would be looking at demonstrating new equipment or improvements to equipment or processes. It might be a new sorting device, for example, or perhaps something novel in fire box design for resource recovery incinerators. We might be looking at new techniques and approaches to source separation, methods for minimizing waste, risk assessment methodologies, or demonstrating both process and hardware. We might also look at new, innovative types of facilities that have been built, evaluating the cost effectiveness of the whole plant, and then publicizing the results.

In terms of the demonstration, we are talking about some cost-sharing between the Federal government, which would be conducting this demonstration, and the developer and/or owner, depending on the kind of technology or process we are talking about. EPA's responsibilities would include that part of the demonstration which would generate most of the numbers: development of the trial plan, sampling, analysis, Quality Assurance/Quality Control (QA/QC) work, and reporting and extrapolating results.

The developer and/or owner of the facility would be responsible for operating the equipment. I think we could do this at any scale. It would not necessarily have to be done on a commercial scale; we could do pilot-scale evaluations or evaluations even earlier in the developmental program.

Program Structure

The program structure would be based on something which we have had some experience with. We have had both positive and negative experiences with the SITE Program, which we have learned from. First, we would set up a steering group that would include people representing the several program offices that have an interest in the outcome of this work, as well as people from our Regional Offices and some state people as well.

I see the need for an outside workgroup, perhaps not unlike this group, that would meet probably once a year. It would include city managers, engineers, equipment manufacturers, and others who either produce equipment and/or technology in this field and/or who use it. The purpose of this workgroup would be to review what was done in the past year in terms of demonstrations or evaluations, provide feedback, and provide advice on the future, particularly what the priority needs are regarding specific demonstrations that the group would like to see the program undertake.

Presumably, we would advertise this program annually to ensure an opportunity for everyone interested in participating to get into the program. We would also have what we call in the SITE Program a fast-track option that would actively try to identify innovative technologies and/or facilities for demonstration by other means. One of the means would be the workgroup meetings where interested individuals could develop a preproposal for review, and then a full proposal.

The mechanism for doing the work would be the same kind of mechanism we use in the SITE Program: a cooperative agreement which in some cases would include site owners and in other cases involve developers, and anyone who might be involved or have a direct interest and responsibility in conducting the program.

Criteria

At the moment, we do not have any money in this program. The SITE Program started the same way and has grown into a substantial program. If this new program has usefulness, over time it might also grow into a substantial program. We are going to need to develop criteria for deciding what to accept and how to rank the kind of work that we need to do. We have what we think may be six criteria that we want to use to rank the activities that we would undertake.

1. Stage of development. Field demonstrations of full-scale or nearly full-scale equipment and/or approaches under real-world conditions make the most sense because the technology in that circumstance is closest to being field usable and available in the arsenal of alternatives that we have for dealing with municipal solid waste. I would give a high priority to larger scale activities.

2. Potential benefit. In this case we will recognize the Agency's priorities for waste management. The Agency's published priorities for waste management include as the highest priority what we call "waste minimization" or "pollution prevention" (product substitution, source separation, etc). We should try to give high priority to technologies and techniques that fall in this category, and less priority to others, however, not excluding technologies and techniques in other areas.

3. Potential for commercialization. We want to look at the track record and the financial structure of the developer or the offeror of the technology. It may be that many organizations (for example, a university) are not the ideal because they are not typically in the commercialization field. The point is to have something commercial that can be used.

4. Market potential. Are we talking about a potentially big market for whatever this is? I think the priority needs from the workgroup would be a strong consideration. We want to look at the potential cost/benefit; in other words, whatever are the costs of the alternative we are looking at compared to other management options we may currently have.

5. Site availability and requirements. We found from the SITE Program that it is sometimes difficult to find a site that fits the technology. We have some projects in the SITE Program from the first round of demonstrations for which we still have not found a suitable site. Therefore, the availability of the site is another item that we will consider.

6. Costs. We do not have any resources for this program as it is only a proposal. The cost of doing this, based on our experience in the SITE Program, in full-scale demonstrations of technology can be substantial, on the order of half a million dollars. The cost to the developer and/or the owner of the facility can also be rather substantial. If we are talking about evaluations at an earlier phase, pilot scale or smaller, then the costs could be considerably less.

Discussion

Question:

One of the aspects of the waste field is, of course, that there is no innovative program. "If it goes bust, they will replace it with something that works." How does that apply to the proposed MITE program?

Response:

The INA Program is somewhat different and would require different authorities than we have now. Money is one thing; authority is another. In the INA Program, if a town or wastewater authority decides to use an innovative technology, the risk is underwritten. If it does not meet specifications, EPA will potentially come in and pay for either upgrading the technology or building something different.

An interesting question is: Would such a process be necessary for this program? It would probably be necessary if local governments are going to actually buy the technology. We are currently talking about a demonstration program, not underwriting the actual use of a new technology by a city.

Question:

How do you define technology?

Response:

I would like to hear some thoughts from you on that question. Technology is clearly innovative types of hardware, such as new treatment devices. I think it is more than that, though. We could be talking about protocols, methodologies, or risk assessments--anything of a technical nature that would help the decision-maker at the local level to evaluate his alternatives and/or provide an alternative.

Question:

One concern I have is that we do not repeat some of the mistakes made in the past. In particular, I am worried that technology would be defined narrowly within the traditional way we looked at hardware, and we will not pay much attention within OEETD to economic and institutional arrangements that are closely related to the technology choice.

Let me give an example. One connection that was never looked at when we were in this business during the last decade was the relationship between user charges for solid waste collection and disposal, and the choice of technology. A lot of work was done on taxes, on the Resource Recovery Act, and so on, but a user-charge question was never looked at, including the effect it has on waste generation, the incentive it has for source separation, and the impact on the demand for separation.

The question is: Does that fit what you have been thinking, or is it even feasible to think?

Response:

I do not know whether we have developed it far enough to decide. I see cost information as definitely being a part of it.

Comment:

I hope that before you develop this program much further, you think of how the original 208-demonstration program affected implementation of solid waste management techniques 10 years after the program started and why today we are living with the results of the 208 program. Remember, with one exception, our 208 grants all failed. Then we went to Europe to see what they were doing. Given the political situation today, the decision-makers are looking for any way to avoid facing the issue. A nice EPA demonstration program gives them just what they need to avoid facing the issue. They are waiting to see what you come up with. Based on what we came up with in the past, it is a big mistake to wait for EPA to develop something.

Response:

Let me just say that I do not see this as a 208 program. It is an interesting question as to whether the same thing would result or whether the problem you point out would ensue. We basically provided money for the 208 program to build full-scale demonstration facilities. In this case, we are not going to be providing money to build full-scale equipment.

Comment:

How do you define cost effectiveness? Your whole program is based on one assumption: that people are not eager to spend money on innovative technologies and the only reason they do it is because there is a legislative mandate to do it. In the hazardous waste area, nobody cared until PRGRA, RCRA, and other programs were instituted. Once those laws were put into effect and people were faced with heavy penalties, they started looking at innovation.

Response:

I submit that this is a different situation here, that basically in the MSW area, cities and localities are being forced to do something because their landfill space is running out, if for no other reason.

Comment:

But there is export: export to other states, export to other countries. One would be surprised to know the amount of private investment that is going on in facilities for combustion. There has been over $200 million of private capital blown in pyrolysis, and I bet there will be another $50 million spent next year, of which about $2 million is public money. All the rest was private money. If you want to see an investment dollar get blown, watch mixed plastics. Another one is a field of processing systems that says "I promise I can do all your garbage." I think that there are many technologies like that which need evaluation, but maybe not demonstration. Do they work? Do they fit what communities need? What are the products they make?

Response:

What you are saying is that this is a question of what is a demonstration versus an evaluation. Are you saying that we do not really need to go out and look at the facility, plant, or equipment, or try it out? Rather, we can tell most of what we need to know through paper study?

Comment:

Yes. I think that if anybody is concerned about where used-car salespeople are in high unemployment, they are in this technology. I think it is time to aid municipalities and others by evaluating. I think your procurement process might be able to get access to the technology and to evaluate it scientifically.

The problem is political decision-making. The technology exists because many people are willing to invest in it. If somebody wants to lose money on it, that is their problem. If EPA wants to start a MITE Program, there must be a good reason. Now, if you notice what is happening in some places, the cost of disposal of MSW is probably in the range of $6 million for the entire nation. That translates to less than $2 per person per month as a disposal cost. You expect an awful lot from people who are paying so little. This $2 a month is less than a videocassette costs. That is the level of expenditure of people facing MSW disposal. It is so cheap that they do not give a damn.

I think the local officials need a lot of help. They are grappling with decisions for which they are totally unprepared. They are listening to the blandishment of snake-oil salesmen. So, whatever information you can provide has got to help.

Question:

Don't the people who push this equipment provide data?

Response:

No, or at least not credible data, and the local official is not in a position to provide this or realize that the data are inapplicable.

Comment:

One suggestion I would make is to define municipal waste from a municipal perspective. I just made a list of the new types of waste a municipal manager is dealing with: household hazardous waste, yard waste, asbestos from public buildings, contaminated soil from source tank leakage, hospital waste, and sewage sludge. The list goes on. There are a lot of new wastes that municipal officials are grappling with, including how to set up a yard waste collection and recycling program. There are a lot of new areas where I think new demonstrations and more and better information is needed.

I would also suggest, to get around the problem we had in earlier days, to set up a performance-based demonstration where the municipality provides the site.

Finally, I would echo what other people have said, that is, to concentrate on the institutional implications and the institutional problems of new technologies, because a lot of the problems we are facing now are not really technological. They have a technological aspect.

Response:

What you seem to be saying is that you would favor something more along the lines of the old INA Program in the sewage area. I think that is going to be hard to do because it is very expensive.

Comment:

I am suggesting a program whereby the amount of money is reduced. Certainly the risk is on the municipal side, and I do not think it is very good to ask the municipality to share the risk of technology registration. They have problems getting rid of the waste, and you do not want to put them at risk. There are other ways to do that, such as setting up a performance-based standard that a facility has to meet, and the municipality basically supplies the location.

Comment:

We have seen situations where things have been identified as being problems in the waste stream and there has to be mitigation of some sort. However, at the state level, which is where most of this is being discussed, the state is told that they have no jurisdiction. Federal law, interstate commerce, et cetera, stand in the way of some innovative systems that might be considered. Everybody I know has been waiting for EPA to come into this because this type of assessment cannot be done on a state-by-state basis. They may run into too many barriers.

For example, in discussing whether or not an incinerator should be built, the question is: What goes in there? If you kept "X" and "Y" out or mitigated something, would that make a difference? Would ash residue not be as toxic? It is a holistic way of looking at it. In some cases, certain things have been identified that ought to be kept out, but the decision-makers have been told that they had no right to make a decision on packaging, for example, or other things that may contain constituents that should not be in the incinerator. That is just one example; what is missing is an overall Federal approach because the states are helpless when they come up with these laws. They do not have the right or the necessary jurisdiction. It is a political system we are talking about now.

Question:

Somewhere in those criteria you should consider a systems approach. A lot of this technology might deal with a part of the waste stream and still leave the local official with other parts. Sometimes, the planning can be cross purposed. The question I had is: How are you going to treat pollution from new technologies? For example, you were talking about a compliance test for incinerators: How would you treat the initiatives program?

Response:

In doing demonstrations, not like under the SITE Program, we actually try to figure out what is coming out of the technology and we try to evaluate that. We might do destruction efficiency, for example. Maybe that is what we could do.

Question:

How could you approach a pyrolysis process where you are not going to have much of an idea of either what is going in or what is coming out?

Response:

If we are doing a field evaluation of either an existing facility and a pyrolysis unit that has been built, or a developer who has a scale unit, we would take representative MSW, feed it into the process and figure out what we are feeding in and what comes out, and try to compare not only the results of emissions, but the entire technology, including costs, to other alternatives. That would be the ideal. That would be where we would try to head.

The cost of environmental testing could be substantial. It could be prohibitive. I do not know that for a fact. We do this in the SITE Program, and we have not found any yet that are prohibitive; however, that is a rather substantial program.

Comment:

I think you make a mistake by starting out this program in saying, "We are not going to deal with the industrial waste stream program, even on the nonhazardous side." I think you have an opportunity right now in this program to realize that more of the industrial waste stream is going off-site because of capacity problems, location standards, and everything else. Service providers, including community leaders, have to worry about the infrastructure for industrial waste as well as MSW. Now is the time to think about it, and not the next round of legislation.

Also, I think there is a need to really evaluate systems that do a better job and not evaluate just hardware or technology development. I would suggest to my colleagues that this may not be the program in which you had best do that, however. There is a panel tomorrow that deals just with planning and management techniques. I came into this session thinking that one of the things we want to talk about in that panel is innovative ways to do system planning that may lie outside technology evaluation programs.

The last thing I want to say is that I still think a technology evaluation program is very important. I will speak only for my company in this by saying that we are basically a service provider. If something works and we can incorporate it while providing a service, we would be more than happy to use it. The truth of the matter is that in the large-scale waste services, there has been almost no technological revolution in the last 20 or 25 years. I think we would strongly support any program that is going to try to get us a little bit closer to new ways of doing business over the next 20 or 25 years. If this program helps, I think we all ought to be behind it.

Comment:

I would be quite surprised if you could see really innovative technology in this field beyond what has already been investigated at one place or another. I would tend to lean toward evaluation of what has been attempted and separate fact from fiction, because the truth of it is that right now we are involved in hearings and we are looking at getting into a community and dealing with its solid waste.

There is a great deal of postulation and theory presented to people who make the decisions on MSW management as to what a system will or will not do. There is no formal mechanism, other than going to the state or going to an evaluation listing of what is out there and what are the real numbers as far as what recycling really can do, as far as what incineration really can do.

Response:

What you are saying is that they have not been evaluated sufficiently to provide information about existing facilities and programs, and that is where we should start.

Comment:

That would be my guess, and I have looked at and been involved with RDF and incineration facilities and recycling processes in the last 15 years. I personally do not expect or project that in the next decade we will observe catastrophic differences from what we are currently doing. I think the difference is going to be fine-tuning our evaluation of those systems so that we pick the one that is optimum for a given community. I think that we need to take what we know, put the science together, and do an evaluation. That may involve comparative analysis or getting people who are presenting from a marketing standpoint that they can do "A," "B," or "C," to prove that they can do it. When you get recyclers who say, "We can recycle 100 percent," let us have them prove that they can do it, because I am getting tired of hearing it on the street.

If nothing else, EPA has got a responsibility to communities to have these demonstrations proven or not proven, so that engineers and people who are involved in MSW handling can have some facts and separate those from theories. At least we should have a foundation of what is empirically, factually proven to date. I do not think that there is any central area where anybody can go to get that information.

Response:

Let me ask a question of those of you who may be equipment suppliers. Suppose you develop something new, such as a better way of getting the solid waste into an incinerator, or a better way or a more cost-effective way of separating aluminum or tin cans; the thing seems to work; you love it. Can you sell it now? Would this kind of a program help to sell it? That was the problem in the SITE Program, and that is basically the reason the SITE Program got put together.

I guess the question is: Taking something like that and having an outside third party, EPA in this case, doing the evaluation and providing not a "Good Housekeeping" seal of approval, we never do that, but some sort of a published evaluation, would that be a help in getting a good innovative technology used?

Comment:

We have developed a lot of innovative things in relation to a combustion system. Our stoker was made in 1929 and has been improved ever since. We have the logic in our computers to control the combustion, ferrous recovery command, single versus dual ram feeders, all of those things. We develop them. They assist us in marketing the system, probably only to the extent of lowering our costs. We would not sell that. Along with some other people, we have developed in-furnace lime rejection. It is for our system, and the only thing we have is what we learned. We cannot patent that. It has been patented 50 times already.

The way Congress is going, a lot of these technologies to improve existing plants will be legislated away. There is a limit to how much effort to put into evaluation of technologies that Congress will not allow you to use anyway. We used to have a technology evaluations program. That was probably Consumat's best marketing tool of small systems, a study that we published.

Response:

The question is if you need a third party.

Comment:

No, because these decisions are made emotionally, and I do not think science will change that.

Comment:

I think it is useful sometimes to know that there are situations that have been resolved, probably because some of these evaluations took place. A couple of years ago I was doing a plan for a small community that did not want to get a larger landfill if they could avoid it. They wanted to go with some kind of modular combustion unit. The problem was that there were a lot of competing interests. Not only were the manufacturers presenting their data, there were also other groups in the community who were anti-whatever.

It would have been extremely helpful if there had been some kind of evaluation process in place at the Federal level. It was because there was not that the city and county fathers decided they would not proceed with it, because they could not disengage themselves from all the competing interests and information that was being put to them. There was no objective source that they could fall back on. That is just one anecdote, but I think an evaluation program is something that would be extremely useful to have.

Response:

I am hearing two different points of view. If we are talking about a major alternative technology or approach, maybe there is a lot of benefit to doing an evaluation to provide credible information. If we are talking about a rather substantial improvement to something like a resource recovery incinerator, maybe the companies who offer that have the wherewithal to incorporate that into their system. Is that rational?

Comment:

I think you can break down technology, innovation, and improvements into a number of different areas. There are those areas that the manufacturers are going to want to do on their own. A good example is the RDF manufacturers who have a problem with keeping their carbon monoxide (CO) levels down within the furnace. There are several things they need to do to make the feed of the RDF system more uniform and arrange the combustion process to keep the CO level down. It behooves them to do that because the EPA regulations are saying, "Keep your CO levels down." Therefore, there is going to be a lot of investment in that area.

There are other areas that are not driven by regulation. Right now we have no NO_x R&D in this country because there is nobody pushing it except the people in the State of California. You can look at NO_x technology development for acid rain and SO_2. We are behind the rest of the world because we have chosen not to regulate those things. Germany has. They are doing a lot of work on NO_x and SO_2 control on the back end, and so is Japan.

If we pushed technology through policy or regulations, then a lot more work would be done in that area. Of course, with the current way we set regulations of the Clean Air Act, there is no incentive for a manufacturer to improve air pollution control technology because when you do, EPA says, "Hey, there is better technology out there. Now you have got to use it." In fact, our policy has a built-in disincentive in certain areas. Nobody wants to get a better system because if you do, the Federal government is going to force you to use it.

Comment:

There is nobody refereeing the argument. The kind of overall policy and technology voice that EPA used to provide has been missing. Now everybody is talking about whether a system should be designed to remove some things potentially hazardous or clean up afterwards. You get into that argument, and there is literally no one to turn to because everybody will be very firm on whatever side they are on.

Comment:

If we were going to do a demonstration or an evaluation of the approach of separating batteries used in France, for example, you could probably do some sort of a paper study to evaluate what has been done in France. Another approach would be to do an evaluation here, at a medium-sized town, and try to evaluate what the impact is, including how it works, what the costs are, etc. Who would EPA work with? Who would be the sponsoring organization?

Comment:

Then the battery manufacturers would say that if you can dry cell it, you would alleviate the problem. You are going to have to continue with some analysis in a resource recovery facility, rather than the landfill. I think that one of the things that is important is to provide policy analysis or program analysis. The MITE Program may not be the vehicle for that because there are other divisions in the Agency with those responsibilities.

Response:

That is correct. The MITE Program would not do policy work.

Comment:

The point is for people not to feel frustrated because this program is not going to capture all of their needs.

Response:

No. This is a technically oriented program. It has to reflect where we are coming from. There might be another program to address different needs.

Comment:

There are a lot of municipal and city/county organizations that cover technology. There are groups that work with local governments that could get the word out, if that is what you are asking.

Response:

Do you think they would be interested in co-sponsoring this kind of program?

Comment:

Yes. I mean, in the energy area we are doing some work with the Department of Energy. One of the projects is a yard waste recycling and collection project. The cities actually do the work, and we get the word out. There are mechanisms to get the word out, and generally cities and counties are interested in at least serving as a demonstration site.

Comment:

Some of the monies for this MITE Program should be spent on evaluating technologies that are already out there. It is being done continually by consultants. Papers are being written all the time on the pros and the cons of various incinerator types and air pollution control types. It seems that this MITE Program should be developed toward improving the hierarchy steps number one and two, source reduction and recycling, where there is a dearth of new technology. How do you recycle everything that is in this room? We have recycling technologies for only a few materials. We need to complete the whole cycle, to separate and to reclaim materials into new products.

Response:

You agree that one of the criteria should be that we would give preference to things higher up on the hierarchical setup that the EPA is agreeing with at this time, and to evaluate technologies that already have a good track record, to compile articles and books that have been written on them, and to compare these technologies. Consultants are getting the bread and butter from that. It does not seem that it should pay to redo that.

Question:

Would the funding of the MITE Program siphon off research dollars from other areas?

Response:

That is a hard question to answer. That is one possibility. In terms of funding something like this, one of the options is to siphon money off from other areas. Another option is to try to obtain new money. We could go either way, or both ways for that matter. I am not going to speculate on how the money might show up, but there are several ways of exploring that.

The first question is: Is it a needed program, is it something that makes sense, and how would we set it up?

Comment:

I would like to give an example of how a program like this could help in terms of ash recycling or ash utilization. Many of us have worked in this area, and know that we can use this material, but we have questions concerning environmental impacts. These are the types of programs where a demonstration is needed. We can put this down on paper and can say it could be done. Unless somebody sees it actually done, it is never going to happen.

I am not sure that the MITE Program is structured to do this because I do not see these kinds of demonstrations as a one-shot deal. We may be talking about something that goes into the environment for an extended period of time, and one has to look at it over a long period of time. It is clear that in this business, unless you see it happen with your own eyes, you should not believe it.

We are trying to plan these types of demonstrations now because we know we are never going to make it happen unless people see it happen, unless they can monitor it, unless they can make certain that it is not going to have any environmental impact. I think this is where a program like this could be of assistance both to local communities, who have a real problem, and to vendors, who want to develop new equipment and demonstrate the idea of recycling batteries or removing batteries from a mixed recyclable stream of glass and cans, for example.

Response:

Let me try to focus on some specifics. One of the criteria I mentioned as being useful in terms of trying to decide what to do and what not to do perhaps was the question of the stage of development: that it would make sense to focus "demonstration." What I mean is field-scale activities as opposed to equipment or ideas on a very small scale--a pilot scale, if it is equipment. I guess that any kind of protocol or methodology that we would use would have to be at field scale to be of any use. I am not sure, however.

Are there any comments on that? Does this make sense? How important is it to do field work as opposed to laboratory work, in terms of providing this kind of information?

Comment:

There is nothing like doing a project, being involved with it, handling it, seeing it done. On the other hand, you have got a lot more money involved when you do field-level evaluations than is typical if you do it on a smaller scale.

Comment:

I think that the disposal, or treatment technologies, whether they be land-filling or combustion, the control technologies are there. No matter what people say, they are there. On the waste reduction and toxicity reduction, however, there is nothing. Do a demo on how you get the local newspaper to convert to a water-based ink. That would have a greater impact on the environment than demonstrating CO destruction.

Response:

All right, so you are agreeing again with the hierarchy.

Comment:

I do not disagree with you. The concern that I have is that the world does not think like us and there is an acceptance of combustion facilities at the moment in the country. However, we are also dealing with a situation where people want integrated waste management, which has not come up here. We have been talking about separate elements of demonstration. We have not talked about trying to design something that proves that you can have integrated waste management.

The things that drive people crazy when they think about integration are the very things that we have just been talking about: trying to find a good way to take hazardous materials out of the waste area. If you could go to a group of people to explain an incinerator project and assure them that the integrated waste management system has to remove from the MSW the things that are potentially harmful, such as batteries, then you would be in a much more sane environment. However, when you talk about putting everything in the incinerator and the public knows that some of those things cause problems, you cannot get them to accept it.

Comment:

I would like to agree with a lot of the comments and reiterate what I said before about doing a demo to show how to get newspaper publishers to remove ink and to make a newspaper. That is called an incentive, and it is not technology. I am afraid that if we focus just on technology we are going to blur the very important interrelationships and articulations that exist between getting things out of the waste stream as opposed to doing something to safely dispose of it. I would like to emphasize that we need to think expansively about these things and not say, "Well, that is policy. It does not relate." Otherwise, we will end up doing what was done in the 1970s, when we spent hundreds of thousands of dollars for a project or two on waste tires. The whole problem with waste tires is that there is no market for them. There is no economic incentive. The technology is there. It is on the shelf. It just is not being used. We are in danger of committing the same mistake if we just start looking at hardware again.

Comment:

There is one thing I am hearing that is disturbing me. It seems that when you listen to yourself long enough, you believe yourself. I think we are jumping to some big assumptions about where various compounds are coming from. My concern is to deal with it as an engineer and do the things in its current frame. I think it would be nice in the future to have a better handle on the use of lead in our waste stream, for example. However, the reality of it is that even though we may have believed that things have been evaluated properly, when you get out there in the street, it is not done.

The community officials and many of the state officials do not have a mechanism to conduct a reasonable, fair comparison between existing technologies. For us to jump to the assumption that they have this ability and then to say that we ought to be looking at recycling because recycling is going to solve any problem with MSW mass burn, is quite a big gap.

I personally do not agree that taking lead pigments out of paper is necessarily going to solve or change the physical variation of lead in the waste stream. I would rather solve first things first. There is a big question as to the technologies that are currently operating. Let us deal with those for now and make sure that is resolved before we start looking at new technology. I think you can mix them together, but I think the priority should be on existing technology.

Comment:

I still say that technology is not the problem we are facing. It is not the question; it is a question of psychology. The question really creating the problem is unwillingness to make a decision. There are risks, as there are with everything. If a political city or a county is unable to make that decision, then they are going to have a problem, and they deserve to have a problem.

4. "STRAWMAN" MUNICIPAL SOLID WASTE NATIONAL RESEARCH AGENDA

Background

The nation's mounting problem of how to effectively manage municipal solid waste (MSW) necessitates reevaluation of MSW practices and identification of new, innovative technologies for management of waste material. The alternative MSW practices relating to source reduction and recycling should be evaluated to reduce the amount of residuals for disposal, and to conserve raw materials and land disposal capacity. New technologies for waste management associated with combustion and composting should also be investigated to insure that human health and the environment are protected. Technical information and guidance for use by municipal officials, designers, engineers, and owners and operators responsible for solid waste management need to be developed.

To accomplish these goals, a two-pronged effort is envisioned. First, there are a number of technical questions, issues involving technology, technology transfer and guidance needs, and research and development projects that the nation should address if we intend to improve the cost effectiveness of MSW management in the United States. Much of the needed work could best be done by the production and waste management industries and their consultants. The rest would fall to the universities, states, and EPA. Second, there are a number of emerging innovative technologies that are becoming available for use, and in some cases have achieved limited use and cost-effective improvements over traditional waste management methods. There is, however, a dearth of credible information on the cost effectiveness of these technologies that has been gathered and packaged in a way that is useful to decision makers. EPA is considering a program, called MITE [Municipal (Waste) Innovative Technology Evaluation], that would evaluate new, privately developed technologies. Goals for the MITE Program would be:

1. Provide up-to-date cost-effectiveness and environmental information to local decision-makers on innovative new equipment and techniques for managing wastes; develop expert systems for local decision-makers.

2. Accelerate commercialization of new, privately developed equipment and waste management techniques by sponsoring early demonstrations. Currently, there is resistance to first-time use of new and unproven technology.

3. Provide support and lend credibility to new techniques and equipment being developed at the bench and pilot scale so as to foster development of improved product substitution, recycling and recovery, waste treatment, and disposal technology.

Specific RD&D Projects

The following list of specific RD&D projects has been developed to meet MSW and sewage sludge management needs as they were identified by ORD, the MSW Task Force, and OSW program staff. For crafting a final research agenda, comments from industry, academia, trade organizations, environmentalists, and end-users are being solicited.

Phase I Research and Development

1. Reduce Volume and Toxicity of Waste

   a. Case study of effective source separation program.

      Evaluate at least one good multimaterial source separation program to document costs, recycle rates, participation rates, avoided costs, and storage, collection, and transportation techniques. Ideal candidate would be a community that is realizing at least a 25 percent recovery rate.

   b. Update the state of the art of front-end separation technology.

      Develop a compendium describing the various technologies available to mechanically separate components of the municipal waste stream. Candidate components for examination include: nonferrous metals separation, glass separation and color sorting, magnetic separation of ferrous metals, ballistic separators, electromagnetic separation, froth flotation, eddy current separators, etc. Air classification, shredding, and densification equipment would also be examined. Report would identify the current technical status, performance (product) specifications, mass balance, sizes, throughputs, capital and operating costs, etc. An assessment of the environmental impacts of the units would also be made.

   c. Assess environmental exposure risks associated with recycling operations and recycled products.

      Examine the effluent, air emissions, and fugitive dust releases from various recycling processes to determine if an environmental or health hazard exists. Identify any special problems associated with the management of residuals from recycling operations. Also test recovered materials for the presence of trace pollutants that could pose a problem with their reuse.

   d. Conduct trace element analysis of a wide range of consumer products to identify targets for reduction.

   e. Develop less toxic substitutes for various components of commercial products.

      This is a task for private industry, with coordination and encouragement from the various trade groups. EPA's role would be to identify the needs and encourage industry to actively pursue product substitution research.

   f. Reduce the impact of paper and paper products on the waste stream.

      There are a number of research activities that should be addressed by the paper industry:

      Better de-inking technology
      Technology for the handling, treatment, and/or reuse of de-inking sludges

Increase "acceptability" of lower grades of recycled paper in more products
Develop more products that can use recycled pulp instead of virgin pulp.

g. Guidance document on operating an "office paper" recovery program.

Develop a guidance document that will show building managers how to set up and operate a high-grade "office paper recovery" program. Include economic projections that would show at what combinations of avoided waste disposal costs and scrap paper values the programs would be cost effective. Work from case studies of actual programs.

h. Materials separation and recovery technology.

Better mechanical systems are needed to extract usable quality materials from the waste stream. Research is needed in the following areas:

High-quality glass cullet, free of contaminants
Color sorting of glass cullet
Separation of plastics from nonplastics
Sorting of plastics by polymer type
Extraction of metals from dry cell batteries
Nonferrous metals recovery from mixed waste, and from auto scrap.

i. Evaluate effect of leaving grass clippings in place.

Evaluate effect on residential lawns of not bagging grass clippings. Look at benefits and problems, including effect on appearance, thatch information, nutrient value, consumption of fertilizer, pesticides, and herbicides, etc. Provide guidance materials and promotion.

j. Evaluation of biodegradable plastics.

Conduct a study of the currently available biodegradable plastics. Examine the products of degradation, including air and water migration. Also look at the effects on costs and weight of products. Identify potential uses, advantages, and disadvantages. Examine impact on land disposal and incineration.

k. Evaluate use of recovered materials in asphalt paving.

Update prior experience and possible new techniques for using crumb rubber recovered from scrap tires, or glass cullet in asphalt paving.

l. Determine potential for changes in processes and packaging to reduce plastics utilization and waste volume (workshop and report).

m. Assess potential new markets for development of guidance documents.

n. Determine management status and current markets for special waste (e.g., tires, white goods, demolition rubble, etc.). Determine need for incentives for reuse/recycling. Develop guidelines on management alternatives for special wastes.

o. Evaluate health and environmental effects of current practices for managing hospital wastes and wastes generated by research facilities.

p. Evaluate state of the art of sewage sludge disposal and identify RD&D needs.

2. Improve the Safety of Incineration

a. Evaluate effect of individual components of the waste stream on combustor performance.

Laboratory and full-scale field tests would be conducted on the impact on air emissions (and fly ash) and bottom ash of selectively removing specific components of the waste stream, as well as from selectively increasing the concentration of specific components. For some components such as tires, an effort would be made to determine the upper limit of concentration which can be tolerated without causing unacceptable increases in emissions. Plastics, dry cell and lead acid batteries, grass clippings, and household hazardous waste would be decreased in stages to levels expected to be achievable through source reduction programs in order to measure the levels of reduction in emissions that can be achieved. Evaluate effects of co-firing various wastes and fuels with MSW.

b. Evaluate effectiveness of new air pollution control devices and waste combustion systems.

As new devices come on line, conduct detailed stack tests along with comprehensive waste characterization studies to determine the performance, economics, and viability of these devices.

c. Develop and/or evaluate new equipment for testing, monitoring, and controlling municipal waste combustors.

Better equipment is needed to measure and monitor the releases of pollutants from municipal waste combustors, especially heavy metals, and chlorinated dibenzo dioxins and furans. Stack-testing equipment and in-plant monitoring equipment that would give a continuous reading of emission levels and plan performance are needed to assure operators, enforcement officials, and the public that proper operating conditions are being maintained. Plants designed with more sophisticated combustion controls require more performance data so that the operating conditions can be continuously adjusted to achieve optimal performance. Both in-house and contract laboratories can be employed to conduct performance testing on commercial equipment and to develop new equipment.

d. Improve environmental exposure and risk assessment models for MSW combustors.

Currently available models need to be reexamined and improved to give a more accurate reflection of the effect of municipal waste combustion (MWC) on the surrounding environment. As we collect better data on emissions, we will need better tools to interpret the data.

e. Case studies of newer advanced waste combustion systems.

Develop case study evaluations of several different types (and sizes) of MWC facilities. These studies should summarize the technical and economic performance, and provide good data that could be used by other decision-makers.

3. MWC Ash Residuals Management

a. MWC residue treatment utilization.

Studies will assess various techniques (e.g., solidification, acid leaching, vitrification, etc.) to treat the residues to eliminate or immobilize toxic constituents. Treated residues will be characterized to determine their suitability for utilization. Small-scale studies and selected field studies will assess performance of treated ashes used as commercial products (e.g., road bed, construction blocks, etc.). Emphasis will be placed on determining environmental impacts.

b. MWC residue and leachate characterization.

Residues (fly ash, bottom ash, scrubber solids, etc.) from representative MWC and associated air pollution control devices will be physically and chemically characterized. These will be assessed for their potential to cause adverse effects on human health and the environment. Ash quench waters and leachates from the disposal facility and groundwater at the site will be analyzed for constituents of concern. Appropriate physical and chemical tests and toxicity criteria will be used to evaluate potential adverse effects of the ashes, leachates, and wastes.

c. MWC residue land disposal.

Studies will evaluate the use of various landfill designs for containing untreated and treated ashes. Studies will determine the migration potential of toxic constituents in the ashes when disposed of in soils, in monofills (especially designed for ashes), and/or municipal waste landfills (co-disposal). These studies will emphasize the performance of different landfill designs being proposed by the Agency for managing MWC ashes.

Migration through soils and clays: Critical evaluation of literature and batch adsorption studies with selected soils and residual types; ash pollutant migration rates in soil columns.

4. MSW Land Disposal

a. Continue research into landfill gas emissions and recovery.

Continue and expand our efforts to collect quantitative and qualitative data on gas emissions from municipal landfills. Data need to be related to the quantity of waste in place, the age of the waste, variations over time, effects of moisture in the fill, and effects of variation in composition of the wastes.

b. Case studies of model sanitary landfills.

Evaluate several municipal landfills. Sites should be of different sizes and types, and should have leachate collection and treatment systems, and gas collection systems. Evaluation should document design, operation, performance, and costs.

c. Develop guidance on postclosure care and corrective action for MSW landfills, including long-term monitoring.

d. Improve environmental exposure and risk assessment models for sanitary landfills.

Currently available models need to be reexamined and improved to give a more accurate reflection of the effect of landfills on the surrounding environment. As we collect better data on leachate and gaseous emissions, we will need better tools to interpret the data.

e. Evaluate effectiveness of landfill liners.

Field testing of one or more state-of-the-art landfill liner systems needs to be conducted to determine how they are performing as they get older. Testing is needed to determine if there is leakage occurring and to quantify the amount of leachate being intercepted. Assessments should be made of the expected life of the liner based on examination of the quality of the liner over a period of time. A site should be selected that is as old as possible, but that has a liner that is considered state of the art.

f. Develop effective leachate control and treatment technologies.

Engineered collection systems work needs to be expanded to include storage, treatment, and residue management technologies.

g. Evaluate subsidence control techniques for subtitle D facilities.

The waste characteristics and methods of waste placement in sanitary landfills are conducive to significant waste settlement and cover subsidence. The subsidence potential (up to 30 percent or more of the original thickness) limits the further use of closed facilities. Decreasing the potential before closure can increase the opportunities for further use. It can also minimize the possibility of subsidence-caused breaching of the landfill cover and increased leachate generation. Control techniques during the operational

period can include refinement of waste placement and compaction, surcharging prior to final cover installation, incineration of low-density materials, and mixing of wastes with materials (i.e., fly ash) to increase density and compressive strength. A research project would evaluate each of the alternatives and provide a guidance document on the prevention and mitigation of subsidence in sanitary landfills.

h. Evaluate vertical expansion and other techniques to extend the useful life of subtitle D facilities.

i. Research on attenuation of synthetic organics in MSW leachate by clay soils.

Recent monitoring information indicates that substantial amounts of synthetic organics (vinyl chloride, TCE, PCB) are found in MSW leachates. This task will collect and summarize recent studies of retention and movement of MSW leachate contaminants in soil and perform a limited amount of laboratory testing to identify any additional work required.

j. Development of techniques to accelerate the physical, chemical, and biological degradation of MSW landfills with and without industrial wastes or incinerator residues.

k. Development of expert systems to assist in selection of control technologies to effectively and efficiently reduce environmental hazards and related human health risks associated with land disposal facilities.

5. Municipal Planning and MSW Management

a. Assess state of the art of MSW management. Report on status and needs (workshops).

b. Economic and benefits assessment of MSW management alternatives and provide guidance tools. Develop models and protocols as guidance for doing risk analyses, cost-effectiveness analyses, and public relations analyses for available options.

c. Develop expert systems for evaluating and selecting MSW management options.

<u>Phase II Technology Evaluations</u>

The following are offered as examples of technology evaluation projects that might profitably be undertaken. No contacts have been made nor firm plans developed to perform any of the listed projects. They are offered as examples only.

1. Source Reduction/Recycling

a. Plastics recycling: Plant accepts mixed waste plastics and softens the plastics for extrusion into usable products which are substitutes for wood products.

b. Battery recycling: Plant in conjunction with community has warranted for collection systems to collect all batteries, including Ni-Cd batteries. Collected batteries are sorted at plant for recovery of silver oxide, mercury, etc.

c. Material recycling facility (MRF): Small-scale central collection/processing facilities which reprocess MSW for recycling. Includes glass separation, paper baling, plastics baling, etc. These types of facilities may be key to increased recycling in the United States.

d. Use of shear shredding: Use of shear shredders rather than hammermills to reduce costs and improve safety, which are key issues in MSW processing for use.

e. Mechanically assisted hand separation: Mechanically assisted hand separation improves quality of recovered items/materials. Produces refuse-derived fuel (RDF) for cement kilns.

f. Multiple materials recycling: Recycling of organic fraction and other materials from MSW.

g. MSW processing: Recovers compost feedstock, produces densified RDF, and processes remaining materials for reuse.

h. Tires as fuel: Discarded tires are shredded, then used as fuel to fire cement kiln.

i. Recycling MSW and sewage sludge: A recycling process that handles both MSW and dewatered sewage sludge.

j. Densified RDF materials recycling: Produces RDF energy pellets (50-60 percent of the waste); the rest of the waste goes into recycle materials that are processed for sales or reuse. There are operating systems that would be available to check the economic efficiency.

2. Municipal Waste Combustion

a. Method to produce heat and CO_2: U.S. patent process burns carbon-based fuel, removing gases, recovering heat, and producing CO_2 by fluid bed combustion.

b. Two-stage gasification/combustion of MSW: The O_2-enriched MSW (gasified) is cleaned and combusted a second time with excess air.

c. In-duct injection of advanced sorbents into flue gas: This process uses recently developed calcium silicates, which are highly reactive toward HCl and SO_2 and contain large waters of hydration, to remove acid gas, trace organic, and heavy metal pollutants from municipal waste combustor flue gas. It is suited to both new and retrofit applications, and promises to be more cost effective than conventional scrubbers, particularly for retrofit applications.

d. Enhanced Hg control via spray drying: Activated carbon is added to the lime spray dryer [retrofitted to an electrostatic precipitator (ESP)] to enhance Hg removal for meeting stringent Hg control requirements. With this modification, the process achieves high pollutant (acid gas, trace organic, trace heavy metals, and particulate) control at a cost advantage over wet scrubbing.

e. In-furnace sorbent injection: Alkali sorbents (lime or limestone) air injected into the furnace burning MSW to remove HCl and SO_2 as well as to inhibit formation to PCDD/PCDF or other products of incomplete combustion (PICs). The process is especially suited to retrofit applications, but may also be more cost effective for new MWC applications with moderate emission limits than conventional scrubbers.

f. Fluidized-bed combustion with sorbent in bed: Sewage sludge or RDF from MSW is burned in a fluidized bed containing an alkali material (limestone or dolomite) to effect pollutant (acid gas, trace organic) control. This process is very compatible with refuse recycling.

g. Integrated control of MWC emissions: This process uses dry lime injection into a slightly quenched flue gas from a municipal waste combustor and a fabric filter to effect high removal of acid gases, trace organics, trace heavy metals, and particulate matter. A low-temperature selective catalytic reactor following the fabric filter permits high NO_x control.

h. MWC pollutant control with zero-effluent discharge: This process uses a spray dryer to evaporate liquid effluents from wet scrubbers used to remove acid gases, trace organics, and trace heavy metals (especially mercury). Particulate collection follows the spray dryer. This system can very effectively control all pollutant emissions (particularly heavy metals).

i. Municipal hearth sewage sludge incinerators: This technology evaluation is needed to show that proper operation of sludge incinerators alone can significantly reduce emission and odor levels.

3. MWC Ash/Residuals Management

a. Ash as aggregate for road building: Ash will be used as road bed material for limited highway section; environmental monitoring; evaluation of engineering integrity. Paving to begin May, 1989.

b. Ash-concrete admixture for reef construction: Stabilization/immobilization of constituents of concern in combined ash for concrete blocks; lab evaluation completed; blocks submerged in marine prototype. Field evaluation underway.

c. Ash-concrete admixture for predisposal treatment and as landfill final cover: Concrete admixture of combined ash solidified for use as landfill (ash monofill) final cover and as construction material for small houses; environmental monitoring; evaluation of engineering integrity. Pilot-scale field evaluation underway.

d. MWC ash utilization: Characterization of MSW feed to incinerator; processing bottom ash as aggregate for concrete and asphalt; stabilizing fly ash with cement; characterization and evaluation. Pilot-scale field evaluation underway.

e. MWC ash processing: Uses sink-float process to recover numerous metals in MWC ashes. Remaining ash components are used to produce road barriers and other products. Plant has been operational, but requires crusher for full evaluation.

f. Mining of metals from MWC ash monofills: There are several potential companies/locations, and several companies are investigating the feasibility of mining MWC ash monofills for metals recovery. This technique could be ready for evaluation rather quickly.

g. Vitrification of MWC ashes: Several locations use electric arc or other means to vitrify or fuse MWC ashes as treatment for utilization. Techniques currently used at several facilities in Japan but not in the United States.

h. Stabilization of auto fluff combustion ashes and other MWC residues: Metasilicate stabilization process for treating ash/residues from incineration of auto fluff (a hazardous waste produced in processing junk autos for recycling). This process has been successfully used at four to six locations in California to delist the hazardous waste. Also potentially applicable for treating MWC ashes.

4. MSW Land Disposal

a. Innovative gas recovery: Recovers gas from landfills and processes condensate to reduce toxicity.

b. Use of artificial landfill cover materials--several locations: Evaluate use of Sanifoam and artificial covers for landfills.

c. Bio-barrier root control fabric for landfills: A combination barrier made up of fabric called typar and herbicides that can be used for up to a hundred years to keep roots out of the compacted clay in a cover system product developed by the Department of Energy, Battelle-Northwest, and is ready to be field tested.

d. Composting/odor control: A system for controlling the odors from mechanical and static pile sewage sludge composting. An ongoing survey of composting plant operating problems has found odor problems to be widespread and to be threatening the future operation of many plants. Proprietary air scrubbing systems, soil filters, and scrubbers containing finished compost need to be compared to determine their effectiveness and relative costs, and the information needs to be transferred to the user community.

e. Autothermal thermophilic aerobic digestion (ATAD): Evaluate ATAD treatment of sewage sludge for economic operation and a high degree of pathogen destruction. This approach to digestion has been used in a number of other countries, especially in Europe, but has not been accepted in the United States. Permitting of sludge disposal, required by the Clean Water Act of 1987, is expected to require upgrading of many aerobic digestion systems. If ATAD is effective, it will provide an approach to this upgrading that can be widely applied. Modular systems are manufactured by at least three companies.

f. Composting/materials recycling: Compost production and materials processing/ recovery.

g. MSW composting systems--several developers: Several new process systems, including plastic drum use, have emerged in recent years. Few data are available to compare and select best systems.

Discussion

What we are concerned with is making sure that the decision-maker has the information he needs. If he chooses not to use it, if he chooses not to make a decision, that is not our responsibility. It is the responsibility of the people who voted for him.

While I personally agree that there are technologies available, I do not know that they have been evaluated. I know my feelings are very strong that technologies, and innovative technologies particularly, have not been well evaluated. If the information is there, it is a well-kept secret.

We repeatedly said that one aspect of our program that we consider to be very important is outreach. Let the decision-maker know what tools and alternatives are available, so that if he should make a decision, it can be an intelligent one.

Question:

Do you want to break it down into near-term research goals, or do you want immediate and long-term research goals?

Response:

One of the things the facilitators discussed was the criteria for ranking. Part of the criteria is time lines, not only how long it would take to develop a project and complete it, but also the startup time. By startup time, I mean how long and how far along the R&D track a project already is, and how much work remains to be done; e.g., is it a brand new concept? Those are the types of criteria that the facilitators are going to help you use to rank these things in terms of priorities.

Question:

How are we going to handle things in an interface area, in say the combustion area, that are going to need technology transfer and deal with localities? Will the group on municipal planning handle those kinds of issues?

Response:

Those are the kinds of issues--outreach and getting the information to the planner--where there is going to be some overlap.

Question:

If there is overlap, how do we decide whether to include it in the group?

Response:

Unless you know for a fact that someone else is going to cover it, include it and we will sort it out.

Even if they do include it--even if you know for a fact someone else is going to cover it--your thoughts on that subject are still what we want. Some topics may be discussed in all five groups. Nothing is wrong with that.

I think that there have been some fairly definite goals laid out for the workgroups in terms of what we expect and what we would like to see come from the workgroups. It should flow fairly smoothly in terms of format. We want to emphasize that this is a national research agenda. It is a part of the MSW agenda for action strategy that the Agency has embraced. Within that context we want your thoughts on what needs to be done and the order in which you would ideally like to see it done.

The Agency people are not here to expound on Agency views or anything else. They are here to listen. The purpose of the workshop is to get your views, and that is important to all of the Agency people. That is why they are spread throughout the workgroups, and that is why they are here.

5. PRESENTATIONS BY WORKGROUP FACILITATORS

5.1 Source Reduction and Recycling
Conrad Simon, U.S. EPA--Region II

We went into this workshop in a very structured fashion but soon agreed to operate as freely and as spontaneously as possible while trying to achieve some specific goals. We listed the types of information that we needed. We did not press the need to get them now because we hoped and believed that there will be opportunities ahead to do that. What we tried to do was make sure that good and substantive ideas came out of this workgroup, and got on the record. I believe this workgroup had a wealth of very good ideas and information.

Unabashedly, we want to emphasize our belief that source reduction and recycling are the most important elements of an integrated MSW management program. This is particularly true because what happens up front in the process to a great extent determines what is available and what has to be dealt with later down the line. Just as importantly, these are the areas that have had the least amount of government attention over the past several years. This is true for the Federal government and to a great extent for industry. The many people who have done work in the area have done so on a shoestring budget. So it is an area that has been neglected--not partially--but rather extremely. Because of this, and because of their importance, source reduction and recycling represent perhaps the greatest opportunity and potential for action by EPA. This does not mean that the major work is done by EPA, rather that EPA becomes the initiator of activities in these areas.

One of the questions we planned to answer was who should do what. We did not succeed in developing those answers in this session. Having completed this round of discussions, we expect to provide feedback to EPA on who should do what.

Many of the activities that we are suggesting are low-cost items. Therefore, we believe that they represent the kinds of things that EPA can get started with implementing even while its budget is low.

For convenience, we divided the workgroup discussions into two major areas. One set of topics involved source reduction, the other recycling. Prior to coming to the workshop, we asked two people to develop proposals for discussion purposes in each of those two areas. We spent most of the morning discussing those proposals at some length. In the afternoon we got to the strawman agenda and merged some of the proposals from the morning's meeting to the strawman agenda; however, we are entering the completed presentations on those proposals into the record.

We struggled with the issue of what really could be addressed by RD&D as opposed to what policies and programs should be put in place. We found that we did not cut that line very finely. Although you will see many specific RD&D proposals, we are giving you issues that should be addressed by EPA in other ways than technologically. In fact, many of the items relating to technology development are really about technology transfer.

One of our major conclusions was that source reduction is maybe 90 percent a matter of education. So we would recommend that education become a big part of future activities by EPA in solid waste management.

Since imported products represent a major part of the goods that we use, we believe that EPA will need to pay a great deal of attention to the whole issue of these imported products in terms of their composition and packaging. We cannot look just at American products.

With respect to recycling, we need to look at it more as a service, and not primarily a money-making venture. That has been a trend that might have occurred in the past.

We need not wait to develop a lot of new studies and guidance. EPA did a number of studies in this area in the 1970s. One of the things we can do initially is to dust off some of those studies, update them, and utilize them.

The manufacturing and packaging industries need to be major participants in what we plan to do in this area. EPA needs to arrange another meeting with the manufacturing community, with the packaging people, and others; and this time we should go with the intention of listening to what they have to say, not just to preach to them. Although we had some of their representatives here today, we do not believe that they were sufficiently represented. This is one meeting we would like to see happen sometime soon.

We believe that a major effort must be made to reduce disposables--not just in terms of packaging, but also in terms of equipment.

In the area of medical waste, which has become a hot topic in EPA recently, the use of disposable items is probably the major cause of the problem.

We need to explore ways of recognizing positive efforts by industry. This may be achieved by giving awards to industry for the creation of good quality products.

We need to explore ways of recognizing positive efforts by industry. This may be achieved by giving awards to industry for the creation of good quality products.

We need to develop models to determine the extent to which source reduction and recycling provisions can be built into decisions that we make.

We need to do a major job of identifying what toxic constituents exist in materials moving through commerce, what kind of harm to the environment they may cause, and what changes can be made to make them recyclable or reuseable.

If we turn to the strawman agenda, we will find the following elements applied to source reduction: D and E as well as I, J, and L of Phase I. There were none under Phase II. All other elements dealt with recycling.

Source Reduction (Nancy Wolf)

We ranked the issues in terms of toxicity reduction and volume reduction. We felt that toxicity reduction should be the first area of emphasis and concern. First of all, there needs to be an identification of the hazardous constituents of members of the MSW stream. Right now we have identified certain things in the category of household hazardous waste. We know here and there of products, either stabilizers or plasticizers as in plastic or coatings, etc. There really needs to be a comprehensive list of what products and which constituents are in the MSW stream. That study would also look at those particular substances. Some have ideas of what the impacts of those particular constituents are on the environment.

The second area is clearly the encouragement of the use of substitutes for hazardous constituents. This is an area where there was some debate by our subgroup as to whether or not the development of such substitutes was an appropriate role for the EPA. I think the majority of the group felt that industry should be encouraged to use fewer toxic ingredients in their products.

We listed some of the ways in which we thought those accomplishments could be sped up. First is to obviously have the Agency provide a guidance document. It is also important for us to know there has been progress. We have seen that this has become especially important in the hazardous waste area. In this case, we need to know in MSW where the aspects of substitution have been successfully implemented. Certainly, we then need to publicize those accomplishments. A little praise goes a long way by serving as a catalyst to other manufacturers to do likewise. We wish that there would be more meetings where people could come and talk that would include the environmental and industrial sectors. We feel that the Agency has a vital role to play in collecting, documenting, and making available information on these types of activities. We also felt that there should be a comparative analysis of the nonhazardous constituents that are being chosen because we certainly do not want to do away with the lead, in our hurry, for example, and come up with a component that is going to be far more deleterious or difficult to manage in the solid waste stream. Some felt that in this analysis we would look at all the environmental impacts, including the cost, so that you would really understand what you were getting and what the impact is.

The next area is labelling. There was a great feeling that encouraging change in the toxicity area could be accomplished by having manufacturers label their products with the fact that it was a hazardous constituent. There also would need to be possibly some symbol. It might not be sufficient for the public in all cases to have a list of constituents if they did not appreciate that constituent A or B had toxic characteristics, so there might be a hazardous symbol that could be used. We heard from Gerald Powell about the work that Canada is doing on some recyclability issues, including symbols for the hazardous constituent. We also feel that labelling is exceedingly important in terms of letting the public know the durability of a product, i.e., its lifetime, and whether or not there are certain disposal recommendations. The Agency has as a requirement, right now, wrapping household pesticides in newspaper to put in the garbage. I will bless the man or woman who does away with that recommendation. I just do not understand how that gets to be a recommendation from this Agency as a disposal recommendation for household pesticides. Again, clearinghouse information is needed for the public, for industry, and for government officials around the country.

In terms of volume reduction, we believe that two guidance documents need to be prepared. One is a design protocol. Clearly, we must begin to see that new products are developed with integrated waste management, including waste reduction and recycling, emphasis in mind, and consideration of the impact of that product on the waste stream designed into the product from day one. There clearly is work underway. The American Society for Testing and Materials (ASTM) has something coming up in Toronto. Ed Carais, from the Society for Packaging and Handling Engineers, has begun to develop some sort of protocol. We need to get these into the design schools and used by companies so that as a product is designed, opportunities for waste reduction, for recycling, and its impact on incineration or disposal are all taken into account.

At the same time, a waste reduction opportunity assessment manual is needed. We have one now that the Agency, the RD&D people, have prepared, but it really is more an opportunity assessment manual that has been done for hazardous waste. We feel a comparable assessment should be done for solid waste as well.

We picked up on the issue of biodegradation and photodegradation. We felt that it could equally belong under the landfill area in this particular meeting. It is recommended that the study should be far broader than was proposed in the strawman agenda. It should not focus just on plastics, as in the strawman research agenda. There were also many questions raised regarding whether this was an important thing that should deserve some quick attention. There clearly has been a growing feeling that degradability is excellent, and since plastics do not biodegrade, supposedly they are bad. Maybe degradation is beneficial in the ocean, but we should look at its impact on recycling. Do we want plastics to degrade if they are going to be recycled? We do not know whether or not degradable plastics that are put back into use as a resin will have a negative impact. We also felt that we need to really study the issues of durability, repairability, reusability, and remanufacturing. We need to study ways to increase these elements in our society. Certainly, this has been something we can all see: less durable, nonrepairable, nonreusable products being increased in our country over the past few years.

An interesting suggestion was made under repairability that we could possibly design a machine so that if you put a product into it, it would let you know where the problem was. You could design components that could be slipped in, so you do not have to go back to the repairman. In other words, make repairability something that is easy. Right now, we have a lot of rechargeable cadmium batteries in the rechargeable appliances, e.g., the dust busters, the grass clippers. The cadmium batteries are sealed into the products so you cannot get them out. The manufacturers say that is so people do not put in a nonrechargeable battery because some explosion may occur. It is a safety element. How do we, who are interested in getting that cadmium out of the waste stream, get access to that battery when the product life is over? Somehow that particular product must be designed with durability, repairability, and remanufacturability so that the battery can be removed. All these things need to be looked at more closely. We need to look at the full impact of durable versus throwaway items, including the cost, the lifetime, the environmental costs, and the environmental impacts of producing throwaway versus disposable products. These were some of the key items.

The composting issue was something that was discussed by our group. We felt that we need to know the environmental impact of grass or composting materials that have pesticides or herbicides on them. We have to find out what the impact is on those items we are going to reutilize.

Discussion

Question:

What are the factors driving the lack of attention on the part of the manufacturers and design specialists to incorporate waste management consideration into products? There is no incentive to take these into account. Did you address the incentive issue at all?

Response:

We did not discuss that. We were trying to find more hard, technical things to focus on, and already a lot of things that we have here are more policy or economic analysis. That is one area where there is a certain amount of frustration in the fact that at the moment EPA does not address this. There was some talk of a products chart. However, so many of the issues that we wanted to discuss did not fit neatly into the idea of a R&D scenario. Much of it had to do with policy, but I think as time goes on, all of the things will come together and be addressed by some unit of EPA. I think we saw from the strawman research agenda that there were certain things that we could skip because they are being done in other areas. Hopefully, that information is being disseminated widely, and EPA may help to disseminate information about research being done, field studies, and research being done by states and other jurisdictions.

The first thing we are suggesting is that we systematically assess exposure and risk associated with all recycling opportunities and products. I think we felt that was an extremely important point because sometimes there is the idea that recycling is always best, that recycling is going to protect the envorinment, and therefore we always go to that choice. There are a lot of unknowns there. There may be all kinds of things about recycling that we need to know to properly assess its role within an integrated waste management system. So we felt that was an important point.

Second, there is no doubt that EPA needs to provide a vital clearinghouse function for technologies, for all kinds of information that people have been trying to get at around the country. What we have now is localities and states working almost independently, although there is some swapping of information. However, there has not been a real national clearinghouse established. We believe this should be EPA's prime function. Also, EPA should do a study of international technology and techniques that may be applicable, and put this together in a systematic way that is useful to everyone. The Agency should also be in charge of implementing that information on a systematic basis so everyone can begin to plan and make decisions as a national prerogative and national priority rather than state by state or locality by locality. Also, we believe that as this happens, EPA's role is to evaluate and in some ways prioritize certain systems that seem to be better than others in terms of solving our waste management problem. This is a very firm recommendation that we assume is going to be implemented.

On the strawman agenda there was something on reducing the impact of paper and paper products on the waste stream. There is a very long list on the strawman agenda. We took that list and added to it. I think people now have vast expectations for paper and paper products in terms of waste management. However, paper is not without problems of its own. We believe all of the items on the list under 1.F to be a very important part of research that EPA should undertake. We added three other items to that list.

One would be to research the viability of why the paper industry says it can only use 50 percent recycle content in making its paper products. Is that really true? Why is it true? Why is it not true? Just find out exactly what that means.

Second, research is needed on alternatives to chlorine bleach in paper production because that is obviously something that is causing problems.

Third, research new sources of carbon black for printing ink because the process in itself is a polluting process. There were a number of things regarding paper and paper products that we thought were important.

It is important to develop minimal standards for the handling of regulated waste with incentives for reuse and recycling, meaning that as we find certain wastes that are problems in the waste stream or that must be specially managed or handled, minimal standards for doing this will be a matter of course. Those wastes would then be regulated under EPA's rules, and EPA itself would set the standards. Reuse and recycling should be encouraged as much as possible for any waste that might have to be regulated because it has certain problems.

We felt that certain projects not being done elsewhere would be better done nationally by EPA. For example, battery recycling; this has so many ramifications that it would be an ideal bit of research for EPA. It has ramifications in terms of recycling, in terms of the fact that some people want to put deposits on batteries, and that they are believed to be a problem in incineration or land filling. Consequently, it is just one of those things that needs to be addressed and settled for everybody. The use of shear shredding was considered to be a very good bit of research that EPA should undertake because this may aid the work and investigation leading to more and better recycling.

The feed stock in terms of composting needs to be examined, especially if you want to go into the food composting angle. We believe that there should be more research on this. Most of the work that has been done on that so far deals with gas and clippings.

An important area of research is the classification of what actually constitutes a MSW problem. This really needs to be more clearly defined. What are various problems in MSW? Prioritization of health and environmental standards in terms of these problems are needed if analysis shows specific problems. Obviously, some problems will turn out to be far more important than others. Research is needed regarding the amount of waste reduction necessary to achieve a collection savings, i.e., how much reduction or recycling is needed before you will be able to cut back on the number of garbage trucks or human resources needed. This is what the Sanitation Men's Union in New York City is most afraid of. They are making sure

they handle recycling because they know that if New York or any other major municipality gets into recycling in a serious way, sooner or later the point is going to come where cost savings can be shown in terms of collection routes. The question is, is there some kind of model that can be set that shows when one will be approaching that point to help planners around the country?

There should be a field study of the general composition of solid waste. Assuming the country is structured so that roughly the same types of things occur around the country, notwithstanding differences in regions and differences within those regions, there ought to be some kind of real-life field study, not just a literature search, done by EPA. It would serve as a kind of guide or benchmark on waste generation and its composition so that people could begin to plan better for what they think they may do to manage it and how much we could reasonably expect reduction or recycling to ensue from it.

Question:

Do we need data before we do our risk assessment for resource recycling?

Response:

Well, I think it is quite possible that some of our studies will be put together very effectively. If you are going to do a systematic assessment, then probably one of those points could be the classification of what is really a MSW problem. I think it is quite likely that anybody who has studied this list would probably put certain things together.

Question:

Did the group and experts in your group discuss the type of data that may be available even on that particular subject?

Response:

No, we did not discuss that in any major way; so obviously, if anyone has information to hand in on that, even the lack thereof or the sources thereof, I think that should be sent in.

Question:

What about research into either incentives or evaluating the effectiveness of different approaches to get people to separate their wastes?

Response:

We did not discuss that, and all I can say from our own experience in doing programs is that it is not a problem. I think there is a perceived problem by many people who have not actually done a recycling project, that somehow people do not want to cooperate. All I can say is that the experience of everyone that I know who has actually implemented a program shows that if you design it in a way that makes it possible to be done within any reasonable way, people will cooperate. You are never going to get 100 percent, but the participation rate and generation rate of the projects that have been done, that I am aware of, show a very high willingness to cooperate.

Question:

How many separations are reasonable?

Response:

Well, as far as we are concerned, the best mark of reasonableness is if you can do it just as you do your other garbage system. The best and most successful recycling programs we have seen are those that join in some way the regular garbage. You put your recyclables in a bag or whatever, and then the garbage in a place that is either very close by or immediately adjacent to that where the recyclables go. We have done this in apartment buildings and we have done it at the curbside--that is the way which makes most sense. This way you do not have to turn yourself inside-out in order to take something to be recycled. Dedicated people of course will drive all over town and waste a lot of gas trying to find a recycling center. I do not think anyone considers that to be the recycling option of the future.

5.2 Municipal Waste Combustion

James Kilgroe, U.S. EPA--OEETD

We did not try to identify any specific organization which would do the research program that we were talking about, nor did we identify any specific amount of money that would be required to fund such research. What we basically did was to divide the research into a number of different topic areas. The first one I will talk about is the health and risk assessments.

One of the problems is that while we need information for regulatory purposes, we also need some scientific evidence to persuade ourselves that incineration is safe. Then we need further information for the public to assure them that incineration is also a safe alternative for solid waste management. We looked at the health and risk assessment area and saw that there was a need for standardization of methodologies. By that we mean that a lot of the different model parameters that are put into the risk assessment models are not used consistently around the country. Ten different people may be doing a risk assessment on incineration using 10 different types of model parameters or data inputs for that risk assessment. So there is a short-term, high-priority need to develop standardized methodologies for risk assessment and incineration. We felt there must be some sort of a clearinghouse or group that standardizes what is acceptable as far as incinerator emissions. This obviously is something that has to be done. We have not identified who should do it, but it is a need that we have identified.

We also have to do research and to develop and improve risk assessment methodology, both for indirect exposure and direct exposure. There are a lot of models for indirect exposure. Models for bioaccumulation and uptake of different chemical compounds lack justifiable research information. Therefore, there is research that has to be done in order to put together models that are credible. We think this kind of research is probably a medium priority. As far as direct exposure is concerned, there is some concern about the techniques that are currently used, such as taking a single compound and looking at its effect upon inhalation or dermal contact. A better approach would be a bioassay that examines the whole mixture, then compare the bioassay total-mixture approach to the single-chemical approach, which is traditionally used. We think that this improved risk assessment methodology would be more effective in persuading the public and ourselves that incinerators do not pose too high a risk.

There is also a need to do some degree of environmental monitoring. That requires measuring emissions from incinerators, not only emissions themselves, but also measuring ambient air quality around the incinerators. There may be some need for looking at things like dairy products; however, we think that potentially poses a much lower risk than the ambient air quality around an incinerator. One can examine ambient air sample bioassays and chemical analyses, and decide whether or not the incinerators really constitute a risk. Our health-effects people at EPA have done this to some extent on other emissions and have been able to determine whether or not these things really constitute a high or relatively low risk. Additional risk assessments are also needed comparing alternative waste management techniques, e.g., incineration, recycling, and all the other waste management alternatives. Finally, a better risk assessment is needed for control alternatives for a given incinerator. For example, what kind of a scrubber is required in combination with residual disposal techniques and the types of technologies used to control emissions from incinerators? Risks from those different control technologies need to be examined.

Next, we looked at the problem of waste characteristics. Obviously, there is much concern about the impacts of different components within the solid waste stream and their effects on emissions and residues. This is a high-priority research area. We think that specifically we have to address the problem of household hazardous waste and hospital and infectious waste. The Agency is faced with a problem if we are going to regulate municipal waste incinerators. That is, do you include or exclude wastes such as household hazardous or infectious waste in regulation? Therefore, there is a high priority for getting scientific information to make decisions on how to handle these wastes.

Technology evaluation was divided into municipal waste combustors and other types of combustors. This meant a traditional municipal waste combustor, rather than sewage sludge incinerators. For example, we felt that a high priority was to look at retrofit technologies for controlling emissions from existing incinerators. The Agency is currently evaluating the best available technology for new incinerators, and we think fairly good information based on those kinds of technologies will be forthcoming. However, when local or state authorities have to make decisions regarding how to fix old incinerators, there is a dearth of information on the performance of different types of technology in controlling trace elements, acid gases, and organics. So we have to go back and look at retrofit technologies.

We felt that emerging and advanced technologies also deserve consideration. We have to go out and evaluate these because the public basically is going to ask questions, such as should we use this technology and is it environmentally acceptable? If it does not get some type of credible evaluation, then of course it will stay off the marketplace. There is a feeling that we also have to do a better job of bench- and pilot-scale research. There has to be a fairly good balance between research activities and full-scale evaluation activities. One of the problems is that there are a lot of mechanisms that we need to understand, e.g., how to control dioxin--is it a condensation phenomenon or is it an adsorption phenomenon? You have to look at that in the flue gas cleaning, in addition to other areas. One must find out where dioxins are being created, how to prevent their creation, and how they can be destroyed in the combustor. There is much research and development that has to go on in this area.

We also felt that greater attention has to be placed on NO_x control techniques. While NO_x emissions from incinerators are not a large national problem, there are many localities that feel NO_x control techniques should be required. If you design an incinerator ignoring the NO_x emissions, you may get a different product than if you try to optimize NO_x control and organic emission control at the same time. A case in point are the Japanese who have optimized their incinerators for NO_x control while ignoring organic emissions, whereas the Europeans have optimized their incinerators for organic emissions control and have largely ignored NO_x. There has to be some middle ground, and we have to look at combustion and flue gas cleaning techniques which will both control organics and NO_x along with other pollutants.

There is also a need to do a greater amount of risk assessment for mercury emissions. That is a major environmental concern in Europe, and we can envision it becoming one in the United States as well. There is a sense that some of those environmental concerns are excessive and what is needed is to go back and look at how much of a risk mercury really poses, and then determine how you control it from the emissions of the incinerators. There has to be additional work in this area.

Sampling analysis needs to have a high priority. There are two components here; one is the continuous emissions monitors, and the other is the operators and designers of incinerators who obviously have a hard time keeping these monitors online.

Essentially, many state and local governments are requiring continuous monitoring of pollutants, and the operators want to have more reliable instruments. There is also a need for improved sampling analysis techniques for the emissions from the incinerators and residues. One of the things we really have not done is to look at the speciation of metals. Generally, when one measures metal emissions from an incinerator, it is assumed that it is an oxide or just a metal. Essentially, that does not tell anything about its mobility or impact on the environment. One needs to examine whether it is a chloride, an oxide, etc., because that has an impact on how it moves through the environment and how it is taken up by humans or other organisms.

We also need to do a better job of looking at four specific organic compounds. We essentially have not looked for any of the nitrogenated organics. These are generally the more hazardous ones, and we have not looked at them in past test programs. We also need to look at the volatile organic compounds. There is virtually no information on volatile organic emissions from waste combustion. Obviously, an approach of looking at emissions both from a bioassay and chemical characterization point of view has much merit.

There are other combustors that we were concerned about. There is not much information on sewage sludge incineration, and we must admit that the members of this group did not have much expertise in the sewage sludge area. However, it was our perception that there is not a lot of information on the emissions from sewage sludge incinerators. There probably has to be more risk assessment and a better job of characterizing the combustion techniques used in the flue gas cleaning devices. Sewage sludge incinerators traditionally have used the multiple-hearth technology or newer technologies, such as a fluidized bed combustor and a wet scrubber, which is not as good for controlling trace elements as it is for organics. We believe that if we both examine the technologies and have tougher regulations, we would have a whole different set of technologies used in municipal waste incineration. We also think that this will be a growing issue in this country. Tougher regulations would force us to use better technology. We know that better technology exists. It is just that we have not been forced to use it. There is also the question of tar combustors and other special types of combustors. We need to look at the emissions from these and try to assess the risk from those combustors and identify whether the technologies that are used in those types of systems are good or bad.

Finally, there are the hospital waste incinerators, and the Agency is going to have to move ahead to do something about regulating these. The larger ones are similar to municipal waste combustors, while the smaller ones are somewhat different. We are going to have to look at the combustion process and the flue gas cleaning technology used in them. Ultimately, somebody is going to have to make a decision whether to continue using these incinerators or some other method for getting rid of hospital waste. One of the things talked about was including the burning of hospital waste with municipal waste combustors. We think the answer is probably yes, but the types of combustor used and the conditions for burning have to be laid out.

Discussion

Question:

Did your group discuss the subject of performance standards for incinerators?

Response:

Yes. That really goes back to the heart of the Agency's current approach in having combustion guidelines, and there are also the emission performance standards for incinerators. I did not include or say very much about these because I think that it is inherent in what we are doing. I do not know to what extent there has to be any national policy for developing uniform standards for incineration. There are issues such as requiring operator training or certification. The Agency is currently looking at these types of things. We think that there probably will be requirements for training and certification of operators.

Question:

Are you saying that as far as air emissions are concerned, standards are going to be put on everything?

Response:

We are involved in a process. Yesterday, we said we were going to propose standards in November of 1989 and essentially promulgate them, that is, finalize standards in December of 1990. So, we are in a process of trying to put together standards for a whole host of different pollutants for incineration. This is on the emissions line.

Question:

I noticed in your group discussion you came up with a list for sampling analysis. We have metal speciation and organic species. Could it also be the intent to validate these test methods on this particular stationary source?

Response:

Yes. We are setting up standards right now using methods that are not validated. However, traditionally the Agency sets standards and then comes back and sets up a standard method. That is sort of backwards, but that is what happens because we do not have money, resources, and time sometimes to validate the sampling method up front. You do that in the process of collecting data for setting the standards and then, obviously, you hope that you have done the right thing.

Question:

But you want to move forward in this with the intention of validating?

Response:

Yes.

Question:

And also in terms of methods development?

Response:

That is right. In terms of validation, the answer is yes. I think the point is that we do not always have all the validated test methods we would like to have when we put together regulations. We take some of the test methods that have been on the books as standard test methods to be used under various regulations. They are still not standardized. That is a fact of life.

Question:

What about continuous emission monitoring correlation of dioxins and furans and things that cannot be monitored continuously?

Response:

We tried to identify what constitutes good combustion, and there are certain things such as temperature and CO that will give an indication that dioxins should be low. There is no absolute certainty that the dioxin is going to be low. There is not enough scientific evidence right now to draw good correlations between those parameters that are available in dioxin emissions.

Question:

Is that something we should work toward?

Response:

We are trying to work in that direction, but we do not have sufficient research dollars.

Question:

The point is, should that be a priority?

Response:

Yes, it should be a moderately high priority.

Question:

Why did not you not identify residuals in the environment?

Response:

Another group will be dealing with the ash if that is what you are talking about. We have not really gotten to the ash, but, in my opinion, there has to be a pretty good interaction between the combustion and the flue gas, and the residuals.

Question:

You can go ahead with metal speciation, but I do not think that the bulk of the health-effects research has gotten to the necessary level of speciation. For example, lead is lead. We do not particularly care at this point or have enough data on whether it is qualified as sulphide or oxide. That is one point. The second point is actually a question. You seem to indicate that you are going to try to keep special wastes separate and deal with them separately. Is there not a possibility that sewage sludge could be co-incinerated, as could tires?

Response:

I think this is especially important, particularly in the area of household hazardous waste where the waste management costs of dealing with it as a separate entity are astronomical. I agree with your comments, but we do not have any information about those subjects on which to base decisions right now. This would be a high-priority area.

5.3 Municipal Waste Combustion Residuals Management

Carlton Wiles, U.S. EPA--OEETD/RREL

I want to clarify the research items. We did not limit ourselves strictly to R&D activities. The charge according to the agenda was to look at actions or barriers that were causing problems in implementing a management plan for the community, implementing a reuse technology, and similar kinds of things. Therefore, we did not limit ourselves strictly to R&D efforts.

Our strategy was that we will rank the research needs or activities when the proceedings come out, so that we can rank specific items rather than trying to rank categories. The problem there was that everybody represents a different need. Some are interested in looking at reuse right away, but others are interested in looking at land disposal and what kind of options there are because that is their immediate need. Therefore, we dropped any attempts to try to rank these.

There needs to be a document or documents containing fact-sheet type of information that is pulled together as to where we stand today with ash management, including land disposal, reuse, and characteristics. This can be distributed to engineers, designers, the public, and so forth so that they know the true facts regarding ash. The suggestion was that EPA should take a strong leadership role in this area whether or not it is the clearinghouse, in conjunction with the clearinghouse, or whatever. EPA needs to have a strong role so that the states and the people have someone whom they can ask questions of and who will provide information. This was number one on everybody's list.

The type of things we talked about under the ash sampling and analysis dealt with developing and evaluating a set of sampling procedures that take into account the intended use of the sample, whether it is for regulatory use or compliance, or whether it is for a scientific-technical study, or other cases. There appear to be some problems with the techniques that are in existence today. There is a need to evaluate these techniques and to further develop sampling protocols taking into account the intended use of the sample. Evidently, analysis procedures used for providing true chemical and physical characteristics of ash are lacking, and it is felt that there needs to be some work done in this area.

Technology transfer transcends all of this. This is an item that needs to be considered throughout everybody's activity. However, in the ash area it appears to be a special need and we identified it as such. In ash handling the discussion centered on the fact that we believe as a group that there needs to be some actual sampling done in plants, during transportation, and so forth, as to potential emissions, etc., that may be taking place. There is a need to characterize these as to whether or not they could cause potential human health problems. In addition, there is a need to provide essentially the status of the way things are being done today and to show good operations and how they have been handled. Once again, guidance is needed and must be distributed to the people who need it.

We also felt we need to pull together the available information on ash toxicity, bioavailability, and biotoxicity. As far as we can determine, not much has really been done in this area. There needs to be a strategy developed on how you handle or look at the data that come out. What do the results mean? How do they

compare with other management options? There was some discussion in this area as to the type of information that we are going to have to have in the long run to convince the public that reuse of this material is an acceptable option. This could be a big-ticket item and it could be a long-term item, but there needs to be some consideration about how we can do this and what the information means once it is developed.

Under treatment/reuse, we essentially decided to consider treatment and reuse separately. Treatment includes treatment for land disposal and for reuse purposes. There are several different items that require evaluation or research under each one of these categories. For example, treatment for land disposal includes immobilization, chemical and physical stabilization, and other solidification activities and on-site and *in situ* stabilization parameters such as moisture optimization and compaction that would be required in *in situ* stabilization or solidification activities. There were a number of these types of things listed related to what to do with the ash in the landfill to reduce leachate, if leachate were a problem.

Some of the same items appear again under reuse. Reuse also includes recovery of precious metals from the ash, whether or not it is in the ashes that come out of the facility or perhaps even in the model landfills that have been around the country for several years. In all these things, economic analysis from primarily an engineering point of view would be included.

It is recommended that a CERI-type document be produced for technology transfer. CERI is the Center for Environmental Research Information. This needs to be done in different aspects of the ash sampling, analysis, treatment, management, etc., so that information can be disseminated to the public. We also discussed producing a fact sheet that would provide a rational stance regarding the true facts associated with ash management because evidently the press and the public hear only the negative aspects, and not the positive side or the true facts.

We also addressed institutional and political problems and barriers, such as the lack of a standard interpretation of regulatory intent. This varies from state to state and region to region, as do problems such as liability. If there is a liability problem or if there is any indication of a liability problem in the future, people are not going to reuse this material. That is a type of institutional barrier that needs to be rectified.

Mentioned earlier was the need to produce a document immediately that essentially tells everybody what the state of the art is and what the status is on ash management. That was the number one priority.

Discussion

Question:

Did you discuss all ashes together or were ashes originating from different sources dealt with separately?

Response:

We thought of residual reuse in general, whether it be fly ash or bottom ash. However, there was some consideration about looking at separating the ash so you could treat only the fly ash and not have to worry about problems with combined or bottom ash.

We decided at the beginning that the objective was to provide credible information so that ash management strategies or plans could be implemented on community levels.

Question:

One of the ways to begin looking at residues is from the recycling perspective. Do you think that this type of program could be applied to ashes or residues from other thermal processes?

Response:

Yes. There are residues from other thermal processes or other thermally degrading waste. However, if it is a hazardous waste, there is a specific set of regulatory criteria that you must be concerned with.

Question:

No, I am talking about, for example, ash from steel recycling and ash from a whole host of processes and industries.

Response:

Yes, although there might be some specific things associated with a very specific waste.

Question:

Was there any discussion of anything other than MSW?

Response:

No. We decided at the beginning that their charge was the residues from the combustion of a MSW.

5.4 Land Disposal

Robert Landreth, U.S. EPA--OEETD/RREL

When we started looking at landfills, we made the decision we were going to address MSW, nonhazardous industrial waste, and sewage sludge. The things that we are talking about today apply to that type of categorization.

The overlying theme that came out when we first started to discuss this was the fact that we did not necessarily feel we had top priority. Rather, we felt that land disposal deserves top priority, but we really did not want to say that. What we are saying, though, is that it should have some priority. It should not be last.

One of the waste management firms indicated that there was a good potential for sharing, or at least identifying, other data that might be available. In doing some things, depending on the site-specific project or the project that we have in mind, they may be willing to work with us. We will pursue this.

We addressed the issue of siting. We looked at design. We looked at construction, operational, and monitoring activities. We looked at closure/post-closure. We also had a category for what we could not shove into the other boxes, and we called it miscellaneous.

Siting. One of the urgent needs right now is to define what the waste characteristics are. We need to know what is going into these landfills. We need to know what type of site is required. Characteristics of the site are very important, obviously. We find that in certain cases people are siting landfills without really paying attention to some of the criteria that one would normally look at.

Vertical expansion. We put this down as a high priority, realizing that it is relatively site specific. If one looks at people on the East Coast, they might think that this is an urgent need because they are running out of landfills. Activity in this area would help them substantially. We also have people from Oklahoma and Kansas, for instance, who do not necessarily share that same experience. However, we put it down as a high-priority category.

Monitoring. I think you will find that in just about every case that we have in every category, monitoring is needed across the board, including monitoring of the particular sites.

Design. We wanted to look at extended performance of clay and flexible membrane liners. There is some concern that we do not know enough about these in long-term performance. We need to look at the extended performance of these materials that we are putting into the landfill in the control technology.

Leachate collection and removal system. Again, these systems are being used, but they are probably not designed or based on any given research data. They are almost designed just by chance. We need to look at collection systems, drainage gravels, geosynthetics, and similar things. We are starting to get a handle on the geosynthetics. A lot of the procedures are not standardized. A lot of the design criteria are incomplete. The overburdening pressures that we need to be concerned about are absent. Also, the long-term performance of these materials is not known. We felt that these things really need to be addressed and addressed almost immediately.

Again, we need to be aware of monitoring considerations in any type of design. Monitoring can go across the board in terms of requiring just a QA/QC program, or a specific set of individual things like the procedures for overall characteristics.

Runoff control. We felt that runoff control is a need from the standpoint of active sites. How do we handle runoff control? What type of controls do we need? Does every site need a National Pollution Discharge Elimination System (NPDES) permit, and so on?

Gas recovery. Issues that need to be addressed include how you design a recovery system and the characteristics of such a system. There is probably some information that could be pulled together relatively quickly.

Although I have not presented the time frames during this presentation, we have identified them and hope that they would give some guidance to the Agency in addressing their resources.

Construction. We had a single item: to better define the procedures. This is an urgent need. We find that we can sit at the drawing board and design these facilities. We draw nice straight lines. We say that material in that band right there has a permeability coefficient of about 10^{-7} cm/sec. It has a nice flat surface on top of which we put a flexible membrane liner, and that is a composite liner. However, it cannot be done in practice.

We do not know how to do it and we cannot tell them. We can show them on a drawing, but you go to the field and the contractors cannot put that 10 to the minus 7 into the facility because they do not know how to do it. We do not know how to tell them to do it. We do not know what the parameters are. We think we have a feel for it, but it has never been verified. We have never really gone the extra step to do that. We probably need to back up and better define each of the procedures for constructing a facility. This is more than just a QA/QC problem. It has to be a design type of construction activity. You really need to get in there and tell these people how to implement the design. Sometimes it is going to be a retraining tool because, in some cases, we are dealing with the wrong professions, for example, clay liners being built by road builders, and there is no disrespect intended to the road builders. We have a lot of good roads around the country, but that is not the type of facility that we are designing. There is a different approach to it.

Operational monitoring. There are several things that need to be addressed during the operational phase of a landfill.

We wanted to look at some of the alternatives to daily covers. We find that a fair percentage of the air space within a landfill is taken up by the daily cover requirement. Are there alternatives that we can use to minimize this? Are there things that we can do to minimize the need for daily covers?

Rapid stabilization. We think that the landfill--and this is not Agency policy--should be used as a bioreactor. There is some thought now that, rather than mummifying the landfill--putting it aside and letting it sit there as a time bomb--maybe we ought to do something with that facility. We have got it lined, hopefully.

We have got it designed so that we can keep it in a nice environment. Let us do something to that, let it work itself. Let us keep recycling the leachate, do the chemistry with it, work with it, let it stabilize so that if, in the future--and let me remind you I said "if"--that liner fails, it will not pollute the environment. This is something that we have some pilot-scale information on, and we think it is a very good system.

Improved monitoring. This is a multimedia approach. What we are talking about is the instrumentation. Does that need to be improved? Do we need to improve particular networks? What are the parameters? People were asking: Why do we need to have the Appendix 8 sampling and analysis? Are all of those necessary, or can we back off and monitor a few indicators? Again, this would be a function of the type of waste characterization work that we might do on the front end.

Leachate reduction. We felt that there are some ways that might be able to reduce the amount of leachate that is being generated during the active life of a landfill.

Leachate collection and removal system. We are starting to find that some of these systems are biologically and chemically clogging with precipitates and biologicals. We need to address this issue and find out ways of either preventing the problem or designing a way in which we can go in and clean the system out again. Runoff control needs to be addressed in this particular area.

Addition of sewage sludge and septage. There is a whole host of things that can be done here. The question for septage is whether it can be put into landfills. Evidently, from the discussions that we had, there was an indication that a fair amount of the states do not allow septage to be put into landfills, and some of them now are not allowing it to be put into Publicly Owned Treatment Works (POTWs). It creates a problem for certain parts of the country, and that needs to be addressed.

Gas emission and recovery. Again, this is an area that probably needs to be looked at in terms of operational aspects.

Odors. Obviously, everybody has a concern about the odors. Perhaps in the new landfills it is not going to be as much of a problem because of the barrier situation that most landfills have, but at least odors should be addressed. We need to be aware of this when we pick a particular site.

Leachate evaporation with landfill gas. This is our first MITE candidate. We think that might be one that is immediately available for demonstration in the MITE program at a facility.

Closure and postclosure. We felt that there was a need to revisit some of the older sites to see if there is a way in which we can close those to prevent further degradation. Perhaps we would have to do something else with them. In this regard, we need to look at that and demonstrate that those systems are different from the new systems. We need to convince the public that the new systems can be designed so that they will be nonpolluting.

A big question came up of, when do we close? Maybe we should not put the final cover on until the 15th year of the postclosure period. If we examine recirculation, we need to look at letting the landfill work biologically. Let it start to settle and subside, and so on, and then in a few years, after everything has happened, put that final cover on. And then that cover should be long lasting and durable.

Corrective action. It is one of those things that we felt will probably go along with some of the older sites. Corrective action is somewhat of a plume management sort of scheme. If we look at some of the older facilities, we must know if odors are a problem.

Miscellaneous. Case studies was top on our list. We felt that there is a lot to be gained from case studies, and we need to do something immediately to convince the public that these landfills can be used safely, and also that they are going to remain a part of waste management. In the future we are going to have landfills, and so we need to have some type of convincing argument for the people. We need to do some case studies to find out a variety of things. Are the systems working? What systems are not working? If they are working, why did they work? If they are not working, why not? Were the designs wrong? What can we learn in terms of the degradation rates other than what we know now? So we feel that the case studies can provide a wealth of information, and this is a very important, urgent need right now.

Characterization of the waste. We wanted to stress the importance of characterizing the types of wastes that are going in.

Technology and information transfer. There is a definite need to get something out immediately to tell the people that here is what you can use, here are the systems that can be designed, here are the techniques that you might want to employ at landfills, and here are some good things about them. We need to identify where we are doing research, and at least tell the people what we are doing. Do not try to hide it right now. Let us get some good tech transfer information out there.

Exposure risk assessment. Again, we felt that there is a need to do this. We owe it to the people working and living around landfills to look at that particular assessment.

Ash, sewage sludge, and hospital/lab-type waste. Research on those is needed because it is in the public's view right now.

The question came up of model fill or the ATAD. This is an urgent need. I think that model fills provide a lot of information to city managers.

We also felt that there could be a need for a national standard for compost. A lot of people do not know when compost is done, that is, when it is ready to use.

We need that standard not only for "when it is soup," but also how we can use it and what the benefits are of using that. We think that is very good information to have.

We considered source separation and preprocessing before landfilling waste, to see if that would improve the overall characteristics of operation of the landfill.

Then we identified two additional items for the MITE Program. One is landfill mining. There have been some proposals regarding this. We have some information that suggests that there is a technique that allows us to mine these facilities for some of the metals or other materials, or use some of the compost or other degradable material as interim cover. This fits very nicely with the recirculation effort in that we would use a bioreactor for a period of time and develop a working system so that we could have a continuous site.

Pretreatment. This is a technique, wet pulping, that the people in England are using right now. They think that they are getting better air space utilization within the landfill.

Discussion

Question:

Hans Bruner, of the Swiss Federal Water Pollution Institute, believes that any more than about 2 to 4 percent carbon in a landfill is very dangerous because you get a bioreactor, and a lot of bad things happen. I believe that what is in these landfills is not waste, but rather it is stuff that is incinerated. Do you have any idea about trade-offs of the kind of a policy, for example, if we went in the direction of having something that is not a bioreactor? Is a bioreactor all good or all bad?

Response:

No. I think that the potential use for a bioreactor is more or less site specific. With the total volume of waste, obviously, it would not work. I do not think it would work for places like New York, for example, and Wellington, Kansas, probably does not have enough waste with which to build a reactor in 20 years. I do think that there are locations around that are suitable. I think that what we have to do is to develop technology or individual techniques and approaches that fit categories of cities.

One thing I forgot to mention in the tech transfer. What we would propose is some sort of expert system approach for the city manager that would say, "Here are your options for managing your waste. You can either incinerate them and go through that type of scenario, or you can landfill them and go through that type of scenario. You might want to do something else, but look at all of those options." He knows what his individual characteristics are. He knows what costs he can play with, and so on. He then puts that information into the system, and it comes back and gives him his best options, including costs. This would allow him to make his own decision.

Question:

I guess my question was that the Swiss are saying, "We shall not landfill anything except the mine waste," and anything which could potentially form a bioreactor, they say is not acceptable. So everything, essentially, has to be incinerated.

Response:

Well, our pilot-scale information would say that it is a doable situation, that there are some benefits to be gained by it, especially when you compare that to the mummified situation of a landfill. Now, maybe they are thinking of a mummified case where in the future, if something ruptures or the integrity of the system is breached, there is a problem. I think it is a case of land availability. The Swiss do not have much land, so they want to minimize their land use.

Comment:

It would be really nice to go out and look at old landfills, to see what the pollutant potential is from those versus new landfills which have all this engineer-controlled technology associated with them to alert the public out there that a landfill is not necessarily an open dump, but an engineered site and as such, that there are "benefits" to be derived from a new landfill versus an old landfill. Where are the data to show that there are improvements in landfill design in the sense that there are fewer pollutants being generated?

5.5 Municipal Planning and Waste Management

Truett DeGeare, U.S. EPA--OSW

We tried to focus early on research that would help local waste managers in dealing with the problem of everyone wanting them to pick up the garbage, and nobody wanting them to put it down. We looked at the current Federal statute, which puts the primary responsibility on local and state governments. We also looked at bills that are pending in Congress and the fact that this situation is likely to continue. There is not going to be a Federal program that is going to come in and solve the problem for the nation. Rather, local government working in a private-public partnership is going to continue to do the job.

We quickly came to a realization that we are not talking just about engineering research and technology; we must also address economic and policy analyses that have to be dealt with by local waste managers. What we all talked about were mostly Federal roles; that is, research that seems to be appropriately conducted at the Federal level to serve local waste management.

The number one need that surfaced was guidance to help solid waste managers evaluate alternatives, including simply what questions they should be asking and where they can get the answers.

There is a need to develop basic information on costs, benefits, and risks on each of the technologies that we have been talking about, including recycling, composting, waste to energy, and landfilling. This should be done on a material-specific basis so people can decide at a local level whether they should be recycling glass, whether plastics is something that is appropriate for them to recycle or something they should be pulling out of their waste stream.

There is also a need to look specifically at special waste streams, such as household hazardous waste, and decide whether there is a value in collecting that material separately or whether there is some other better way to handle it, such as with latex paints. Is there a better way to handle those than to go through an expensive collection and treatment system? Medical waste was also brought out as a special area of focus.

As others pointed out, there is a lot of information that the Agency, in concert with states and others, developed back in the 1970s that still could be of value. We ought to be looking at dusting some of this information off and recycling that back into the system to try to help local waste managers.

There is a need to focus on siting and get information out to state and local government officials about what works and what does not work, and to look at incentives to try to ease the siting burden. There was also a discussion on fee systems and user fees, and ways to get people to have a more personalized ownership of the problem that they are creating as they produce waste, and how better to get that cost back to the waste generator.

We talked about planning and the need to provide state and local governments with better characterization techniques so that they can determine what they are going to be dealing with and know how changes in the waste stream, such as those caused by pulling out a particular component for recycling, might affect other parts of their system. The EPA should be providing information; it should be a source of information, providing accessibility to and facilitating the exchange of information.

The last point I would make would be about capacity planning. We talked about the need to look, not just at the MSW stream, but also at the huge nonhazardous waste, industrial waste stream from a couple of perspectives: one being economic development and the desirability of a community to want to continue to serve their businesses and industry and to be able to accommodate that waste stream, and the other to plan for capacity and the possibility that some of those wastes might be diverted into the municipal landfills.

6. GENERAL DISCUSSION

Question:

We really did not hear in the proposed research agenda a great deal of emphasis on understanding the biochemistry of landfills in terms of better management, i.e., whether gas production can be beneficial, whether enhanced degradation is desired to minimize leachate production, etc.

I know from reviewing degradation studies that there is an apparent movement in this country to really understand the chemistry of landfills. In addition, we are having a continuous discussion with members of industry regarding household hazardous waste. We need to know, what happens when you put these into a landfill? How do these contribute to constituents found in the leachate?

Response:

In other words, is it important to know from a landfilling perspective, in terms of the adequacy or inadequacy of landfills, where the various pollutants come from?

I think that the use of a landfill as a bioreactor is an all-inclusive type of program in that we would be investigating the kinetics, the degradation process, the end-products from those processes, along with a variety of things under that whole area. For example, we would look at the addition of sewage sludge to enhance biological activities or use chemicals as the solvent in the recirculation area to maximize the leachability for the removal of certain pollutants, and then fix those pollutants in another manner.

Comment:

The point was not clear. I assume what you are talking about is looking at different strategies for using the bioreactor concept. You can take one concept of maximizing bioreactivity so that over the period of time when you have a leachate collection and control system, you are getting rid of almost all of the bad actors.

If one takes the opposite approach, which is to minimize the bioreactivity, then while you are looking at the landfill for the next 100 years, there is no problem. However, later on, in 150 years, bioreactivity builds up and there are potential problems that you cannot readily solve. I think there is an analogy between that and acid mine drainage. There are a lot of old coal mines out there, and they still cannot fix the acid mine drainage problem because the biological activity is below the ground.

Therefore, it might be better to maximize biological activity over a short period of time, get rid of most of the bad actors, and then have a relatively lower reactivity rate over the long haul, rather than trying to suppress the activity initially and then have it build up later. I do not know if you are doing research to look at those.

Hundred-year-old landfills are still there. The materials are still there and very discernible; they are not degrading because they were put in a mummified sort of situation. When the integrity of the controlled system is breached, then we have another problem, and that is what a lot of Superfund sites are about. We do not want to do that. We want to make sure that whatever we do in using the landfill as a bioreactor is an end system. In fact, we would like to reach the point where we can complete the cycle in 10 years, and after 10 years, the liner just disintegrates. We would not have to worry about a cover system that will last forever. We could just let the leachate loose through the ground and not worry about polluting the groundwater.

That is the kind of concept that is in the back of our minds.

Response:

Just to reinforce this, let me state that one situation is a closure that is perpetuity. Let us assume, however, that the closure integrity lasts a finite period and it is 30 years. I think there is an overrunning consideration that perhaps it would be prudent to remove potential contaminants in the time frame where we have a responsible party, and get the landfill to a form that is not only biologically stable, but is also reasonably safe from the standpoint of future contamination.

If there is a liner system that will work in the 30- to 50-year time frame, let us make use of that and also the opportunity where those pollutants can be purged, treated, and removed, so that future generations do not have to be the ultimate recipients of these.

So the consideration here was not only on the bioreactivity, but also the structural stability and the gas migration.

Comment:

It seems to me that most everybody is putting everything in plastic bags these days, wrapping it up and throwing it away. That is what ends up going into the landfill. Is it practical to think of using the modern-day landfill as a bioreactor, when everybody has their own little encapsulated goodies? There is a strong interest in bioreactors, and that is why it was listed as a research area. Recent studies show that excavated waste 9 years old still contained chicken with meat on the chicken bone and carrots were orange in color. They were wrapped in plastic. Therefore, the plastic bag concept or use of plastic bags in landfill environments appears to go against the grain of using landfills as bioreactors.

There are air and water going through the site, so you can maximize bioreactivity. This means you have to get people to stop using plastic bags. An interesting research question is whether that is really desirable from other perspectives.

One additional point. At the University of Arizona they have looked at the constituents that form the waste stream. They have analyzed the pollutants in the pesticide bottle that is thrown out, and they have analyzed the pollutants that are in the waste medicine bottle, and in other things like that.

So we basically know what constituents are in there from the standpoint of liquids that are in containers, and from looking at all of those containers we know that there are hazardous wastes that are in the waste streams. Therefore, we have a handle on the characterization of the leachate or the liquids that are already inherent in the waste stream.

Question:

This is a question of clarification for the source reduction and recycling plans. There was an emphasis on hazardous constituents, but I did not hear any discussion on hazardous concentrations and the whole issue of toxicity independent of the inherent hazardousness. Is your approach basically saying that if a product contains any level of a constituent that is considered hazardous, then there needs to be a regulatory program directed at minimizing that, or is there an additional question that needs to be asked of the potential accessibility of that constituent in the commercial system, whether it be in the waste stream or whether it be in the product?

Response:

I think that there are a few forces operating. Some forces say that we should not rely on man as he designs, operates, and regulates black boxes or systems in the solid waste arena, rather that we should get toxins out instead of relying on the system to deal with them. There are people who are offended by hazardous constituents. There are also people who are now using that element as a tool, a weapon, a big stick against the siting of a recycling facility, or an incinerator, or a landfill.

This perception is certainly driving a lot of activity and action. We do not have the quantifiable data. We just do not know what the real risks or health effects are. In the absence of that data, I am afraid that public policy decisions are being made, and we are getting people's concerns, fears, or even basic attitudes on what is right and wrong for industry to do, or what burdens they are willing to bear rather than a risk-based or a health impact decision. I do not know that the data--even if you begin to collect them, I think it is probably too late--can change that momentum.

Question:

Is the recommendation coming out of the group that EPA should make an attempt at defining whether or not just the existence of the constituent is a problem in itself, or whether there is some definable standard that might allow you to accept some of the constituents?

Response:

There is a duality here, I agree. You have the forces that are saying, "Get the stuff out," and at the same time also asking for more data to quantify what the real impacts are.

Comment:

One of the groups was talking about the lead and cadmium paints on white goods, for example, and the question of whether that poses a real hazard or just a perceived hazard. Just because it is there, it is a problem.

Response:

Well, that is the same issue everywhere. It is the same issue with ash. What I think is being said is that in the absence of knowledge of whether it is a problem, the fact that a hazardous constituent is present tends to make people say, "Well, we need to err on the safe side." I am not saying that we are getting ready to regulate white goods or anything else; on the other hand, this is the kind of thing that is of concern.

Questions:

So the white good stays in the landfill where it starts to rust and then goes in the groundwater. Is that a problem?

Response:

It is going to rust, but whether or not it migrates depends on what form it is in. However, it is in the landfill.

Question:

So now do you have a hazardous waste site on your hands because it has hazardous waste in it?

Response:

I do not know. Do you?

Comment:

Solely because you took an overly conservative approach to begin with, there was no incentive for anybody to recycle. The crux of the issue is toxicity, and your whole approach to the problem of toxicity is that when in doubt, call it toxic. We are down to parts per billion of everything.

Question:

Yes. Do you think it is public opinion that forces that kind of decision in your mind set?

Response:

No. I think it is the chicken and egg thing, where you guys have started it and the public picks up, and it goes back to you guys, and it goes right back in.

Comment:

I would add that the household hazardous waste collection programs, per se, take a variety of forms, but certainly try and deal with the past. All the jawboning with industry, the education of the consumer, et cetera, is trying to deal with the future. Those are nonregulatory approaches where you try to educate the consumer to properly dispose of that material rather than pour it down the drain or put it out in the backyard.

You are trying to encourage them through education to buy alternatives or encourage the manufacturer to manufacture products without hazardous constituents. Those are not, in that respect, regulatory attempts.

Response:

Yes.

Question:

With respect to recycling, I do not think I have heard anything concerning the markets or evaluation of potential markets. What would happen in the event New York City began to recycle 25 percent of its waste? What would happen to the glass market, the paper market in the Northeast area? Some type of guidance as to how a market is going to accept this is needed.

In a similar vein, with technological improvements, could we improve the size of a market for a given kind of material, paper, for example? If we could find better ways of separating or de-inking or taking out dyes, etc., could we improve the size of a market for certain materials, like paper?

Response:

You will find discussions in the record on markets. When you go into that, you will find that this is one of the big issues. However, one of the key observations that was brought up was not to be guided or misguided by the sense that you have to have a profitable system for recycled materials or for recycling to be preferred. It might be a necessary thing to meet other community needs.

Question:

There is a point here, because our group did discuss backup methods at length. What does one do if the market fails and you are stuck with this waste?

Comment:

As a matter of fact, shear-shredding actually should be just shredding, because a shredder can be an integral piece of equipment that will enable a community to do something with paper or plastics that have failed markets for recycling. A shredder can be used for doing other things with that material, shredding it first, and then doing other things with the material. Markets are always going to rise and fall. You can develop some kind of strategy.

Question:

I have not heard any discussion whatsoever about what may be one of the major risks with solid waste, and that is bacteria and virus. We know that if MSW does not get managed, it starts spreading bacteria and virus around. Short of war, poor solid waste management is the leading cause of death since the beginning of time, if you remember the plagues in Europe. Why does nobody seem to care about the pathogens in waste and ways to reduce the movement of those pathogens into the environment? They are there.

Response:

There has been quite a bit of work done at the National Center for Resource Recovery. There was actually an ASTM subcommittee that was involved in health and safety aspects of MSW. In Ames, Iowa, quite a bit of work continued in that area, sampling in the plant and in an area around the plant. However, I do not know that they ever really identified any major problems with pathogens in the solid waste that would cause serious health problems.

Question:

Maybe it is an issue that needs to be looked at again. Do you ever want to correlate that flu that is going around with the fact that maybe the garbage did not get picked up that week on time?

Response:

We did an analysis years ago that began with pathogen or virus survival in the municipal landfill. They did not survive in the landfill leachate, and the survival time was very low. Of course, what has happened since then is that there has been an increase in disposable diapers that have come into the landfill, and we have not done any studies on that.

Comment:

That would be a fun job to work on!

Comment:

Part of the reluctance of our group to go into all of these policy or economic analyses was due to the thinking that they might fit in some other part of the Agency. So we just stayed away from market development type of research, although everyone would agree that is a necessary element in terms of what and where to recycle.

7. CONCLUDING REMARKS

John Skinner, Acting Deputy Assistant Administrator
U.S. EPA--ORD

Thank you all for your participation in this 2-day workshop. It is obvious that you have worked very hard. The list of research areas that you have put together is very impressive. It is really overwhelming just to see the length and the sophistication of the important issues that we have to deal with, and there have been a lot of good suggestions. Let me tell you what I think the next steps are. They are really the next steps for the EPA people. I have questions about each one of these, and I think we need to go back over them and ask the following types of questions about every item that is on these lists.

1. In what areas should EPA be conducting research to understand the fundamentals?

2. In what areas should we be evaluating private sector activities?

3. Where are we talking about the need for EPA to simply put together existing information on the state of the art and package it in documents that people can use?

4. In what areas should we establish standards of good practice that can be used by state agencies in overseeing and regulating activities at the state level?

5. In what areas is it appropriate for EPA to do actual development work

I would like to go back and look at all the workgroup recommendations with these points in mind and then lay out a plan that would extend over a 5- or 7-year period. I think an intensive effort and commitment are going to be necessary in order to answer some of these questions. These questions are the same questions we were asking 5 or 7 years ago. There are some new questions, but if we had conducted the research necessary to answer the previous ones, we would be farther along today. We need to lay out a research program that will extend over that period of time, resulting in both short-term and long-term outputs, and see what sort of effort we are talking about on a national basis. We need to work that through the Agency and through the Congress. I would like to invite all of you to make the same presentations that you made today to our Appropriations Committee when they consider this next year, because they are the people who are really going to have to agree to proceed in this direction. These are the next steps, and I see us coming up with a national R&D program over the course of 6 months or so. We should suggest research that needs to be done by others as well as by EPA. We should define what EPA's role will be in stimulating that research, and what research the Agency will be doing. We must bring our plan forward to the Bush Administration to make it a priority and try to get the support we need to get the research done.

8. CONCLUDING DISCUSSION

Comment:

Regarding the concept of a clearinghouse, there should be a two-way exchange of information. There is an awful lot going on out there. For example, CONEG, which is the Conference of Northeast Governors, held a workshop regarding siting methods analysis in order to try to show some of the trade-offs and how one goes about siting in a more equitable manner. I would also suggest this in order to understand some of the environmental impacts. A good example of this can be found in two completed documents: one, in the paper and paper board industry, 1982; another one, in the steel industry, again 1982. These were effluent limitation guideline documents.

There is a lot of information in those about the effluents and emissions from certain types of recycling facilities. Ordinarily, you probably would not go into that because it is not in the OSW or OEETD. You are going to find that in the Office of Water programs.

Response:

Let me just say that the Office of Water and the OAQPS, along with OSW, will be involved with this review.

Comment:

I know this meeting is not really the forum for talking about the economic aspects of these issues, but I would like to point out that our nation's entire export economy depends principally upon the economic well-being of only about 250 companies, which are only marginally competitive in the international marketplace. I hope the point I am making is taken into consideration when we talk about product modification. In other words, the effect of doing product modification work on the competitive position of the American industries must be considered.

Comment:

Even though these groups were working in different areas, there were some common themes that went through all of them. One of these was the idea of tech transfer and the need for guidance documents in various areas, particularly looking at dusting off some of the old reports that are around. There is an awful lot of information that is probably still relevant to this that needs to be looked at. The point is: Do not reinvent the wheel until you know what the wheel looks like to start with.

A couple of other common areas that I think are important include looking at the comparative risks in various technologies, so that we are solving the problem without creating another one. In addition, we have not really looked at waste characterization for a while. I thought that was an important thing. Of course, technology evaluation and sampling analysis were a couple of other common themes.

Finally, although I think we have tried to steer away from it a little bit, the issue of siting was a theme that I think carried through all of these groups. It may be tied into this idea of comparative risk.

Comment:

A point on waste characterization. I think we need better techniques that can be applied for local waste characterization.

Response:

The common thread with regard to waste characterization had to do with toxins and the fact that there are toxins in some of these wastes. I do not think we ever really looked at the aspects of lead and paint on the white goods, for example. We have sort of taken the first crack at this in terms of identifying the major sources of what we think are the major sources of lead/cadmium in the consumer products stream. We are starting to do that kind of work and are aware of the problem.

Comment:

I think you have to be careful when you talk about waste characterization because there are a number of different levels of characterization. Are you talking about characterization for recycling, or talking about waste characterization for combustion or for some other purpose? Each process has a different characteristic that you are interested in, so you have to be well aware of that sort of onion-like affair in that one process is interested in a different property than another process.

II. SUMMARY OF WORKGROUP CONCLUSIONS/RECOMMENDATIONS

SOURCE REDUCTION AND RECYCLING

Rationale

The U.S. EPA Municipal Solid Waste (MSW) Task Force recommended source reduction to be the favored option in the hierarchy of "integrated waste management." The goals of source reduction are to decrease the volume and toxicity of waste. Recycling is the preferred waste management option to further reduce potential risks to human health and the environment, divert waste from diminishing landfill and incinerator capacity, and slow the depletion of nonrenewable natural resources. Research, development, and demonstration (RD&D) are needed to develop, evaluate, and implement strategies and technologies for maximizing source separation and recycling in an integrated waste management approach. The task of this workgroup was to:

- Identify what technological barriers impede effective and efficient source reduction and recycling of MSW
- Identify research areas that address those technological barriers
- Recommend specific RD&D projects that meet MSW management needs.

Participants

Conrad Simon (facilitator)
U.S. EPA--Region II

Jim Bridge
U.S. EPA--OEETD

Marjorie J. Clarke
Inform

Dana Duxbury
Dana Duxbury and Associates

Marge Franklin
Franklin Associates, Ltd.

Erica Guttman
Rhode Island Solid Waste Management Corporation

Bruce Perlson, Ph.D.
Plastics Environmental Affairs

Gerald Powell
Resource Recycling

Darlene Snow
National Solid Waste Managers Association

Marion Sills
Environmental Defense Fund

Joseph Visalli, Ph.D.
NY State Energy Research and NJ Development Authority

Nancy Wolf
Environmental Action Coalition

Research Areas

The workgroup identified six areas requiring further RD&D. Each of these areas deals with reclamation or utilization through design, manufacturing, and disposal at various stages in the flow of materials:

1. Durability
2. Reusability
3. Remanufacturing
4. Design for Recyclability
5. Toxicity Reduction
6. Composting.

Our society is characterized by a "throwaway" lifestyle, i.e., many products are designed and purchased to be disposable following a solitary use. Other durable products are designed with limited usable lifespans and in ways that make repair unfeasible. Many products require disposal because they are not designed for reuse, recycling, or remanufacturing. Often these products contain materials that are potentially harmful to human health and/or the environment when incinerated or landfilled. In addition, the volume of these products requiring disposal places great stress on existing disposal facilities.

Disposable products comprise a large proportion of the total MSW stream. Development of products that can be reused, repaired, remanufactured, or recycled can significantly reduce the total volume of MSW requiring disposal. Following minimal treatment, reusable products may be utilized by consumers for either the same purpose for which they were originally purchased or for an alternative purpose. These include products that can be reused after simple cleaning, like resealable food and beverage containers, and diapers. Recyclable products are those that may be reprocessed, using part or all of the products' constituent materials in manufacturing the same or other products. Examples of recyclable products include paper, beverage containers, and batteries.

Durability is the quality of a product to withstand wear and tear, and decay. Products with low durability are used and discarded relatively faster than more durable products. Increasing product durability prolongs the potential usable lifespan of a product and thus the time between production and ultimate disposal. Related to durability are repairability and remanufacturability. Many products are designed so that repair or remanufacture is impracticable; e.g., sealed units, absence of replacement parts or repair and remanufacture facilities. When such products malfunction, the entire unit requires disposal.

RD&D in these areas is important to educate consumers, change market forces, and encourage industry to develop and implement economical and efficient source reduction and recycling. Incorporating reuse, recycling, repair, remanufacturing, and/or durability into product design must be economically feasible. One of the problems encountered in implementing source reduction and recycling programs is to

demonstrate that the *actual cost* of a product can be much higher than the initial outlay as a result of secondary fees like repair, replacement, downtime, and disposal costs. For market forces to favor product designs incorporating source reduction and recycling considerations, consumers need to be convinced that a larger initial outlay for a product will result in long-term economy.

Data are needed relating the cost of a product to its potential usable lifespan for a number of durable goods within various price ranges. Standards that rate goods for quality and expected lifespans, as well as studies and surveys on labelling effectiveness, need to be developed so that effective consumer education can be initiated regarding initial *apparent* costs of products relative to *actual* product costs. In addition, there is a need to develop cost-efficient technologies and explore programs that encourage manufacturers to develop more durable, repairable, and recyclable products and prevent planned obsolescence, without negatively affecting competitiveness. Institutional barriers to procuring remanufactured and recycled goods should be identified. Data are needed regarding costs of recycling and remanufacturing, including labor, energy, waste management, resource costs, and environmental impact. Toxins in the waste stream need to be identified and quantified, and use of nontoxic and biodegradable alternatives in product design and manufacturing should be explored. Finally, composting of grass and clippings should be encouraged to reduce the quantity of yard waste entering the waste stream.

Recommendations/Conclusions

The workgroup recommended that all of the following activities be initiated immediately in the area of recycling, volume reduction, and toxicity reduction.

Recycling

1. Systematically assess exposure and risks associated with all recycling operations and products.

2. Research technologies, both national and international, and disseminate information through a clearinghouse. Systems should be evaluated and prioritized.

3. Reduce the impact of paper and paper products on the waste stream.

4. Develop minimum standards for handling of regulated wastes, with incentives for reuse and recycling.

5. Research battery recycling.

6. Research use of shear-shredding.

7. Research compost feedstock in MSW processing.

8. Classify what constitutes a MSW problem. Prioritize health and environmental standards vis-a-vis problems.

9. Research amount of waste reduction necessary to achieve MSW collection cost/savings.

10. Conduct field studies of generation and composition of waste streams.

Volume Reduction

1. Guidance documents should be prepared on design protocols and waste reduction opportunity assessment.

2. A study is needed on biodegradation and photodegradation of materials in MSW and environmental impacts of MSW options.

3. A study is needed on ways to increase durability, repairability, reusability, and remanufacturability.

4. A comparative analysis should be undertaken of durable versus throw-away cost, lifetime cost, and environmental cost.

Toxicity Reduction

1. A study of hazardous constituents in MSW including environmental effects, composition, emissions, ash, and leachate.

2. To encourage the development of products without hazardous constituents:

   a. Document and publicize accomplishments
   b. Sponsor more meetings, workshops, and conferences
   c. Develop an information clearinghouse.

3. A comparative analysis of nonhazardous constituents is needed.

4. Labeling of domestic and imported products to include hazardous constituents, durability/lifetime, and disposal information.

Addendum

Erica Guttman made the following proposal on source reduction issues. The questions and discussion points are divided into six sections:

I. Durability

II. Reusability

III. Remanufacturing

IV. Design and Recyclability

V. Toxicity Reduction

IV. Composting.

I. Durability

A. Data are needed on ratio of cost of product to lifetime of product for a number of types of durable goods within various price ranges.

B. Can we develop standards for "rating" durable goods for quality/expected lifetimes?

C. How can we encourage the development of products that are more readily repairable? Can we work with manufacturers to prevent planned obsolescence? (Imports need attention too.)

D. Study/survey labelling effectiveness; can we (how can we) convince consumers to spend more on a product today so that they will spend less tomorrow?

II. Reusability

A. Quantify disposables.

B. Gather data on *full* costs (including water, waste management, energy, resource depletion, environmental "heirloom," etc.) of disposables versus reusables for common types of products (e.g., diapers, dishes, linens).

C. Identify possible institutional barriers.

III. Remanufacturing

A. Gather reliable data on lifetimes of remanufactured products to costs of labor, energy, resources, etc. (How much do we save by remanufacturing versus producing/procuring "new"?)

B. Examine institutional barriers to procuring more remanufactured goods.

IV. Design for Recyclability

A. Costs/benefits of complex, multimaterial packaging.

B. Processing technologies to recycle complex packaging

1. Cost-effective collection and processing
2. Markets?

C. Redesign coated cardboard (chipboard) packaging to be more readily recyclable/commonly recycled.

D. Biodegradable plastics study (*Research Agenda*) should examine impact on recycling systems, technologies, end-products, as well as impact on incinerators and landfills.

E. Gather data on surveys of consumer attitudes of "recycled."

V. Toxicity Reduction

A. Quantify problem of toxics in MSW.

B. Develop nontoxic alternatives.

VI. Composting

A. Gather data to determine impact of herbicides, pesticides, and chemical fertilizers on compost/food.

Additional comments included the following:

A. The EPA papers were primarily concerned with technical research questions; however, most source reduction and recycling questions are nontechnical, "soft" issues; must also focus on research questions for innovative *planning* programs. Although this may be done in another division of EPA (e.g., OSW), it must be addressed.

B. Education is clearly a major key to successful source reduction programs. Each of the issues on the handout has education elements.

1. Durability. We have a sense that quality products will last longer, but we do not really know for which products this is true or how much longer they really last. This is one of the tougher public education issues, yet critical to successful source reduction programs. We need to be able to tell consumers how much longer a product will last and how much money will be saved.

2. Reusability. We need to know how serious the disposables problem is and where we should place our energies. This has the potential to be an easier public education message than durability, if we can show true costs.

3. Remanufacturing. Similar to reusability; probably more applicable at industrial level; corporate and agency policies that favored procurement of remanufactured goods could go a long way toward increasing reuse, but we cannot expect people to adopt such policies if we cannot provide cost/benefit data.

4. Design for Recyclability. Buying recyclables is one of the easiest public education messages. In Rhode Island, we want to be able to say: "Buy the product in the package that will go in your blue recycling box."

C. Source reduction elements can be applied to different problems in the waste stream:

1. Tires:

a. Durability (e.g., high-mileage tires)
b. Reuse/remanufacture (e.g., retreading)
c. Design for recyclability (if unable to retread)

2. White goods/brown goods:

   a. Durability (long life, easily repaired)
   b. Remanufacture
   c. Recyclability (easy to segregate materials)
   d. Toxicity reduction (capacitors or metals)

Marge Franklin made the following suggestions for a source reduction research agenda. The suggestions are divided into two sections:

I. Reduction of Toxicity
II. Reduction of Volume.

I. Reduction of Toxicity

A. Identify toxic constituents in products in MSW. (Considerable research has already been done on lead, cadmium, and household hazardous wastes. Consistent data base on laboratory analyses is lacking.)

B. Determine the actual effects of heavy metals and other toxic constituents on MSW management alternatives--recycling, combustion, landfill. (See research agenda in other areas.)

C. Focus on materials/products identified as most potentially harmful in (A) and (B), and investigate methods of source reduction.

   1. Investigate substitutes for harmful constituents.

   2. Compile and evaluate experience in existing state and local programs, and other countries. (Unfortunately, there is little long-term experience in the United States)

   3. Compile and evaluate existing educational programs to reach two distinct groups:

      a. Industry
      b. Consumers.

   4. Evaluate Federal role in reduction of toxicity. Choices range between two extremes--from outright ban of toxic constituents to education and "jawboning."

II. Reduction of Volume

A. Investigate economic and social trends that lead to increases (and decreases) in generation of MSW. (Economic incentives for industries to decrease materials use; new products, e.g., facsimile machines that use more materials; demographics that influence use of throwaway products and packaging; and effect of economic growth and recessions, etc.)

B. Investigate the pros and cons of degradability of plastics and other materials, such as litter, in the water, recycled, incinerated, landfilled.

C. Repeat items (2) and (3) above.

D. Evaluate Federal role in volume reduction.

Joe Visalli, Program Manager of NY State Energy Research and NJ Development Authority, made the following points during his presentation.

I. New York State Energy Research and Development Authority (NYSERDA)

A. Public benefit corporation of New York State

B. RD&D of alternative energy concepts

C. Nonrecourse bonding program

D. Low-level radioactive waste management

E. Facilities management--West Valley, Saratoga

F. Funded from utilities assessment, fees from nonrecourse bond sales, royalties from R&D projects, fees from waste generators, rents, and site management funds.

II. Municipal Wastes

A. Solid wastes

1. Existing and planned incinerators
2. Combustion quality and air pollution control
3. Recycling and waste reduction
4. Ash management
5. Landfill management
6. Advanced systems.

B. Sewage treatment

1. Existing facilities
2. Anaerobic pretreatment
3. New systems.

C. Sludge management

1. Basic anaerobic microbiology
2. Integrate biological and engineering requirements
3. Incineration and heat recovery
4. Composting
5. Ultimate disposal.

III. MSW Program Basis

A. Produce and/or conserve energy

B. Environmental impacts--all alternatives

C. Landfills necessary but minimize use

D. Site-specific needs--difficult to generalize

E. Integrate technological alternatives and provide for backup approaches

F. Need for improved process efficiency and reliability

G. Need for improved product quality and increased acceptance

H. Large capital investment/complex technologies--need for training.

IV. NYSERDA Program Plan Objectives--Recycling

A. Evaluate collection and preprocessing methods for recovery efficiency and ability to meet market specifications

B. Develop and demonstrate innovative processes to produce new or improved products, or to improve recovery yields

C. Develop and demonstrate interim backup methods for collected wastes that cannot be marketed

D. Test emissions, effluents, and solid residues from recycling systems and evaluate "remaining wastes"

E. Evaluate sociological/psychological factors affecting household participation rates, and evaluate the effectiveness of public information programs

F. Evaluate consumer product composition for hazardous constituents.

V. NYSERDA R&D Recycling Projects

A. Broome County recycling demonstration

1. Newspaper and glass
2. Baling and color sorting/crushing
3. Three collection methods
4. Operational cost estimates
5. Air emissions/residue testing.

B. Pilot-scale intensive recycling and composting in the town of East Hampton

1. Household source separation
2. Mixed paper, glass, cans, food/yard wastes composted with sludge
3. Metals, organics, bacterial air emissions testing for metals and pesticides.

C. Co-composting and sod production

1. Yard waste composting with sewage sludge using windrows
2. Determine best operational control parameters/mixes
3. Identification of product quality/market relationship.

D. Assessment of residential participation behavior in recycling programs

1. Assess demographics, sociological and psychological factors, educational methods of importance in two to three communities.

E. Yard waste management technology transfer program

1. Set up central core of expertise at Cornell ("SWAT team")
2. Develop various management scenarios and equipment/economics interactive computer model for use by county agents and local governments
3. Develop training films and educational handouts/work forms
4. Hold a statewide conference for training county agents
5. Set up local training programs in all counties
6. Feedback - economics from local governments/county agents to Cornell model for updating
7. Evaluate effectiveness of overall program.

F. Composting of solid wastes and sewage sludge

1. Waste paper, yard waste, sawdust, and wood ash composting with sewage sludge
2. Windrows and in-vessel composting
3. Air emissions, leachate, and product testing.

G. Recycling of individual polymers from mixed plastics wastes

1. Lab science testing of five different polymer mixtures
2. Two or three different solvents/temperature regimes
3. Testing of physical properties of recovered polymers and comparison to virgin polymers
4. Optical testing for purity
5. Sludge quantification.

H. Multimaterial recycling and production of animal bedding from mixed waste paper

1. Produce animal bedding (mixed paper, glass, cans, yard waste).
2. Compost used bedding
3. Evaluate collection method and use of drop-off containers
4. Quantify costs and revenues of Potsdam and surrounding communities
5. Test air emissions, bedding, and compost quality.

Jerry Powell, editor of Resource Recovery Magazine, developed a list of research needs following discussions with readers of the magazine. The list was submitted to Conrad Simon (the workgroup facilitator) on October 13, 1988. The list is divided into three sections:

I. Material-Specific Research

II. Recycling Facility Research

III. Recycling Economics Research.

I. Material-Specific Research

A. Special wastes

1. Tires
   a. Evaluate various tire processing technologies, such as pyrolysis.
   b. Assess the air pollution issues involved in tire-derived and whole-tire fuel use.
   c. Attain a better understanding of rubber-asphalt use.

2. Plastics
   a. Research the separation of polyolefins from mixed plastics.
   b. Assess opportunities for on-route densification of residential plastics.
   c. Develop specifications for mixed thermoplastic products.
   d. Describe methods of sorting plastic containers by resin type.

3. Yard wastes
   a. Assess specifications for yard waste compost products.
   b. Perform research into yard waste compost contamination from fertilizers and pesticides.
   c. Research techniques for on-site yard waste composting.

B. Bulk materials

1. Waste paper
   a. Research animal bedding production (costs, uses, specifications).
   b. Assess the potential for using magazines in the production of de-inked newsprint.

2. Glass containers
   a. Analyze the experience in using glass in asphalt (glassphalt).
   b. Evaluate mechanical and optical sorting of containers by color.

3. Metals
   a. Assess manual methods for removing PCB-contaminated capacitors from scrap white goods.
   b. Research the environmental aspects of ferrous scrap-shredder fluff handling and disposal.

II. Recycling Facility Research

A. Describe the environmental impact of various recycling processing technologies.

B. Research the effectiveness of proposed mixed waste processing systems, such as Orfa, Sorain-Cecchini, Reuter, etc.

III. Recycling Economics Research

A. Evaluate the recycling and waste reduction effects of waste collection rate schemes per container.

B. Estimate the amount of waste recovery needed to attain waste collection cost savings.

C. Evaluate the quality of selected products made from waste materials.

MUNICIPAL WASTE COMBUSTION

Rationale

Incineration technology has developed new and more efficient methods of burning solid wastes as suitable sanitary landfill space has become less available and more expensive. This includes technology for both single-purpose incineration and co-generation plants. However, mounting concern for possible health and environmental risks associated with municipal waste combustion (MWC) residuals management and stack emissions has resulted in apprehension for siting incineration facilities.

This workgroup was tasked with identifying technical approaches and RD&D priorities for emissions control and combustion process modifications related to products of incomplete combustion, products of combustion, and monitoring associated with incineration technology.

Participants

James Kilgroe (Facilitator)
EPA--OEETD

Theodore Brna
EPA--AEERL

James Crowder
EPA--OAQPS

David DeMarini
EPA--ORD/HERL

Larry Fradkin
EPA--ECAO

Holly Hattemer-Frey
Oak Ridge National Laboratory

David Linz
Gas Research Institute

Jack Lyman
IRR

Al Ruben
EPA--OW/OWRS

Walt Shaub
CORRE/U.S. Conf. of Mayors

David Sussman
Odgen Projects, Inc.

Curtis Travis
Oak Ridge National Laboratory

Research Areas

The workgroup identified three major areas where RD&D is needed to improve the acceptability of incineration technologies:

1. Risk assessment analyses

2. Understanding the effects of the waste stream on incinerator performance

3. Understanding and controlling regulatory effects on MWC processes and technologies.

Risk assessments are conducted to evaluate the potential risk of proposed actions on human health and the environment. These assessments take the form of system models that estimate emissions of hazardous substances from proposed facilities. They utilize characteristics of the proposed facility along with data gathered from similar, already existing facilities. These estimates are then used in additional models to estimate the potential health risks to different demographic groups at various distances from the site.

The working group identified the following six aspects of risk assessment where EPA should focus RD&D efforts:

1. Standard methods for conducting risk assessments

2. Health effects subcomponents of risk assessments

3. Comparative analyses

4. Effects of direct and indirect exposures

5. Emission source monitoring and deposition data

6. Changes in the waste stream and their effect on incineration.

Standard methods for conducting risk assessments are lacking. Currently, each proponent of a facility can select from numerous risk assessment methods, many of which are either poorly validated or are untested modifications of more widely used methods. The results of these assessments are not necessarily comparable. To determine comparability often involves major effort on the part of regulatory personnel. Methods can be selected to favor or disfavor a proposed action, depending on the objectives of the analyst. The solution to this problem could be to standardize risk assessment methods for routine evaluations of incinerator applications. These standard methods should include specified protocols, data sets for use in rate functions, and assumptions for use in the assessment. Subcomponents of the methods should include probabilistic components and uncertainty analyses when inadequate data are available or when data indicate that large variances could exist.

Existing risk assessment model subcomponents that deal with health effects often rely upon insufficient data for meaningful evaluations. Available data for specific exposure pathways and all reasonable pathways of exposure are insufficient. In general, emission data from incinerators tend to be the highest quality data, followed by transport and fate data. However, data about bioaccumulation in food chains related to emissions are almost nonexistent. Standard data sets with known error estimates are needed for use in many of the health effects subcomponents. For example, a data set of the ingestion rates for human populations of varying demographic composition would be very useful in all risk assessments related to incinerators. Similar data sets are needed for biological accumulation processes.

Risk assessments should include comparative analysis of the risks associated with alternatives to incineration, as well as alternative incineration technologies and locations. For example, risk assessment alternatives should include assessments of recycling and waste reduction efforts. Disposal methods and waste reduction approaches and evaluation of the risks associated with everyday activities and con-

ditions should be considered in addition to comparing the risks associated with alternative incineration technologies, i.e., analyses of risks associated with cigarette smoking, heating with wood stoves, and diesel exhaust emissions would be useful as public education devices to compare with estimated risks from incinerators.

Additional data are needed regarding the effects of direct and indirect exposure to incinerator emissions. These data should include the toxicity results of exposure tests using single compound exposures as well as mixtures of whole emissions gases. Indirect exposure data are needed in addition to data sets about fate, transport, and bioaccumulation processes. Prioritized rankings of the hazards associated with compounds would be very useful.

Monitoring efforts at emissions sources should be expanded to provide data for risk assessments. Data are needed for organics, trace elements, fugitive dusts, and mixtures of compounds in stack emissions and at receptor sites. In addition, deposition rates on various surfaces, e.g., forest soils, pastures, and open water at various distances from sources would help refine risk assessment models and improve their reliability.

Waste minimization, recycling, and product substitutions will affect the volume and characteristics of the waste stream to municipal waste incinerators in coming years. However, few data are available that indicate the sensitivity of incineration processes to changes in the chemical and physical nature of the waste stream. There is an extreme need for data in this area. Data should be collected as soon as possible, *before* expected policy requires mandated changes in the waste stream. Questions that cannot be answered, given current data, include:

- Should EPA policies minimize the presence of some trace elements in the waste stream based upon environmental risk?

- What concentrations of various materials, such as tires, can be tolerated in the waste stream without adversely affecting emissions?

- What effects do increases and reductions of biomedical waste in the waste stream have on emissions and ash characteristics?

Although many different incineration technologies exist or can be developed, all share the characteristic of burning a fuel to heat and incinerate the waste stream. The best measure of good combustion design and incineration effectiveness is the heat release rate per cubic foot of fuel and waste mixture. The heat content of common fuels is readily established. An ideal incinerator would allow complete release of the heat content of the fuel. However, actual incineration technologies allow varying degrees of heat release from fuels. These varying release rates are measures of the efficiency of the incineration technology. This concept also applies to incinerators that use MSW as fuel. Since the heat release rate of varying MSW streams is not well known, it is difficult to design a reliable and efficient incinerator. As a result, MSW incinerators have utilized various control technologies, such as flue gas cleaning, to ensure reduced emissions resulting from incomplete combustion. Changing technologies in incinerators may make such controls obsolete by achieving the desired emissions during combustion.

Regulatory approaches address the use of specific best management practices (BMPs). These BMPs are often thought of as mandated technologies for achieving specified levels of control. Although desirable as a means of showing levels of achievable control, the use of BMPs to guide design development can tend to suppress innovation and improvements in combustion processes. Currently, incinerator design uses concepts and equipment that were approved earlier by regulatory bodies. Responsibility for performance of these designs resides with the operator of the incinerator. The workgroup felt that EPA should either be willing to accept direct responsibility for the operational performance characteristics of incinerators designed according to BMP guidelines, or should provide "performance-based" standards that allow for innovation on the part of operators and require the operators to assume responsibility for the performance of their incinerators. Implicit in the use of performance standards is the need for an integrated program of RD&D that addresses concept, bench, pilot, and operational scale efforts, and an adequate testing and evaluation program for proposed incinerator designs. This should apply both to new designs and to retrofitting existing facilities with upgraded incineration or flue gas cleaning equipment.

Additional efforts in monitoring and control of "new" pollutants, such as mercury and oxides of nitrogen, should be pursued. Concern regarding these pollutants relates to indirect exposure through biomagnification of heavy metals in food chain organisms, and to the potential ecological effects of oxides of nitrogen in the atmosphere and in precipitation. The National Science Foundation (NSF) recently recommended that research should be conducted to determine the fate of metals in flue gases, including both metal oxides and metal halides. The workgroup recommended that NSF scientists be contacted to assist in developing a strategy for basic research and cooperation in this area.

Monitoring costs at incinerators can be extremely high, and additional RD&D efforts are needed to achieve two specific objectives: 1) to reduce the cost of Continuous Emissions Monitoring (CEM), and 2) to increase the effectiveness of monitoring efforts. Both of these objectives can be achieved by use of limited numbers of monitors that are carefully selected and well located in the incinerator and stacks. For example, two excellent measures of efficiency that can be well correlated to emissions are the temperature of the control devices and the rate of particulate emissions. Use of continuous monitors for these measurements, coupled with a measurement or a surrogate of opacity, should provide adequate monitoring at most facilities. A surrogate for opacity that uses low-cost, reliable measurements would help to lower the total cost of CEM.

The list of pollutants subject to CEM requirements should be trimmed to only those of known biological or ecological significance, plus those that may be reasonably expected to participate in adverse atmospheric transformation processes. When optimum combustion and control systems performance can be ensured through monitoring, permit specifications should allow reduction in emissions monitoring to the extent that it can be demonstrated that hazardous or environmentally unacceptable compounds cannot be formed in the existing combustion process or cannot exceed specified levels in the emission. The use of alternate control and monitoring approaches that achieve the desired results should be acceptable to EPA. RD&D efforts should be increased in the areas that expand the number of acceptable choices for both combustion and monitoring/control technologies.

Recommendations/Conclusions

Items of high priority were identified throughout the session. The consensus of the workgroup was that primary importance should be given to the following items:

- o CEM should be increased and focused toward filling data requirements of risk assessment models.
- o The cost of implementing CEM at incinerators should be reduced by focusing efforts on the biologically active components of emissions.
- o An EPA-approved risk assessment method or set of methods should be established.
- o An ambient monitoring program should be established that is based on bioassays of full suites of compounds associated with emissions from incinerators.
- o Sensitivity analyses of MWC processes should be conducted on emissions and ash characteristics to evaluate the effects of changes in the waste stream. These analyses should utilize monitoring efforts at operating facilities at which it is possible to control the quality of the waste stream.
- o Research is needed to determine whether biomedical wastes can be successfully incinerated in municipal waste combustors, and if so, under what conditions.
- o An assessment should be conducted to estimate the health risks associated with mercury emissions at present levels and the efficacy of existing technology for mercury control to determine the need for developing new mercury control technologies.
- o More effort should be directed to demonstrating additional approaches to CEM and to lowering the cost of CEM.

The following recommendations were suggested to further the RD&D efforts of EPA:

- o Improve coordination between EPA and other Federal agencies, including NSF, to better focus research efforts on applicable topics.
- o Better coordination and relationships between EPA headquarters and the Regional Offices to increase technology transfer, uniformity in the application of standards, and stimulation of RD&D activities.
- o Standards for incinerators should be evaluated and possibly rewritten to assure that they relate to performance of facilities, as opposed to design. Whenever required, the words "or equivalent" should be applied to design specifications to ensure that desired levels of performance are achieved and that incinerator designs are not unduly constrained.

MUNICIPAL WASTE COMBUSTION RESIDUALS MANAGEMENT

Rationale

Incineration of MSW may reduce the volume of waste requiring landfill by 90 percent. However, proper management of combustion residuals is necessary to minimize potential hazard to human health and the environment. The presence of heavy metals and some organics in MWC ash has increased concern that these materials may leach from ash that is landfilled and migrate into ground and surface water supplies. This workgroup was tasked with identifying the technical and social problems hindering implementation of residuals management options and possible RD&D solutions to these problems. The group agreed that the overall objective for RD&D efforts is to provide technically correct information for use in implementation of community ash management.

Participants

Carlton Wiles (facilitator)
EPA--OEETD

Warren Chesner
Chesner Engineers

Phil Cook
EPA/ERL Duluth

Ken Cundari
Malcolm Pirnie & Co.

Dr. Taylor Eighmy
DCE--University of New Hampshire

Mike Flynn
EPA--MSWP

Keith Forrester
Wheelabrator Environmental Systems, Inc.

Hector Mendieta
ASTSWMO--Texas DOH

Dr. Frank Roethel
MSRC--State University of N.Y.

Sheree Stewart
HDR, Inc.

Bob Van Deman
Florida--DSWM

Research Areas

The workgroup identified eight areas where RD&D efforts are needed to facilitate better residuals management in communities. Discussions centered on both combined ash (fly plus bottom ash) and discrete ash sources due to the different possible management approaches necessary because of differences in the chemical and physical properties of fly and bottom ash. The eight research focus areas are as follows:

1. Sampling protocols and analytical (chemical and physical) methods
2. Handling of ash
3. Toxicity, bioavailability, leachability

4. Landfilling

5. Treatment and reuse

6. Technology and information transfer (both technical and management information)

7. Sociopolitical aspects of reuse acceptability

8. Formulation and dissemination of interim guidelines/recommendations by the Agency.

Discussion of ash management stressed the importance of identifying the objectives of monitoring efforts, i.e., the differences between the goals of research, engineering, and regulatory/enforcement programs may require different monitoring strategies. Existing data bases in many areas are inadequate as a result of the lack of goal-oriented monitoring strategies and application of diverse methods in analysis and sampling. The ability to model performance of disposal and reuse strategies depends on comparability of data. Therefore, effort is needed to standardize methodologies for sampling and analytical programs. There is also a need to define data quality objectives in studies so that accuracy, precision, sensitivity, and system variability can be assessed to add statistical certainty to monitoring and modeling efforts.

Development of better measurement tools to assess relative bioavailability and toxicity of hazardous materials is also needed. The relevance of extraction methods that do not reflect true solubility or bioavailability of toxins is debatable. Leach testing methods are needed that are more predictive of various engineering operation scenarios.

Of primary importance in research on handling of ash is the need for protocols that evaluate options for ash disposal or reuse. There is also a need to address the problems associated with transportation, storage, processing, and final disposal of ash. In the case of remote disposal, total management by the MSW manager is virtually impossible because of the number and remoteness of handling steps. Little if any data appear to be available to assess risks; existing data are usually contractor proprietary information. The greatest need in this area is for data to evaluate exposure and risk associated with remote disposal. These could be most useful in the development of BMPs. Research in this area should seek to assess current knowledge on BMPs and provide interim guidance.

In the areas of ash toxicity, leachability, and bioavailability, the greatest needs are for compilation and assessment of existing information. There has been some research in the areas of leachability and bioavailability in aquatics. Work in the Saugus (MA) Marsh, where ash has been disposed in a landfill adjacent to the brackish marsh for several years, has not demonstrated any measurable detrimental effects on the fauna. In addition, environmental impact versus human toxicologic effects relative to risk assessment should be differentiated. Methods and strategies for assessment, evaluation, and interpretation of bioassay data with reference to effects on human populations need to be developed. There is also a need to develop predictive models.

Of several research needs identified in the area of landfill disposal, the first was the necessity to produce performance standards for landfill construction that restrict toxic material leaching. The second was the need to develop better methodologies to minimize leachate loss from ash fills, including application of innovative technologies. This would involve documentation of incentives for community or vendor application of innovative technologies. The third need was to compile and disseminate information on potential effects of co-disposal.

In the area of ash treatment and reuse, several needs were identified, including the compilation and dissemination of BMP "success stories"; full-scale demonstration of reuse and treatment technologies; development of protocols for evaluation of demonstrations; review and acceptance of technologies by the Agency as BMPs; characterization and reduction of liabilities in reuse and treatment; development and adoption of Federal legislation to create incentives for technology utilization by state, county, and municipal authorities; development of economic incentives for reuse by MSW managers, including clearinghouses for seeking markets for reuse materials; and more effort to advance research technologies to the utilization stage. A high priority was given to developing performance criteria for reuse options technologies.

For each of these research areas, there is a need for more effective technology and information transfer. Many developments in the technology application and management approach go unnoticed because the Agency is not effective in the area of technology and information transfer. The workgroup saw clear needs in the following areas: evaluation of delivery mechanisms; creation of an EPA clearinghouse for direct information transfer; provision of fact sheets for various technologies; provision of technical evaluation information in the form of CERI-style documents; press briefings to enhance coverage in the "popular press"; and formulation of an international committee to expedite cooperation and sharing of new information.

There are sociopolitical aspects of MSW residual management that are intrinsic to each research area. In many cases, political discomfort with alternative technologies in ash disposal is caused by a paucity of empirical information on risk, cost, and liability. An effort should be made to overcome the concepts that ash is toxic pending demonstration to the contrary. There needs to be a coordinated effort in information dissemination that provides timely and complete information affording credibility to the Agency and to the technology. Persuasive information on risk comparison (re: oil versus coal versus gas) may be valuable in addressing political concerns. It is also important to implement sound technology transfer methods to avoid disproportionate negative press. Factors worth considering in this area are potential liabilities; conflicting regulations resolution; impedimentary regulations relief; enhancing the Agency's capability to provide information and willingness to invoke supremacy over state authority; and the current lack of consistency in these policies at the Agency.

Finally, the panel discussed the need for EPA leadership in providing interim guidelines for BMPs. This would go far in convincing the public that the Agency is serious about the application of appropriate technologies and is willing to assist interested parties in compliance with innovative approaches. Approaches to guideline formulation may include high-priority testing of technologies on expedited time scales; development of surrogate test methods for toxicant measurement; implementation of screening tests and surveys; and acceptance of interim measurements for rapid data base development.

Recommendations/Conclusions

The workgroup felt that the highest priority item was the formulation and promulgation of interim guidelines for BMPs. However, with the knowledge that this and many of the other tasks are interconnected, the panel felt that the remaining seven research areas were equally deserving of major effort. Work on these action items should be directed as tasks through OEETD, with the active participation of interested parties in industry and state, local, and Federal governments.

LAND DISPOSAL

Rationale

Historically, the responsibility for managing MSW has fallen under the jurisdiction of local and county governments. During the past 20 years, landfills have evolved from large open pits where wastes were periodically burned to reduce their volume, to today's modern sanitary landfills where wastes are covered by a layer of soil at the end of the workday. Many of these modern landfills incorporate subsurface leachate collection systems, the use of artificial and natural liners, and systems to recover generated gas as an alternative energy source. These technological advances were implemented as a result of regulations by state and local governments to improve the operating systems of landfills in an effort to control the migration of gases and leachate.

Operating deficiencies of the older landfills have led to a lack of public confidence in landfills as a waste management technique and serious siting problems for new facilities. As a result of this and an increase in the quantity of waste generated, landfill capacity is rapidly declining. Over one-third of currently operating landfills will reach saturation capacity and close within the next 5 years.

Concern over rising disposal costs, limited and uncertain disposal facilities and siting problems, and changing regulations and legislation has led the Federal government to reevaluate MSW practices and identify new, innovative technologies for the management of MSW. This workgroup on land disposal was convened to develop specific RD&D needs for a national research agenda by soliciting comments from industry, trade organizations, academia, and government. The goal of this workgroup was to identify and prioritize specific research that addressed environmental and health concerns and other impediments to expanding land disposal capacities.

Participants

Robert Landreth (facilitator)
EPA--OEETD/RREL

Kurt Fisher
Center for Environmental Management
Tufts University

Roy Herndon
Center for Biomedical and Toxicological Research and Hazardous Waste Management

Vic Lambou
EPA--OADEMQA

James McNab
EPA--ORD

Hal Monague
EPA--Region III

Ky Ostergaard
Technical Resources, Inc.

Ronald Poland
Waste Management of North America

Norbert Schomaker
EPA--OEETD

N.C. Vasuki
Delaware Solid Waste Authority

Research Areas

Those areas where the workgroup felt research was needed immediately were programmatic areas that would affect the siting, design, operational monitoring, construction, and closure and postclosure process of municipal landfills. Identified research needs included a better understanding of wastes and waste streams, more case studies of landfills, long-term performance assessment of liners and leachate recovery systems, technology transfer, and research into monitoring requirements. Some concern was expressed regarding the hierarchy of "integrated waste management" recommended in the "Agenda for Action," prepared by the U.S. EPA--OSW. One member of the workgroup felt that future MSW disposal requirements would make land disposal the preferred method for waste management, and not the last consideration in the hierarchy.

Research into these areas is mandatory if the technology of solid waste disposal is to keep pace with increasing demand. There is a need to demonstrate to the public that land disposal is safe, reliable, and a long-term solution for MSW management. Public confidence that human health and the environment are not adversely affected by landfills is required if more state-of-the-science landfills are to be constructed to meet the needs of municipalities. Technology to improve operating efficiencies and monitoring programs will result in significant cost savings for local governments managing land disposal facilities. Increased land costs and liability, and limited land availability will drive research into looking at new alternatives to use existing disposal facilities, such as vertical expansion techniques.

Recommendations/Conclusions

The research concerns that follow were identified by topic and the time frame required for completion. It was the consensus of the workgroup that the areas identified would best be implemented by the Federal government and that effort should be made to disseminate available information to state and municipal governments as quickly as possible. Research needs were prioritized within each topic relative to their perceived need for attention.

List of Research Needs

Siting

Urgent priority (U)/Short Term 1-3 years (ST)	Waste characteristics
U/ST	Characteristics of site
High priority (H)/ST	Vertical expansion
Medium priority (M)/ST	Monitoring (baseline data)
M/ST	Odors

Design	
U/Short and Long Term (SLT)	Extended performance of clay and FML (liners)
U/ST	Leachate recovery systems (LCRS)
U/SLT	Monitoring
H/ST	Run-off control
H/ST	Gas recovery
Operational Monitoring	
U/ST	Daily covers and alternatives
U/Long Term 3-5 years (LT)	Rapid stabilization of wastes (bioreactors)
U/SLT	Improved monitoring (cost effective)
H/ST	Leachate reduction
H/SLT	LCRS
H/ST	Run-off control
H/ST	Addition of sewage sludge to system
H/ST	Gas emission/recovery
M/ST	Odors
Candidate for MITE Program (MITE)	Leachate evaporation with landfill gas
Construction	
U/ST	Better define QA/QC procedures

Closure/Postclosure

U/ST	Old versus new site requirements
U/ST	Time of closure
H/ST	Corrective action
M/ST	Odors

Miscellaneous Research Needs

U/SLT	Case studies
U/ST	Characterization of waste
U/SLT	Technology and information transfer (expert systems)
U/SLT	Exposure/Risk assessment
U/ST	Ash, sewage sludge, hospital, and pathological waste (co-disposal issues)
H/ST	National standard for composting (methodology)
M/ST	Source separation/pre-processing/pretreatment (MITE)
M/ST	Landfill mining (composting, liner replacement)

MUNICIPAL PLANNING AND WASTE MANAGEMENT

Rationale

Although a national concern, management of MSW is largely the responsibility of local government. Local and regional MSW managers are the "end-users" of MSW technology. Proper planning based on sound data is an essential element of the integrated waste management approach. The problems, needs, concerns, and resources of individual regions and communities must be incorporated into management strategy. There are several factors that need to be considered when deciding among alternative MSW programs, including:

- Composition and volume of the waste stream
- Existing and planned disposal and recycling facilities
- Availability of natural resources, including land
- Local economics
- Geography and geology
- State and local laws and regulations
- Public opinion.

Empirical data on which planning decisions can be made must be available for use by local and regional MSW managers. Further, managers need to know how and where such data can be acquired, and how to best make use of these data in the MSW planning process. The goal of this workgroup was to assess the state of the art of MSW management and to report on the status and needs of MSW managers. In doing so, the workgroup was to identify areas that MSW managers feel require more data for effective MSW planning, and to suggest how further RD&D could be used to fill these data gaps as well as assist in the planning process itself.

Participants

Truett DeGeare (facilitator)
EPA--OSW

Richard F. Anderson
Wheelabrator Environmental Systems, Inc.

David L. Eger
County of Fairfax, Virginia

Haynes Goddard
EPA/University of Cincinnati

Joseph M. Greenblott
Technical Resources, Inc.

Jeremy O'Brien
Public Technologies, Inc.

Ed Skernolis
Waste Management, Inc.

Jack Stanton
EPA--ORD/Tech. Transfer Office

Edith A. Tanenbaum
Long Island Regional Planning Board

Research Areas

Regardless of sanctions, local politics is often the determining factor of MSW planning decisions. In order to overcome this situation, people must be both convinced that chosen alternatives are safe and encouraged to accept decisions through economic incentives and penalties. Information is needed that is credible to the public on both new and existing technologies. Often, the public is reluctant to believe information even when adequate data exist.

There are existing, emerging, and new MSW technologies. Proposed RD&D programs for MSW place the majority of resources into new and emerging technologies by emphasizing increased source reduction and recycling. However, there appears to be a deemphasis on existing technologies in solving MSW problems. In order to know where resources should be placed, the planning process itself must be examined. The planning process can be divided into four steps:

1. Goal Identification

2. System Analysis

3. Alternative Evaluation

4. Implementation.

Goal identification refers to the process of delineating the problems and needs for which a solution must be found. In this step, the specific problems, environmental concerns, and waste characteristics of a locality need to be addressed. However, communities need better waste characterization technology and sampling methodology to accurately assess their waste stream, including industrial nonhazardous solid waste, household hazardous waste, and institutional wastes.

A system analysis refers to determining parameters of a specific MSW technology. There seems to be little difficulty in performing system analysis. However, the ability to perform accurate and credible analyses between various MSW technologies is limited. Lack of data and methodology for performing alternative evaluation is a serious impediment to deciding from among various processes and in implementing an integrated MSW management plan. Alternative evaluation should include analysis of all steps in MSW management, including how changes in the waste stream result from treatment and handling processes, and how source reduction and recycling will affect subsequent MSW management processes. The evaluation should encompass both environmental and economic analysis of waste reduction, composting, recycling, incineration, ash management, and land disposal, and determine both the costs and benefits of individual treatments and technologies. This includes impact assessments, "cradle to grave" systems analysis, materials selection analysis, capacity planning, and collection impact analysis.

Implementation of MSW management plans is sometimes difficult even when adequate empirical data exist to support management decisions. The public is often reluctant to accept the credibility of data supplied by vendors or even local and state authorities. Guidance is needed in the areas of enforcement, compliance, and implementability of MSW management decisions. This guidance should address crisis issues, public participation models, and separate and integrated fee systems. In

addition, there is a need for analysis and development of incentives for siting MSW facilities and for assessment and guidance pertaining to the decision-making process itself.

Recommendations/Conclusions

The workgroup concluded that there is a need for a stronger leadership role on the part of the Federal government in the form of guidance to local and regional MSW planners and managers. Guidance is needed to help evaluate alternative management plans; to establish what considerations and data are important in the evaluation; and to aid planners in obtaining, analyzing, and using the acquired data in the decision-making process. The workgroup recommended that the following activities be undertaken by the U.S. EPA to provide guidance and data:

- Revise the 1970s and 1980s literature on recycling and the documents pertaining to facilities siting, including the OSW report (Centaur Report) on hazardous waste (addressing siting issues and public participation) to be applicable to MSW.

- Conduct a national review of alternative technologies from a costs, benefits, and risks perspective, including recycling, source separation, composting, waste-to-energy processes, and land disposal. The review should emphasize analyses based on specific materials and on waste stream characteristics. Analyses should also include macro- and micro-economic analysis, demonstrations, and case studies.

- Prepare a siting methods analysis, including case studies of failures and successes.

- Prepare guidance to help MSW managers evaluate alternative management plans, including what questions need to be asked and where to go for answers.

- Fill data gaps regarding MSW technologies and prepare credible analyses when necessary.

III. LIST OF PARTICIPANTS

Richard F. Anderson, Ph.D.
Environmental Affairs Manager
Wheelabrator Environmental
Systems, Inc.
55 Ferncroft Road
Danvers, MA 01923
(617) 777-2207

Jim Bridge
EPA/OEETD/RREL
26 W. Martin Luther King Drive
Cincinnati, OH 45268
FTS 684-7683

Theodore Brna, Ph.D.
EPA/AEERL (MD-65)
Research Triangle Park, NC 27711
FTS 629-2683

Carl Brunner, Ph.D.
Chief, MWWB
EPA/RREL
26 W. Martin Luther King Dr.
Cincinnati, OH 45268
(513) 684-7655

Warren Chesner, P.E.
Chesner Engineers
2171 Jericho Turnpike
Commack, NY 11525
(516) 499-1085

Marjorie J. Clarke
Program Director
Municipal Solid Waste Research
Inform
381 Park Avenue South
New York, NY 10016
(212) 689-4040

David Colbert, Esq.
Chief Counsel
Subcommittee on Transportation,
Tourism & Hazardous Waste
House Annex II
Room 324
3rd & D Streets, SW
Washington, DC 20515
(202) 225-9304

Phil Cook, Ph.D.
EPA/ERL-Duluth
6201 Congdon Boulevard
Duluth, MN 55804
(218) 720-5553

James Crowder, Ph.D.
EPA/OAQPS
MD-13
Research Triangle Park, NC 27711
FTS 629-5596

Ken Cundari
Malcolm Pirnie
2 Corporate Park Drive
Box 751
White Plains, NY 10602
(914) 694-2100

Truett DeGeare
Branch Chief
Municipal Solid Waste Program
US EPA--Office of Solid Waste
OS-301
Washington, DC 20460
(202) 382-3345

David DeMarini, Ph.D.
ORD/HERL
MD 68
Research Triangle Park, NC 27711
FTS 629-1510

Gerry Dorian
U.S. EPA-OEETD
West Tower G3C
401 M Street, SW
Washington, DC 20460
(202) 382-2583

Dana Duxbury
151 Hidden Road
Andover, MA 01810
(508) 470-3044

David Eger
Director
Fairfax County Division of Solid Waste
Fairfax, VA 22030
(703) 256-5040

Taylor Eighmy, Ph.D.
Department of Civil Engineering
University of New Hampshire
236 Kingbury Hall
Durham, NH 03824
(603) 862-2206

Kurt Fischer
Associate Director of Research
Center for Environmental Management
Curtis Hall
Tufts University
Medford, MA 02155
(617) 381-3486

Mike Flynn
Branch Chief
Municipal Solid Waste Program
U.S. EPA--Office of Solid Waste
OS 323
Washington, DC 20460
(202) 382-7920

Keith Forrester
Senior Environmental Engineer
Wheelabrator Environmental
Systems, Inc.
55 Ferncroft Road
Danvers, MA 01923
(508) 777-2207

Larry Fradkin
EPA/ECAO
26 W. Martin Luther King Drive
Cincinnati, OH 45260
FTS 684-7584

Marge Franklin
Franklin Associates, Ltd.
4121 West 83rd Street
Suite 108
Prairie Village, KS 66208
(913) 649-2225

Holly Hattemer-Frey
Oak Ridge National Laboratory
P.O. 2008
Bldg. 4500 S.
Oak Ridge, TN 37831-6109
FTS 626-2128

Hayes Goddard
EPA/RRL
Room 236
26 W. Martin Luther King Drive
Cincinnati, OH 45268
FTS 684-7685

John Greenberg
Browning-Ferris Industries
1150 Connecticut Avenue, NW
Suite 500
Washington, DC 20036
(202) 223-0659

Joseph Greenblott
Environmental Scientist
Technical Resources, Inc.
3202 Tower Oaks Boulevard
Rockville, MD 20852
(301) 231-5250

Erica Guttman
Environmental Program Planner
Rhode Island Solid Waste Management
Corporation
Waste Exchange Center
260 West Exchange Street
Providence, RI 02903

Mark Hammond
GRCDA
Solid Waste Authority of Palm Beach
County
5114 Okeechobee Boulevard
Suite 2C
West Palm Beach, FL 33417
(407) 471-5770

Roy Herndon, Ph.D.
Director
Center for Biomedical and
Toxicological Research and
Hazardous Waste Management
361 Bellamy Building
Florida State University
Tallahassee, FL 32306
(904) 644-5524

Dick Kattar
President
New England Crinc
74 Salem Road
N. Billerica, MA 01862
(508) 667-0096

James Kilgroe, Ph.D.
EPA/OEETD
AEERL (MD-65)
Research Triangle Park, NC 27711
FTS 629-2854

Vic Lambou
EPA/OADEMQA/EMSL-LV
LaPlaza
4220 S. MD Parkway
Plaza Building C
Las Vegas, NV 89119
(702) 798-2259

Robert Landreth
EPA/OEETD/RREL
26 W. Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7836

Will Laveille
EPA/OEPER
RD 682
401 M Street, SW
Washington, DC 20460
(202) 382-5990

Steve Levy
OSW/MSWP
OS-323
401 M Street, SW
Washington, DC 20460

David Linz
Gas Research Institute
8600 W. Bryn Mawr Avenue
Chicago, IL 60631
(312) 399-8198

Rod Lowman
Vice President Government Affairs
Council for Solid Waste
1275 K Street, NW
Suite 300
Washington, DC 20005

Jack Lyman
Director IRR
NSWMA
1730 Rhode Island Avenue, NW
Suite 1000
Washington, DC 20036
(202) 659-4613

Jim McNabb
Chief, EAEB
EPA/ORD/OEPER
Kerr Laboratory
P.O. Box 1198
Ada, OK 74820
FTS 7432216

Hector Mendieta
Chair, RCRA Subtitle D
Implementation Task Force ASTSWMO
Director, Division of Solid Waste
Texas Department of Health
1100 W. 49th Street
Austin, TX 78756
(512) 458-7271

James J. Nobel
Tufts University
Center for Environmental
Management
Medford, MA 02155
(617) 381-3468

Jeremy O'Brien
Public Technology, Inc.
1201 Pennsylvania Avenue, NW
Suite 704
Washington, DC 20004
(202) 626-2471

Susan O'Keefe
Municipal Solid Waste Program
US EPA-Office of Solid Waste
WH565B
Washington, DC 20460
(202) 382-4489

Ronald Poland
Director of Environmental Engineering
Waste Management of North America
3003 Butterfield Road
Oakbrook, IL 60521
(312) 572-3034

Gerald Powell
Editor
Resource Recycling
P.O. 10540
Portland, OR 97210
(503) 227-1319

Sheila Prindiville
Program Director
NSWMA
1730 Rhode Island Avenue, NW
Washington, DC 20036
(202) 659-4613

Bruce Pulson, Ph.D.
Manager
Plastics Environmental Affair
Quantum U.S.I. Division
11500 Northlake Drive
Cincinnati, OH 45249
(513) 530-6642

Frank Roethel, Ph.D.
State University of New York
MSRC SUNY
Stony Brook, NY 11794-5000
(516) 632-8732

Al Ruben
EPA/OW/OWRS
WH585
401 M Street, SW
Washington, DC 20460
(202) 475-7311

Walt Schaub, Ph.D.
CORRE/U.S. Conf. of Mayors
Suite 600
1620 I Street, NW
Washington, DC 20006
(202) 293-7330

Norbert Schomaker
EPA/OEETD/RREL
26 W. Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-779

Roland Schrecongost
Deputy Division Dir.
EPA/Region III
3HWOO
841 Chestnut Building
Philadelphia, PA 19107
FTS 597-9492

Marion Sills
Environmental Defense Fund
1616 P Street, NW
Washington, DC 20036
(202) 387-3500

Conrad Simon
Director
Air and Waste Management Division
EPA/Region II
26 Federal Plaza
New York, NY 10278
(212) 264-2301

Ed Skernolis
Director of Regulatory Affairs
Waste Management, Inc.
1155 Connecticut Avenue
Suite 800
Washington, DC 20036
(202) 467-4480

Jack Stanton
EPA/ORD/OTTRS
RD 672
Washington, DC 20460
FTS 3827669

Sheree Stewart
HDR Inc.
Suite 225
5100 West Kennedy Boulevard
Tampa, FL 33609
(813) 287-1960

David Sussman
Vice President for Environmental Affairs
Ogden Projects, Inc.
5301 Eisenhower Avenue
Alexandria, VA 22304
(703) 751-2523

Edith Tanenbaum
Long Island Regional Planning Board
H. Lee Dennison Building
Veterans Memorial Highway
Hauppauge, NY 11778
(516) 360-5195

Curtis Travis, Ph.D.
Oak Ridge National Laboratory
P.O. 2008
Bldg. 4500 S.
Oak Ridge, TN 37831-6109

Bob Van Deman, P.E.
Director of Solid Waste Management
2800-110th Avenue N
St. Petersburg, FL 33716
(813) 892-7565

N.C. Vasuki
General Manager
Delaware Solid Waste Authority
P.O. 455
Dover, DE 19903
(302) 736-5361

Joseph Visalli, Ph.D.
Program Manager
NY State Energy Research and NJ Development Authority
2 Rockefeller Plaza
Albany, NY 12223
(518) 465-6251

Carlton Wiles
EPA/OEETD/RREL
26 W. Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7795

Nancy Wolf
Environmental Action Coalition
625 Broadway
New York, NY 10012
(212) 677-1601

APPENDIX

COMMENTS TO DRAFT WORKSHOP PROCEEDINGS

TO: Norb Schomaker

FROM: Jim Bridges

RE: MSW Research Agenda Review

DATE: January 20, 1989

Attached are my comments to the MSW Research Agenda Preliminary Draft for Discussion. Most of my notes reflect the Phase I R&D portion which has the list of projects to reduce volume and toxicity of waste .

To summarize:

1. We need to include a project to go back to the earlier studies for reevaluation, especially at the curb, to determine the changes in the waste stream due to new technologies, new products on the market, lifestyle changes, and changes in costs. The old recommendations with certain cost factors may be acceptable today.
2. Some of the projects need to be expanded to include more of the "Pollution Prevention" concept. I normally see this concept shortchanged by the hazardous waste minimization folks, but also recognize it when treatment and disposal people gather to discuss research. Most of these projects focus on wastes that have been generated. For example, project "e" only mentions less toxic substitutes rather than both toxicity and volume reduction.
3. It looks like we really need an assessment manual with economic benefits for MSW much like our waste minimization opportunity assessment manual and companion economics benefits manual being developed by the Pollution Prevention Office.
4. Item "g" should include federal facilities and particularly EPA through the Regions. The old "glass house" adage applies here! Procurement practices also fits with this project.
5. In item "l" , we must include all of the foreign products and packaging when determining recycle and even process changes and product durability. Maybe we can figure a way to control import goods that generate wastes.
6. The WREAFS Program can help in item "o" through studies with the VA hospitals and technology transfer to other hospitals. Because in most cities like Cincinnati, the hospitals are located in close proximity to one another as well as clinics and doctors offices, there should be some consideration for centralized waste management practices.
7. Finally, I don't want to sound like the "L" word,but there is a need for socio-politico-economic studies to determine the barriers to good MSW management. I am aware that there are a myriad of reasons why people don't act the way we think they should. For instance, I am aware of one mainstream Church denomination that is making an issue on the "Theology of World Preservation". This include world conservation as well as world peace, and this is certainly an untapped avenue. Education and indoctrination is needed through all groups and organizations.

INFORM

381 Park Avenue South • New York, N.Y. 10016 • (212) 689-4040

of Directors

Kenneth F. Mountcastle, Jr.
Chairman of the Board

Linda Stamato
Vice Chairman

James B. Adler
Michael J. Feeley
Barbara D. Fiorito
Jane R. Fitzgibbon
Kiku Hoagland Hanes
C. Howard Hardesty, Jr.
Timothy L. Hogen
Lawrence S. Huntington
Sue W. Kelly
Martin Krasney
Jay T. Last
Charles A. Moran
n Reichman
T. Thoelen
Grant P. Thompson
Edward H. Tuck
Frank A. Weil
Anthony Wolff

Joanna D. Underwood
Executive Director

Gerry Dorian
OEETD, USEPA
RD-681
401 M St. SW
Washington, DC 20460

January 13, 1989

Dear Gerry:

I have looked over the draftProceedings of the Workshop on Municipal Solid Waste Technology and overall it is a good presentation, and I hope the final version includes what EPA's response is to all the recommendations as well as the specific funding requests to Congress for research it will make and for what, as well as the programs and regulations it proposes to initiate in-house to accomplish them. In addition, I hope the final report gets wide dissemination, particularly to municipalities and state governments where local decisions are made, and to places of research, including universities and private research institutions, as well as serious consideration, cross-fertilization, and implementation within EPA itself. In the very limited time I have had to review the document), I do have a few comments on the draft, though, and they follow:

#	page/para.	comment
1.	61	To infer that the people who push technological solutions to the solid waste problem are not also in some cases those who provide the data is rather naive, in that it ignores the contribution and salesmanship of the Jeff Hahns (Ogden), David Beachlers (Westinghouse), Jim Donnellys (JOY/NIRO), Mike Coopers (Foster Wheeler), etc....What is said in the previous paragraph is true; there must be an independent, unbiased, and knowledgeable institution (e.g. EPA, in addition to INFORM) to evaluate, sift, and present useful information and options to municipalities.
	77	As regards source reduction and recycling being the most important aspect of integrated solid waste research, we were not coming up with totally original thinking here. In the Agenda for Action and New York State law, we noted that EPA had already decided that these are the most important waste management

77 cont'd options. Also, I disagree that the source reduction group did not discuss who should do what. We did say that EPA should be the initiator, that is, the granting institution and the one which prompts what research is a priority. That also means that there would be grantees, such as universities, private laboratories/consultants, industry labs, and even EPA labs which could do the necessary research.

78 Recycling is not only a service, it is more importantly a waste mangement option, just like resource recovery, landfilling and source reduction, which should be considered alternatives which are equally eligible to receive not only municipal dollars for the disposal/management of wastes, but also federal and state dollars for research into superior technologies (in terms of technical feasibility, economics, and environmental impact). In short, there should be an equal playing field for all alternatives -- none should "have to pay for themselves" or "be left to industry to study" which is what the recycling and source reduction options, respectively, have been required to do in the past. It is the latter attitudes which have left incineration and landfilling the dominant means of waste management today.

79 I don't believe we said that medical waste is the largest problem as regards disposables, though it was recognized that medical waste does consist largely and increasingly of disposables (perhaps unnecessarily on many counts). I think it unlikely that medical waste, which is a small fraction of total solid waste, would be the major contributor to disposables in the solid waste stream.

Also, I don't believe we said that we should identify the toxic constituents in materials so as to make them NONrecyclable! I think there are two different issues here: (1) to identify toxics in the waste stream items and (2) to encourage and design consumer products to be recyclable. Regarding the latter, we also stressed the need for products to be designed so that they are easily repairable, reusable, refillable, rechargeable, etc.... -- preferably so that the consumer him/herself could purchase and install replacement parts

and not just batteries, as was described on page 82 but also all working/exhaustible parts. Bicycles, for example, are rather complex machines, but they are, nonetheless designed so that the consumer can buy a book or take a course and purchase any replacement item necessary, including the frame, and make the necessary adjustment, installation, replacement or repair. There are also many bike repair shops for people who don't want to bother. Also, there are opportunities for trading-in rather than throwing away used models, and for buying used bikes. Finally, bike stores still train people to be bike mechanics, so the continuation of this trade may continue into the future. Unfortunately, none of this is possible for most other consumer products, and this list of reusable, repairable, etc.. items is becoming shorter daily.

80 An editorial comment: Though the group did say EPA should convene more meetings with industry and environmental sectors on source reduction, the one held by EPA last summer (sponsored by Conservation Foundation) did, by our accounts, not produce anything in the way of substance regarding industry's prior or planned actions in implementing or researching source reduction. Thus, industry seems to require more incentive to move in this area. EPA could provide such incentive--be it economic, regulatory, informational, etc....

81 Regarding the training of people in schools, this extends not only to designers of consumer products as was indicated, but also the design of packaging. For instance, Pratt Institute in Brooklyn has a whole degree program in packaging. Who knows what is being taught there and whether minimization is even considered, much less encouraged, since many of the graduates undoubtedly end up on Madison Avenue designing the latest in chic (trendy=disposable, rather than classic, well-made=durable) fashions, furnishings, other products, and their packaging.

82 As regards who wants plastics to degrade if they are going to be recycled, the question should really be, why is plastic, an inherently indestructable material, being used in disposable items at all? Since one of our most important tasks is to minimize the

creation of disposable, shoddily-made, unrepairable, unrefillable, unreusable items, why not encourage that plastics not be used for such purposes at all, rather they (and preferably natural, durable, or renewable, and recyclable materials such as paper, metals, ceramics, glass) should be used for durable products. Certainly incentives could be structured to bring this about as a long-term strategy.

In addition to the necessity to examine the lifetime, environmental costs and impacts of producing throwaway items (not throwaway vs. disposable as indicated on p. 82 which is the same thing), I mentioned that it is also necessary to examine the natural resource costs of this practice. How long will the supplies of aluminum and other metals, and petroleum last if we continually plunder these finite resources for throwaway items (cans, batteries, gasoline, packaging, dinnerware, etc...) A long-term solution necessitates consideration of the hope that the human race will survive for many millenia, but that the many of the Earth's resources and even renewable resources are now being depeleted at a fast rate, and that they can only be stretched so far before they are gone or can't be renewed any more.

83/3 Though it is a good idea to assess the environmental impacts of recycling processes already developed, it is a mistake to consider that recycling of a particular item might be less desireable than, say burning or burying it if (1) the two alternatives have not been compared on an even basis -- that is, with BACT or LAER and the other best control technologies for both, and, if the recycling technology examined still seems inferior to burning or burying, (2) there is no impetus to do research to arrive at a environmentally, technically and economically superior recycling technology. Not following this procedure is another example of an uneven playing field tilted in favor of the overall less favored solid waste management strategies insofar as the EPA hierarchy is concerned.

128/2 One of the reasons that the actual cost of a product can be much higher than the initial outlay as a result of secondary fees like repair, replacement, downtime, etc... is that

the economy has moved not only to throwaways, but the repair and reuse industries have literally dried up. For whatever reason, one cannot get certain things repaired anymore even if one looks around and offers to pay a premium. Some small electronics are typically just thrown away when brought in for repair even when all that is needed is a tiny wire to be soldered or replaced. Perhaps being a repairman is not seen as a glamorous job and no one wants to do it anymore,

perhaps the reason is that there is no where to get the training to be a repairman,

perhaps the companies who make new products price replacement parts at an exorbitant price so it is not economically practical either for the customer to pay for the repair or for the repairman to keep a business going (this maximizes profit for the manufacturer of new products -- to keep sales and revenues up),

perhaps the thrift shops (Salvation Army, Goodwill, etc... have gotten finicky, greedy, etc... so they won't pick up in certain neighborhoods, or they won't take anything if it has a scratch or a stain because they don't want to fix it and don't think it can be sold as is. I have personally experienced many of these things and I suspect that all of these contribute to the overall problem, and that financial incentives by government would contribute to the solution. As long as these issues are not addressed and corrected, I don't believe that significant source reduction can occur.

Additionally, since the per capita generation of waste rises at about 1% per year (Franklin & Associates) -- this due, I'm sure, to the increasing number of disposable, shoddily-made consumer products on the market and increasing sale of these items -- any source reduction must be preceded by cessation of design of new types of disposables and reversal of the trend towards nondurability in manufacture. If this issue is not addressed, then implementation of other methods to encourage reusability will likely be an uphill struggle.

129/VR 3-4 These two suggestions need elaboration. Though the studies need to be done, they are a first step. In order for society to act in ways which allow for purchase and reuse of durable goods which have minimum environmental and natural resources costs, it is necessary

to spell out definitively how the findings of the study will be implemented. It does no one any good to have a study gathering dust which points out the ways to increase durability, etc... and the comparative assessments of durable vs. throwaway goods in terms of disposal, lifetime, and environmental costs if there is no mechanism to provide industry and commerce the incentives to use the findings and change "business as usual"or to provide disincentives for not changing.

133/II.A As regards fax machines, though it may be true that they use more or environmentally deleterious materials (paper), it is also true that their use saves packaging for sending by mail, saves handling by the post office or overnight carrier, saves costs of the same, saves gasoline, reduces the need for some trucks (postal/overnight carrier), as well as saving time. Any comparisons between alternative consumer products or technologies must, to be fair, compare all environmental, resource, economic, and technological costs and benefits.

134-7 The outline of Visalli's talk does not give the reader a good, complete picture of his presentation. Could more of the notes taken by the recorder be added so that the recommendations he may have made insofar as EPA's research programs be made more clear?

Again, thank you for the opportunity to participate in this workshop and to review and comment on the Proceedings. I will be interested to see the final product and the plans for its implementation both in terms of the research agenda, but also whether and in what form other parts of the Agency (e.g. Office of Solid Waste) will be acting on some of the recommendations. Also, I would very much appreciate being given additional time to comment on the incineration portion of the document. If this is possible, would you please let me know?

Sincerely,

Marjorie Clarke

Marjorie J. Clarke
Program Director, Solid Waste Research

FRANKLIN ASSOCIATES, LTD.

Engineering/Environmental/Management Consultants
4121 West 83rd Street, Suite 108
Prairie Village, Kansas 66208
913·649·2225

February 4, 1989

Ms. Gerry Dorian (RD-681)
Office of Environmental Engineering
and Technology Demonstration
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Gerry:

I have started to write this letter of comments on the Source Reduction and Recycling Workgroup meeting October 3 several times, but have found it a difficult area to get a focus on. Here is another try.

Source Reduction

1. I agree that source reduction should be at the top of the management hierarchy, but progress will be very difficult to measure.

2. I agree that education is the most important tool in reduting waste.

3. I agree that more research is needed into the effects of removal of certain products (or constituents) in the waste stream.

4. I disagree with some members of the Workgroup who thought that EPA should be involved in the actual redesign of products. EPA (and its consultants) are not qualified to do that. Toxic constituents could be banned, if necessary, but industry would have to be involved in finding substitute products. I do believe that focusing attention on the problems (e.g., education) stimulates industry to come up with solutions.

Labeling to identify toxic constituents of products would probably have the same effect, that is, stimulating industry to lower toxics, but that would require some investigation.

5. I agree that a Clearinghouse for information is badly needed. I hear requests for this everywhere I go.

6. The issues of photodegradation and biodegradation need a lot more thought and investigation, and not just for plastics. I believe that the Subtitle D landfill criteria will prevent many materials from degrading by keeping water out. That presumably also keeps their constituents out of the groundwater. On the other hand, it would be nice if wastes in the ocean or littered would go away. The effect on recycling is a question, too. Some organizations other than EPA are also working on this issue.

Recycling

1. The lead/cadmium report confirms that battery recycling should receive top emphasis in terms of reducing toxic constituents in MSW.

2. I agree that composting should get high priority because of the large volume of yard wastes in most parts of the country.

3. Paper recyucling is also a high priority. New/better markets are needed for some waste paper grades. For instance, animal bedding is being tried as a use for old newspapers. Also, hydromulching for roadsides (pulp made of old newspapers mixed with grass seed) could be considered as a federal procurement item.

4. A lot of good information is already becoming available on methods for collection of recyclable materials: curbside, drop-off, buy-back, etc. Technology transfer is needed.

5. The suggested field work on waste composition will be very expensive. It looks like New York City will be spending up to $1 million for theirs. Better dissemination of techniques and available data from other sampling activities would be helpful right away.

I appreciate the opportunity to be part of these discussions.

Sincerely,

Marge

Marjorie A. Franklin

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Atmospheric Research and Exposure Assessment Laboratory
Research Triangle Park, North Carolina 27711

Date: January 26, 1989

Subject: Review of the Municipal Solid Waste Research Agenda and Material for Inclusion

From: Joseph E. Knoll, Chemist
Source Methods Standardization Branch/QAD/AREAL (MD-77A)

To: Gerry Dorian
OEEDT (WH-565B)

The plan described in the MSW research agenda comes to grips with the municipal waste problem in a way that is both appropriate and timely. It divides the research needs into a number of areas which are sufficiently inclusive to encompass any activity one might propose in the municipal waste area. There is also a nice blend of practical and innovative ideas.

The enclosure contains a number of additions that deal with emissions and ash testing. These need emphasis because of the important effects stack emissions and ash have on the environment. There is also the further consideration that such testing may be required by future legislation.

Enclosure

Background

An essential element in ash disposal is its categorization. Ash that is hazardous should be handled as a hazardous material, and ash that is not hazardous should be treated in a different way and not be allowed to burden hazardous waste disposal facilities. Thus it is important to characterize ash by developing sampling protocols, developing chemical and toxicity testing protocols, and developing guidelines for separating ash into different categories, according to the results of chemical and toxicity testing.

If RCRA is reauthorized, regulations for municipal waste combustors may require testing for emissions of particulate matter (total and fine), opacity, sulfur dioxide, hydrogen chloride, oxides of nitrogen, carbon monoxide, lead, cadmium, mercury, halogenated organic compounds, dioxins, and dibenzofurans. Further, information about emissions of the following substances may also be required: volatile organic compounds, beryllium, hydrogen fluoride, antimony, aresnic, barium, chromium, cobalt, copper, nickel, selenium, zinc, polychlorinated biphenyls, chlorobenzenes, chlorophenols and polynuclear aromatic hydrocarbons. Test methods for particulate matter (but not for fine particulate), the metals, hydrogen chloride, dioxins and dibenzofurans are being validated at MWCs, but will have to be developed for the other substances cited here.

Further, as the Agency promulgates testing requirements, quality assurance materials and procedures will be needed to ensure that compliance tests are competently performed, and that continuous emission monitors (CEMs) are calibrated and operated properly.

Phase I Research & Development

1. TO REDUCE VOLUME AND TOXICITY OF WASTE

   b. Update the State-of-the-Art of front-end separation technology.

   (insert) A feasibility study on the use of robotics in waste separation will be conducted.

   c. Assess environmental exposure and risks associated with recycling operations and recycled products.

   (insert) The emission of biological pathogens from air classifiers and pneumatic transport systems will be studied.

2. IMPROVE THE SAFETY OF INCINERATION

   b. Evaluate effectiveness of new air pollution control devices and waste combustion systems.

   As new devices come on line, conduct detailed stack tests, along with comprehensive waste characterization studies to determine the performance, economics, and viability of these devices. Develop, evaluate, and validate stack test methods for the criteria pollutants, semi-volatile organics, opacity VOCs, halogenated organics and hydrogen fluoride. Develop methods for non-gas chromatographable compounds and for the speciation of metals in stack emissions. Develop methods for the use of indicator compounds and indicator organisms to test the efficiency of combustion. Validate continuous emission monitors and develop quality assurance materials and calibration standards to ensure that emission testing is competently performed.

3. MWC ASH/RESIDUALS MANAGEMENT

b. MWC Residue and Leachate Characterization.

(insert) Protocols for ash sampling and for chemical and toxicity testing will be developed. Guidelines will be developed for separating ash into different categories, on the basis of chemical and toxicity properties. Methods for metals speciation will be developed to determine migration potential.

4. MSW LAND DISPOSAL

a. Continue research into landfill gas emissions and recovery.

(insert) Methods to determine biological pathogens, organo-mercury and sulfur compounds in landfill gas will be developed.

gas research institute

January 12, 1989

Ms. Gerry Dorian
Office of Environmental Engineering
and Technology Demonstration
U. S. Environmental Protection Agency
RD-681
401 M Street, S.W.
Washington, DC 20460

Subject: Comments on MSW Workshop Proceedings

Dear Ms. Dorian:

Comments are provided on the combustion sections of the proceedings only (5.2, Section II). The transcription of the proceedings seems complete. However, there are numerous typographical errors and in some cases the wrong words have been used.

In general, Section 5.2 is a good summary of the discussion in the work group. On page 90, the first paragraph discusses retrofitting of existing incinerators. I want to emphasize the importance of this activity and that it should be given high priority, especially in view of the fact that retrofitting of technologies like spray dryers and fabric filters may be very costly and difficult on some of these existing units, particularly the older ones.

Paragraph 2 on page 90 outlines the need for more basic research and understanding of the mechanisms involved with waste combustion. I agree with the need for this and that it should be very high priority. In addition, I would add that there are other pollutants which are equally important besides organics such as dioxin. The other pollutants include metals, of which the questions would be the effect of temperature and partitioning of metals to the flue gas stream versus the residues. Another important pollutant is NO_x. The effect of the combustion process on NO_x formation and NO_x emissions levels should also be investigated.

In paragraph 3 on page 90, the last sentence talks about a "middle ground" between controlling organics and controlling NO_x. The implication is that there is some trade-off or compromise between emission levels of organics and NO_x. This in general is true for a simple single-stage combustion; however, it is well known that fuel or air staging can achieve reduced levels of NO_x and very high combustion efficiencies (i.e., low levels of organics and CO and NO_x). Examples of this are the NKK waste incinerator concept used in Japan and the use of reburn for NO_x control in coal-fired utility boilers.

Gas Research Institute, 8600 West Bryn Mawr Avenue, Chicago, Illinois 60631 312/399-8100

One final item that could be mentioned in Section 5.2 is that of co-incinerating waste, e.g., as municipal waste with other types of wastes such as sewage sludge or tires or perhaps even medical wastes. The R&D issues associated with this practice would be the development of control systems such that this co-incineration process could take place in a well controlled and efficient manner; and the range of applicability and limitations of the co-incineration concept.

In contrast to Section 5.2, the summary of work group conclusions/ recommendations section, which for the combustion work group begins on page 139, in my opinion is not very well done and does not in all cases reflect the discussions of the work group. I believe this section needs major revisions; unfortunately, I don't have the time or resources to rewrite the section. I will offer a few comments, however. In general, I think the combustion technologies have been short changed in comparison with the extensive discussions on risk assessment. There are some statements in this section that are policy-type statements and I don't feel these appropriate for a discussion of an R&D agenda.

On page 143, the first full paragraph right in the middle of the page, a sentence that starts, " The work group felt . . ." is such a policy statement and I don't think it was endorsed by the entire work group as the sentence implies.

On page 144, the second paragraph is another example of a policy-type statement, "Permit specification should allow reduction . . ." This should not be the subject, but rather, this section should outline the R&D issues or technical issues that should be addressed to demonstrate that proper monitoring of an incinerator operation will ensure good operation and acceptable emissions performance. This is the technical issue which needs to be researched.

On page 142, the paragraph at the bottom of the page is very confusing. The sentence that begins, "The best measure of good combustion . . ." may express the opinion of one working group member; however, this matter was not discussed in the work group. This discussion is incomprehensible and, I believe, incorrect.

Turning to the Recommendations/Conclusions on page 144, the very first item "CEM should be increased . . ." is confusing as written. Furthermore, I disagree with the focus completely.

Missing from the list of items in this section are two which I think are the most important. The first is the recommendation that more work should be done on understanding the combustion process, including the formation mechanisms and release of NO_x, metals, organics. A better basic understanding of the

combustion process is important, both as a basis for lowering emissions and as a basis for improved monitoring to better control and measure the efficiency of the combustion process.

Another item deserving high priority is the validation of the best combustion practices, guidelines and various retrofit strategies. This information will be especially important because of the organizations most likely involved or interested in this information--that is, municipalities.

Finally, the last item on page 145 is another example of a policy-type statement that doesn't belong in this section.

If you have any questions on my comments, please call me at 312/399-8198.

Sincerely,

David G. Linz
Manager
Land and Water Quality Research

DGL:Djm

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

JAN 10 1989

Ms. Gerry Dorian
OEETD
U.S. Environmental Protection Agency
RD-681
401 M Street, S.W.
Washington, DC 20460

Dear ~~Ms.~~ Gerry Dorian:

Thank you for the opportunity to review and comment on the draft proceedings of the Workshop on Municipal Waste Technology. We believe the proceedings have been identified the major areas of concern that the agency should address in its future research activities. Of equal importance is the availability of adequate funds to support all of these initiatives. We would like to review the final program plan when it is complete.

Very truly yours,

Albert Montague, P.E.
Regional Solid Waste Manager

cc: Robert Allen

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
RISK REDUCTION ENGINEERING LABORATORY
CINCINNATI, OHIO 45268

DATE: January 27, 1989

SUBJECT: Municipal Solid Waste Research Agenda Workgroup Task

FROM: Norbert B. Schomaker
Acting Director, Waste Minimization, Destruction and Disposal Research Division, RREL

TO: Gerry Dorian
Workgroup Chair

My comments relate to the proposed format and to the concluding remarks of the Workshop Proceedings. In regard to the proposed format, my comments are as follows:

Background: I agree that we need to identify which waste streams we are discussing. (1) Residential household waste, (2) sewage sludge, (3) commercial waste, (4) yard waste, (5) agricultural waste, (6) industrial nonhazardous wastes and (7) demolition rubble waste are the primary waste streams which relate to Subtitle "D" regulations. Are we to pursue research into all of these waste streams. If so, I would propose that we research them in the priority order as listed above. Also, an appendix could be identified in this section which lists, by categorical research areas, the previous reports published by the Agency on this subject.

Research Area: The research areas identified follow the general hierarchy of integrated waste management as discussed in the "Solid Waste Dilemma: An Agenda for Action." The hierarchy included: source reduce, recycle, incinerate and landfill. The one component missing is collection. I believe new techniques relating to waste collection needs to be considered. Also, I concur that some write up is needed to briefly explain the recommendations listed under the research areas. I have reviewed the previous documents on the subject and I believe the following outline is appropriate.

1. Waste Reduction* (Includes Source Reduction and Recycle)

   a. Process Manufacturing Change

   b. Market Development (Includes Product Development)

   c. Separation

d. Recycling

e. Biodegradation

f. Toxicity Reduction

g. Risk Assessment (Includes Health and Environmental)

h. Case Studies

i. Technology Transfer

2. Waste Collection*

a. Curbside Containers (Includes Household Containers)

b. Residential Truck Modification

c. Transfer Truck Modifications (Includes Transfer Station)

d. Rail Haul

e. Barge Haul

f. Case Studies

g. Technology Transfer

3. Municipal Waste Combustion*

a. Combustion Performance

b. Emission Control

c. Monitoring (Includes Sampling Protocol)

d. Waste to Energy

e. Risk Assessment

f. Case Studies

g. Technology Transfer

4. Municipal Waste Combustion Residuals Management

a. Ash Handling

b. Emissions Control

c. Monitoring (Includes Sampling Protocol)

d. Treatment (Includes Metal Recovery)

e. Market Development (Includes Product Development)

f. Risk Assessment

g. Case Studies

h. Technology Transfer

5. Land Disposal*

a. Landfill Performance

b. Emission Control

c. Monitoring (Includes Sampling Protocol)

d. Biodegradation (Includes Composting)

e. Expert Systems

f. Closure/Post Closure

g. Corrective Action

h. Risk Assessment (Includes Siting)

i. Case Studies

j. Technology Transfer

6. Municipal Planning and Waste Management*

a. Workshops (Includes Attitudinal Problem)

b. State of the Art

c. Economics

d. Expert System

e. Case Studies

*Refers to all waste streams mentioned earlier.

From the above outline, it can be seen that certain research topics appear commonly throughout all the research areas (i.e., market development, monitoring, risk assessment, case studies, and technology transfer). These topics could become research areas to themselves. Also, note the asterisk above relating to all waste streams. This means that, for example, sewage

sludge would be investigated under all research topics. I am sure that sewage sludge alone could merit its own research program just like combustor residues. This needs to be considered.

Comments regarding the concluding remarks from the workshop proceedings are as follows:

1. In what areas should EPA be conducting research to understand the fundamentals? From a fundamental research standpoint, I do not believe we need to do research in any area except the market development aspect. Fundamental research has been done and I believe many of the concepts derived from this research are still applicable. The cost/economics of this application to the current market needs to be addressed. We can expand on our current knowledge to have a better data base to render decisions. This data base expansion has been identified in the above comments relating to the proposed research outline.

2. In which areas should we be evaluating private sector activities? In the above discussed research outline, this subject is identified as "Case Studies." I believe we should evaluate the private sector in all of the research areas discussed.

3. Where are we talking about the need for EPA to simply put together existing information on the state of the art and package it in documents that people can use? I believe we need to put together a SOA document in each of the research areas initially, just to set the stage for future development. Over the last ten years there have been SOA documents published in these research areas. We are currently working with OSW on an update to the "Sanitary Landfill Guidance Document for MSW." These SOA document preparations need to be coordinated with OSW who are also processing the development of various SOA documents covering a variety of topics. After the initial SOA document is prepared, then periodic updates depending upon generation of new data is appropriate on a regular time cycle. In the area of waste collection, since this area was not identified in the hierarchy of integrated waste management and since no research has been pursed by the Agency for the last 15 years, this might be an area of strong interest under the pending MITE program.

4. In what areas should we establish standards of good practice that can be used by state agencies in overseeing and regulating activities at the state level? From the standpoint of "we" as Federal

facilities (including DOD and DOE) I think we could establish standards of good practice in all the topics mentioned in the previously discussed research outline. If "we" means USEPA, I think the good practice standards could relate to waste reduction, specifically source separation and recycling.

5. In what areas is it appropriate for EPA to do actual development work? Actual development work for EPA could be pursued in the following research topic areas as identified under the research outline below:

   1. Waste Reduction

      a. Process Manufacturing Change

      b. Market Development

      f. Toxicity Reduction

      g. Risk Assessment

   2. <u>Waste Collection</u>

      No development work except for co-funding under the MITE program.

   3. <u>Municipal Waste Combustor</u>

      a. Combustion Performance

      b. Emission Control

      c. Monitoring

      e. Risk Assessment

   4. <u>Municipal Waste Combustion Residuals Management</u>

      a. Ash Handling

      b. Emissions Control

      c. Monitoring (Includes Sampling Protocol)

      e. Treatment

      f. Market Development

      g. Risk Assessment

5. <u>Land Disposal</u>

   a. Landfill Performance

   b. Emission Control

   c. Monitoring (Includes Sampling Protocol)

   d. Biodegradation

   e. Expert Systems

   f. Closure/Post Closure

   g. Corrective Action

   h. Risk Assessment (Includes Siting)

6. <u>Municipal Planning and Waste Management</u>

   c. Economics

   d. Expert System

CORRE

Walter M. Shaub, Ph.D.
Technical Director
Coalition on Resource Recovery and the Environment

U.S. Conference of Mayors
1620 Eye Street, N.W.
Washington, D.C. 20006

(202) 293-7330

January 10, 1989

Ms. Gerry Dorian
Office of Environmental Engineering
and Technology Demonstration
U.S. Environmental Protection Agency
RD-681
401 M Street, S.W.
Washington, D.C. 20460

Dear Gerry,

I have received your letter of December 15, 1988 in which you request review and comments regarding the Draft of the Proceedings of the Workshop on Municipal Solid Waste Technology that I participated in on October 3-4, 1988. My comments are appended to this letter. They are restricted to observations regarding the material that is presented on pages 139-145 which appears to be a synthesis of the actual discussions that took place during the session on Municipal Waste Combustion at which I was a participant. The synthesis appears to be nicely done. Consequently my comments are either to clarify some points that were raised or to indicate areas where I feel I have minor disagreements with the general sense of the group.

The Draft report also contains a summary by Mr. James Kilgroe, U.S. EPA--OEETD of the group activity. This appears on pages 88-95. Mr. Kilgroe made his remarks at the time of the meeting without benefit of the tape recording of the group meeting. Therefore I regard his remarks as being representative of his personal opinion of what transpired. Everyone is entitled to their own opinion, therefore it seems to me inappropriate to make any observations about Mr. Kilgroe's remarks, as I assume the Draft is a faithful re-counting of exactly what it was that he said.

I was not a participant at other sessions of the Workshop. Therefore I am not making any comments about other sections of the Draft report. Thank you for allowing me to participate in this exercise.

Sincerely,

Walter

Dr. Walter M. Shaub
Technical Director, CORRE

encl.

COMMENTS REGARDING OEETD OCTOBER 3-4 WORKSHOP

Remarks made by:

Dr. Walter M. Shaub, Technical Director
Coalition on Resource Recovery and the Environment
The U.S. Conference of Mayors
Washington, D.C.

On page 139...

1. My last name is spelled "Shaub," not "Schaub."

On page 140...

2. Perhaps the phrase "...risks to different demographic groups" could be written as "...risks to different biological receptors" to emphasize that risk analyses consider more than just impacts upon human populations.

3. Regarding the six aspects of risk assessment, I feel that the highest priority item is item #3 - Comparative analyses.

On page 141...

4. I'm not so sure that food chain data is "almost non-existent," but certainly it would be useful to put all the data into one place and evaluate its reliability.

5. Given the level of funding that EPA appears likely to receive, I think that to develop standard data sets may require some inter-governmental Agency interactions.

On page 142...

6. Regarding the comment per sensitivity of the incineration process to changes in the chemical and physical nature of the waste stream, that there is an "extreme" need for data in this area: I would not use the word "extreme" to indicate the present situation. We know a fair amount about physical and chemical processes associated with incineration. Consequently we are able to use scientifically based heuristic reasoning to infer likely effects absent a lot of data. The role of the data is to refine our understanding and to check our reasoned inferences. So far, what data has become available seems in my opinion to indicate that there aren't likely to be any surprises, i.e., outcomes that differ substantially from what can be inferred. In addition, given that control and treatment technologies can be applied to incineration, there are opportunities to control emissions and residue absent direct data-based knowledge of effects associated with changes in the solid waste stream.

7. Per the statement that "The best measure of good combustion design and incineration effectiveness is the heat release rate per cubic foot of fuel and waste mixture.":

First, in a direct sense, I think it may be important to consider design and effectiveness as two separate aspects of incinerators - we don't speak of monitoring design; we do speak of monitoring effectiveness (e.g., emissions monitoring). Second, in relation to the latter aspect of incinerators, my own opinion is that combustion stability is the most important indication of reliable performance, whether it be relevant to power generation or to emissions minimization.

If emissions minimization associated with combustion performance in the combustion chamber is of interest then I think (for reasons that I can justify absent any experimentally developed correlations) it is important to maintain stability in the long term in carbon monoxide emissions. Post-combustion emissions characteristics and pollution abatement control devices are a separate aspect of incineration which I think are reasonably discussed on page 144 of the draft report.

On page 143...

8. If the intent is to suggest that we don't know how, then I disagree with the statement, "...it is difficult to design a reliable and efficient incinerator." In fact, actual operating experience and tests have shown that we do know how to design a reliable and efficient incinerator. If there are shortcomings, it is more related in my opinion primarily to lack of a clear establishment by legislators and regulators as to what performance is required or expected; secondary issues are related to operational requirements and to monitoring requirements. None of these issues are associated, however, with shortcomings in system design expertise.

9. Regarding the comment that "The workgroup felt that EPA should either be willing to accept direct responsibility for the operational performance characteristics of incinerators designed according to BMP guideleines, or should provide 'performance-based' standards that allow for innovation on the part of operators and require the operators to assume responsibility for the performance of their incinerators":

I give the higher priority to performance standards. In my opinion, BMP guidelines should only be a consideration when there is no metric of performance readily available at reasonable cost. Given that there are surrogate indicators that can be used to gauge performance I feel that the only acceptable use of BMP guidelines is with the proviso that implicit in BMP guidelines is the concept embodied in the phrase, "or equivalent." Absent such an understanding we might as well throw technological innovation out the window, because in my opinion that is exactly what is

likely to happen if unreasonably restrictive BMP guidelines are established. ...And what happens if more affordable means to accomplish the same ends are developed but cannot be implemented due to overly restrictive BMP guidelines?

10. I would rephrase the statement "Additional efforts in monitoring and control of..." to read, "Additional efforts in understanding/evaluating prospects for monitoring and control of..."

On page 144...

11. I would rephrase the statement, "The list of pollutants subject to CEM requirements should be trimmed..." to read, "The list of pollutants subject directly - or indirectly, if there is an appropriate surrogate - to CEM requirements should be trimmed..."

12. I would change "CEM should be increased and focused toward filling data requirements of RA models" to read "CEM should be focused toward demonstrating compliance with performance standards."

On page 145...

13. I would change "An ambient monitoring program should be.....from incinerators" to read "Research aimed at an ambient monitoring program should be.....from incinerators, recycling plants, landfills, compost operations, etc."

14. In regard to an assessment of health risks associated with mercury and mercury control....

...have you examined the evaluation of impacts associated with mercury emissions that was discussed in the risk assessment prepared by Dr. Allan Smith, Ph.D., M.D. for the Brooklyn Navy Yard Resource Recovery Facility?

...have you seen the OECD document which indicates what technical and economic problems have been encountered regarding control or reduction of mercury in OECD member nations?

...if not, I can provide you with this information if it is not available to you.

15. I think the very last observation on the bottom of page 145 should be bold-faced when the report is printed.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: JAN 1 2 1989

SUBJECT: EPA's Research Agenda for Solid Waste

FROM: Conrad Simon, Director
Air and Waste Management Division

TO: Gerry Dorian
Environmental Scientist and Engineer

Thanks for the copy of the proceeds. My review indicated that the workshop was successful in getting a large number of ideas which need to be converted into specific projects. I don't feel that I can make this conversion as well as potential contracters can if a solicitation were made.

I am sorry that I did not get a chance to edit the transcript of my remarks in chapter 5. I believe that there is sitll something to be gained from correcting pages 77-80 to make them more readable. Thus I have provided substitute pages.

[Ed. note: The substitute pages have been incorporated in the Proceedings and therefore do not appear in the Appendix.]

REGION II FORM 1320-1 (9/85)

HDR Engineering, Inc.

Suite 225
5100 W. Kennedy Boulevard
Tampa, Florida
33609-1806

Telephone:
813 287-1960

January 14, 1989

Ms. Gerry Dorian
OEETD
U. S. Environmental Protection Agency
RD-681
401 M Street, SW
Washington, DC 20460

Dear Ms. Dorian:

Thank you for the opportunity to comment on the draft proceedings of the Workshop on Municipal Solid Waste Technology. I enjoyed participating in the workshop and found it very positive and thought-provoking.

In general, the question/response sections would be much more informative if they were rewritten by the appropriate participants from EPA. Due to the format and time limits of the sessions, it was impossible for the EPA participants to formulate good answers to the individual questions. If these sections are to be included in the final Research Plan, the responses should be rewritten and expanded.

It is unfortunate that there is limited input from public officials. Perhaps it would be useful to solicit comments from several more county and local government officials before finalizing the Research Plan.

The comments included herein are not limited to any one area of the program.

Municipal Waste Combustion Residuals

The summary of the workshop session on residuals management (pg. 146) is very informative. Of all topics discussed in the session, one particular area that did not receive enough attention was standards for landfill/monofill construction. In developing the final Research Plan, consideration should be given to examining the standards recommended in the EPA Draft Guidance (1988). EPA should consider the applicability of uniform design standards to construction of monofills. If design standards are the preferred approach, local government should have the option to implement performance standards in lieu of design standards. EPA could specify certain (limited) parameters that could be used to re-evaluate the standards for construction. For example, local government may only consider three parameters: 1) leachate quantity, 2) operating controls and 3) background groundwater quality as justification to change standards. The ORD workgroup should give consideration to recommending that the EPA Draft Guidance be expanded and re-issued as soon as possible.

Municipal Waste Combustion Program (pg. 11)

EPA is collecting an impressive amount of data in the Municipal Waste Combustion Program. The type of data being collected appears to be appropriate for the purposes of standard setting. However, EPA's intent regarding the format and extent of the NSPS for waste combustion is not clear. Therefore, the adequacy of their data collection program cannot yet be assessed.

In setting NSPS, and in their research program, EPA should carefully consider the heterogeneous nature of solid waste and hence, the variability in emissions. This should affect the averaging times for NSPS that are set as emission limitations. In addition, EPA should consider the variability in stack sampling and analysis techniques in their standard setting. In particular, EPA should consider the parallel testing efforts conducted at the Commerce facility by the Los Angeles County Sanitation Districts and the California Air Resources Board (CARB) in July and August of 1988. This effort shows that differences in results can occur even when much effort is made to exactly duplicate test conditions. This is particularly a problem when considering the extremely small quantities per sample of the trace metals and organics.

Municipal Waste Combustion (pg. 88, 139)

Regarding continuous emission monitoring (CEM), it is not clear what is meant by focusing efforts only on "biologically active" components of emissions. If this means that these are the only pollutants that should be monitored, then we disagree with this recommendation. Components of the flue gas such as O_2 and CO_2 should be continuously monitored if they can be used as a surrogate for the continuous monitoring of other substances such as toxic organics. EPA should expend a considerable amount of effort to determine those parameters that can be continuously monitored in order to give a continuous evaluation of facility performance. In terms of the cost of monitoring, EPA should consider whether additional CEM data could be used to eliminate or reduce the need (and associated costs) for frequent stack sampling of trace metals and organics.

The research program identified by workgroup participants to improve the various components of health risk assessment has some merit. However, it seems even more important that EPA determine how health risk assessment can be used as a tool to aid agency decision-making and standard setting. Perhaps this is part of the workgroup recommendation for standardization of risk assessment approach. This allows the comparison of the results of risk assessments for different projects.

In discussing the use of risk assessment (p. 141), it is stated that there should be comparative analysis of the alternatives to incineration. Recycling and waste reduction efforts are given as examples. We do not think it is appropriate to compare recycling and

waste reduction directly with incineration as these approaches are not capable of addressing the same quantities of solid waste. In addition, all three of these "alternatives" are not really alternatives, but rather potential components of an overall waste disposal strategy. As such, it is not valid to compare the risks of individual components of solid waste management, but rather it is valid to compare alternate strategies of waste disposal. These strategies may consist of various amounts of reliance on recycling, waste reduction, composting, incineration and landfills.

Thank you, again, for the opportunity to comment on the draft proceedings. Please don't hesitate to contact me if there are any questions. I also look forward to participating in the Solid Waste Technology conference in San Diego later this month.

Sincerely,

HDR ENGINEERING, INC.

Sheree L. Stewart
Project Manager

SLS/tl
TL-SS-Q

cc: Richard J. McCormack, VP, HDR Engineering, Inc.

OGDEN MARTIN SYSTEMS, INC.

5301 EISENHOWER AVENUE
ALEXANDRIA, VIRGINIA 22304

AN OGDEN COMPANY

DAVID B. SUSSMAN
VICE PRESIDENT
ENVIRONMENTAL AFFAIRS
(703) 751-2523

December 27, 1988

Gerry Dorian
OEETD RD-681
US Environmental Protection Agency
Washington DC 20460

Dear Gerry:

I've reviewed the draft proceedings of the Workshop on Municipal Solid Waste Technology and found them to be an accurate reporting of the meeting. There are, however, a few items worthy of comment.

First, I do not believe there is as much support for the MITE program as the proceedings indicate. In other words, we hate it. Let's not stop the wheel again.

Secondly, as the Agency cannot make up it's mind with regard to NO_x emissions and BACT, I suggest more effort be directed toward resolving that internal conflict. Whether it be development or evaluation of control technologies, or a decision as to what BACT is, a position is necessary.

The last item is CEM. The requirement for "reasonable" CEM is extremely important. EPA should focus on what is necessary to protect public health, and should strive to lower the cost and complexity of systems. We cannot have a viable industry if we have to monitor everything! In addition, in the first paragraph on page 144, there is a discussion about opacity. Opacity is a low-cost CEM which is a surrogate for gross particulate emissions. From the discussion, one could get the idea that opacity CEM is a problem.

Should you need any more information, please call.

Sincerely,

David B. Sussman

Long Island Regional Planning Board

Edward Cook
Chairman
John J. Hart
Vice Chairman
Patrick F. Caputo
Paul J. Fitzpatrick
John Wickham
John W. Wydler
Lee E. Koppelman
Executive Director

H. Lee Dennison Executive Office Building
Veterans Memorial Highway, Hauppauge, L.I., N.Y. 11788
Area Code (516) 360-5189

January 11, 1989

Ms. Gerry Dorian
Office of Environmental Engineering
and Technology Demonstration
U.S. Environmental Protection Agency
RD-681
401 M Street, S.W.
Washington, D.C. 20460

Re: Proceedings of the Workshop on Municipal
Solid Waste Technology

Dear Ms. ~~Dorian~~ Gerry:

I have read the draft of the Workshop Proceedings. The task was far less onerous than I had anticipated. EPA and its consultants have done an excellent job of summarizing the comments and translating our thoughts into coherent and comprehensible language.

As per instructions, I am enclosing a list of typo's, questions and corrections. I'm sure most of them have already been reported but, for what they're worth, here they are.

Best wishes for a happy and healthy 1989.

Sincerely,

Edith

Edith G. Tanenbaum
Bi-County Planning Coordinator

EGT:sm
Enc.

p.87 First paragraph, line four -- third word should be "cooperate."
Final paragraph, line four -- isn't the word "recyclables," not "unrecyclables?"
The sentence is not clear.

p.88 First paragraph, line four -- third word should be "was."
Second paragraph, line three -- last word should be "assure."
Second paragraph, line ten -- sentence starting "So there is...," not clear.

p.101 Third paragraph, line one -- believe the last word "flammable" is incorrect.
Fourth paragraph, line six -- fifth word should be "are."

p.117 Second paragraph, line three -- word should be "dyes," not "dies."

p.118 Second paragraph, line one -- is it National Center <u>for</u> or <u>of</u> Resource Recovery?

p.120 Last paragraph, line seven -- fourth word should be farther.

p.122 First paragraph, last line -- first word should be "effluent."

p.128 First complete paragraph, last three lines -- sentence needs punctuation or other clarification.

p.130 <u>"Addendum</u>," line one -- spelling of last name doesn't match that indicated in list of participants.
<u>"Durability</u>," line one -- fourth word should be "ratio."

p.137 Paragraph "H," line six -- sixth word appears to be incorrect. There is a Potsdam, N.Y.

p.138 Paragraph "II," line four -- fourth word should be "Sorain-Cecchini."

BROWN UNIVERSITY *Providence, Rhode Island • 02912*

Center for Environmental Studies
Box 1943

Telephone: (401) 863-3449

21 January 1989

Gerry Dorian
Office of Environmental Engineering
and Technology Demonstration
USEPA
Washington, DC, 20460

Dear Gerry,

Erica Guttman has been kind enough to pass along a copy of the draft proceedings of the workshop on Municipal Solid Waste Technology and to invite my comments on it. Since I am somewhat past your suggested deadline of 15 January, I am sending my comments to you directly with a copy to Erica. As you will see, most of my comments are similar to ones I made to you directly at the Rhode Island Solid Waste Corporation outing in Little Compton in early November.

All of comments relate to the sections of the Proceedings dealing with source reduction and recycling. This is in part because I have worked more extensively in this area, and in part because I believe this section is significantly weaker than the parts of the reports dealing with landfilling and with burn technologies. Therefore my first point is:

1. **If we truly mean to give priority to reduction and recycling, that priority should show up in our planning studies.** In this case, a simple measure like the number of pages allocated to each subject suggests that the minds of the proceedings' writers still dwell more heavily on the "hard" engineering solutions than on the more kind and gentle changes in incentive structure and information systems that favor reduction and recycling. Perhaps the final version of the Proceedings could set research priorities that make clear that, in a case of limited budgets, the reduction and recycling work will be done *before* demonstration projects on burning and burying.

2. **Product labeling is a highly promising approach to encourage reduction and recycling, and thus should be given a high priority in the research agenda.** Labeling is discussed briefly at different places in the Proceedings. This discussion would be more effective if it was integrated. For "durable" goods, the label should give an estimated annualized cost, much as appliances now give annualized energy costs. On appliances, annualized capital cost (purchase price divided by expected lifetime) should appear right along with the annual energy cost. The label also could contain information on content of recycled materials, recyclability of materials, hazardous materials contained therein, repairability, and perhaps much more. My own view is that these will be much less influential with the consumer, more controversial and, in the case of repairability, more

difficult to quantify. Therefore, I would give high priority to developing a testing protocol for annualized capital cost measurements (why not give a contract to Consumer's Report?), but would give lower priority to the other labeling possibilities. *I would propose a federal labeling requirement only for annualized cost, because asking for everything will almost certainly get you nothing.* Even if Congress is reluctant to impose national labeling standards, a few progressive states are quite likely to do so, once the testing protocol is developed. Of course, as soon a few states do so, preferably with some differences in their approach, manufacturers will be begging for the protection of federal standards. It is not even unthinkable that a few states will try setting minimum standards for lifetimes for certain products; that certainly will get the manufacturers attention.

3. **Research on technologies for reprocessing recycled materials not presently generally regarded as recyclable and for marketing materials after processing should be given a high priority.** As the Northeast is discovering, and will feel even more keenly very soon, we know quite a lot more about collecting recyclable materials than we do about selling them. How about some federally funded studies of markets, with some creative ideas about state action to favor these markets. Should a coalition of states, for example, be building mills to accept secondary fibers at the same time as they build the materials reprocessing facilities? And how about some work on technologies to cope with coated paper (magazines) and with glue. There are beginnings here, but there is a ways to go. The states are going to be frantic for this type of information very soon, but except for the biggest ones, are not well positioned to run research projects of these types.

4. **Description and evaluation of existing systems for source separation in a few major commercial/industrial operations would be quite helpful.** The states share information on, for example, offices separate paper, how bars deal with glass, etc., but usually there is little or no evaluation, and few studies are comprehensive. Even looking at the dozen largest generators of common materials would be worthwhile. To pick an example close to my heart, someone needs to do a generalized plan for colleges and universities. They are ideal places to begin, since waste is recycled and graduates are trained to recycle, both at the same time.

5. **Describe and evaluate options for taxing products based on durability, recyclability, toxic content, etc.** Having read the lips of Mr. Bush, I assume there is not likely to be much interest in federal taxes of this type. But if a nice taxation scheme was there, ready for a state to pick up, a few states might do so. When several do, again manufacturers will be looking for federal regularity.

6. **Get some of these research needs on the broader EPA agenda.** I was quite disappointed to find that the 1989 Topi Catalog for the National Network for Environmental Management Studies (NNEMS) had little or nothing on solid waste, and absolutely nothing on reduction or recycling. Why not take advantage of these possibilities, and get graduate students interested in questions of these types at the same time?

The imminent beginning of the next semester prevents me from going on at greater length. I would be pleased to discuss any of these with you if you like, just give me a call.

Cordially,

Harold

Harold R. Ward
Professor of Chemistry and
Environmental Studies

cc: Erica Guttman