waste management research Report

News from State University of New York at Buffalo and Stony Brook, and Cornell University

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Waste Management Research Report

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About This Newsletter

Waste Management Research Report appears three times per year in order to share research results from the magazine's contributing institutions. Each issue of the publication will focus upon one major area of concern in the field of waste management and will highlight the contributing institution where researchers devote their efforts to the featured topic. Each issue contains at least one scientific/technical article, as well as news reports on activities in waste management research and advance notices of meetings and symposia.

The Cornell Waste Management Institute is responsible for the Winter 1989 issue of *Waste Management Research Report*. The spring edition will focus on incinerator ash research. The Waste Management Institute at State University of New York at Stony Brook is responsible for the issue.

April 3 is the deadline for submitting articles. April 10 is the deadline for news briefs and announcements. Please include black-and-white, glossy photographs with article submissions, as well as a head-and-shoulders photograph of each author, also black-and-white glossy. Mail all material to Louise W. Laughton at the editorial office address.

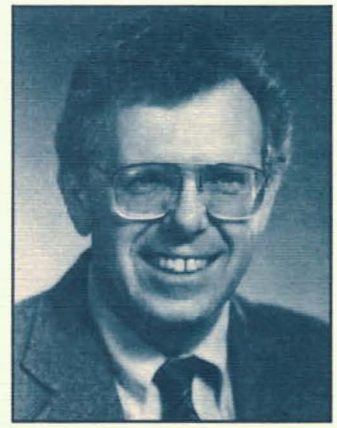
On the Cover

Dr. Frederick Gouldin, director, is shown in the Combustion Simulation Laboratory of the New York State Solid Waste Combustion Institute at Cornell University.

Director's Comment

Three Universities Receive Waste Management Research Funds

By Richard E. Schuler



Richard E. Schuler

To paraphrase Garrett Hardin ("Tragedy of the Commons"): waste management is everybody's responsibility; therefore no one is responsible. That is one reason why three universities in New York have received legislative appropriations to study different aspects of the state's waste management and disposal problems, and that is why we have banded together to issue this newsletter. We want to pool our efforts and keep you abreast of what is being investigated and what might be done to solve these problems—that is one of our responsibilities. A second is to ensure the effective deployment of public-supported research dollars, and that is why we are coordinating our research efforts as well.

The New York State Center for Hazardous Waste Management at State University of New York at Buffalo, assisted by the SUNY College of Environmental Science and Forestry at Syracuse, the New York State Solid Waste Combustion Institute at Cornell University, and SUNY Stony Brook's Waste Management Institute, each have different research priorities. The primary focus of Buffalo's Hazardous Waste Center is on toxic materials that arise largely through the industrial sector; the Combustion Institute at Cornell is concerned with municipal solid waste management, and the Waste Management Institute at Stony Brook has focused on marine waste disposal issues and the ultimate disposal of waste residues, primarily incinerator ash.

What these three research programs hold in common, however, is the perspective that there is no single technological panacea on the horizon that is likely to cure our problems; instead, what is required is much hard work on many fronts simultaneously. Recycling and reuse can be a big help, but at most it can reduce the waste stream by 30-50 percent which, in 20 years, would place us exactly where we are today because of projected continued economic expansion. Combustion can reduce waste volumes by 80 percent, plus provide process steam for industry or generate electricity as a bonus. Much has yet to be learned about the complex chemical reactions in combustion of the ever-widening diversity of materials that appear in products we consume, their packaging, and the waste we produce.

While composting of yard-wastes may reduce the volume and cyclic swings of household waste, and the biological treatment of some industrial wastes holds promise for reducing their toxicity, neither step represents a total solution to the problem. To the extent that residuals can be stabilized, and the toxic byproducts of historic production processes remediated, health risks and public debate might decrease—if it were not for the projected tremendous volume of materials and ash that might have to be stored in the future.

What does seem clear is that every phase of the waste disposal process interacts in some way with another. That is why high temperature combus-

Continued on page 2

Dr. Richard Schuler is director of the Cornell Waste Management Institute and the New York State Solid Waste Combustion Institute. The latter is an independent entity, funded by New York State, located at Cornell University.

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tion research of toxic substances undertaken at Buffalo might provide insights for municipal waste incineration investigations at Cornell. Similarly, since incinerator ash could be deemed hazardous under some circumstances, successful research on ash stabilization at Stony Brook might open the way for other lines of waste reduction inquiry at Buffalo and Cornell. We therefore are all committed to viewing the problem of waste management as just that: a problem of systems management. Because of the interaction among our research activities, we want to be sure our programs are coordinated and that there is no duplication of effort.

One way of ensuring this coordination is by serving on each other's research review panels. Furthermore, the Legislature has mandated that research funded by the Hazardous Waste Center and the Combustion Institute be open to proposals from research entities throughout New York State. Once received, those proposals are reviewed for technical merit by experts both within New York State and from the rest of the country. Finally, technical advisory committees comprised of researchers and practitioners from universities, industry, and government in New York State make the final recommendations for awards. Of course, as institute directors, we also have a responsibility to assure coordinated (coherent) programs and to maximize the prospects of successful research on these topics.

Finally, each of our centers has a strong commitment to outreach activities that will keep the state's communities and their residents appraised of the latest policies, programs and technological advances affecting waste management. Because by their very nature those outreach programs involve many other avenues of communication, we will not emphasize those outreach activities in this newsletter. Instead, we will describe our activities that have potential for longer term payoffs—current research on emerging solutions and policies.

Nevertheless, one measure of the success of our initiatives will be the ability of the outreach programs to deliver the findings to those who need them and to guarantee that our research programs are developed to serve the ultimate beneficiaries. It also keeps us in contact with the ultimate source of society's waste disposal problems. As Walt Kelly's Pogo once said: "We have met the enemy, and they is us!"

Trash compactor at landfill.

Introduction to Report Contributors

New York State Center For Hazardous Waste Management

In 1987, the New York State Legislature, in recognition of the critical need for a broader and more comprehensive approach to the complex problems associated with the management of hazardous wastes, created the Center for Hazardous Waste Management at the State University of New York at Buffalo. The SUNY College of Environmental Science and Forestry at Syracuse was named as a participant.

The Center is empowered by law to support coordinated technological research and development activities and develop technology transfer and other educational programs that will enhance hazardous waste management practices in New York State.

The Center's research program emphasizes the development of basic or applied research on:

- source reduction technologies and methods,
- technologies and methods for recovery, recycling and reuse of hazardous substances,
- hazardous waste treatment, storage, or disposal technologies and methods,
- technologies and methods for clean-up of inactive waste sites.

In less than one calendar year, the Center has established itself as an important contributor to the resolution of hazardous waste management issues and problems in New York State. The Executive Board to the Center was formed and met in February and June 1988. The appointment of a Technical Advisory Committee was completed and this group met three times in 1988. A research and development program is underway with a Center contribution of $1,462,792 towards a total program cost of $2,683,444.

Outreach initiatives that have been accomplished include co-sponsorship of a major conference in April 1988, submission of an application on June 27, 1988 for a New York/Massachusetts consortium of eight universities to serve as the EPA Regions 1 and 2 Hazardous Substance Research Center, preparation of a special hazardous waste information and education needs assessment, and the development of a Center business-industry affiliates' program is underway.

Several factors contributed to the Center's success. Noteworthy among these were the excellent cooperation given by the New York State Department of Environmental Conservation, the support of the New York State Joint Legislative Commission on Toxic Substances and Hazardous Wastes, the superb response of the academic research community in New York State (both to the Center's April research solicitation and in the development of the application for designation as a federally-funded hazardous substance research center serving EPA Regions 1 and 2), and the effective support and cooperation provided by the State University of New York at Buffalo, the College of Environmental Science and Forestry, and the SUNY Research Foundation.

At this early stage in the development of the Center, immediate plans involve the expansion of the research program and continued promotion of the business-industry affiliates' program. For the Center to achieve its full potential, it needs direct and substantive involvement of business and industry in its research and outreach programs.

A total of 15 projects, located at nine public and private institutions in New York State, were funded by the Center. Funding from the private sector represented 13 percent of the total cost of the research program, involving three industries: two environmental services companies, and an industrially-supported center from another state. There is considerable opportunity for an expanded involvement by New York industry and businesses in the Center's research program. The establishment of the affiliates' program will provide an effective vehicle for improved interaction between industry and the Center.

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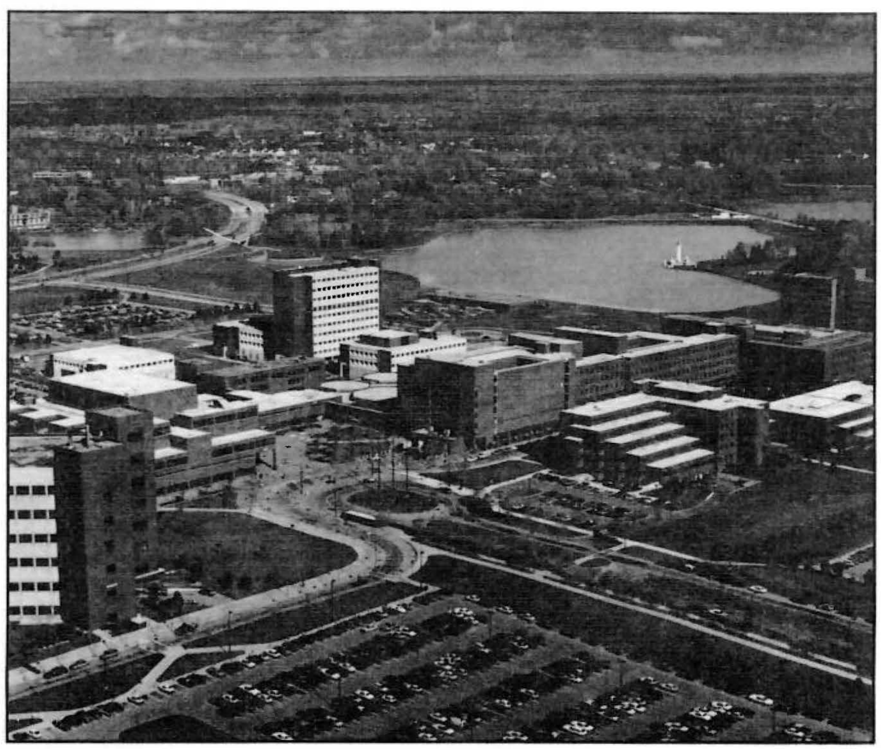
Aerial view of State University of New York at Buffalo, North Campus, with engineering buildings in the foreground.



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A New York State Perspective: Combustion of Municipal Solid Waste

By Daryl Ditz

Daryl Ditz

Last year, some 20 million tons of municipal solid waste (MSW) were generated in New York State. Of this, over 80 percent went to landfills. About 9 percent was burned in waste-to-energy (WTE) facilities and another 5 percent was incinerated without energy recovery. Yet hundreds of landfills are under orders to close and few new landfills have been created. The NYS Legislative Commission on Solid Waste Management projects that if current trends continue, landfill capacity for municipal solid wastes in New York State will be virtually depleted by the Year 2000. At this rate, even if we were to achieve 50 percent reduction and recycling of MSW tomorrow, many millions of tons will require some alternate form of management.

One response to shrinking landfill capacity in New York State is a renewed push for the long-standing practice of burning. Combustion processes hold promise for the management of municipal solid waste because they can reduce the volume of solid waste requiring land disposal by up to 90 percent. As disposal capacity dwindles, volume reduction can buy valuable time for pursuing long-term plans for reducing waste generation. In addition, incineration of MSW yields energy in the form of steam and/or electricity which can, to a limited extent, supplement conventional fuel sources.

Despite this basic appeal, MSW combustion raises a number of important issues. First and foremost, it is necessary to understand the potential health and environmental consequences of pursuing this and other management strategies. Hazardous chemicals and heavy metals are present in the air emissions and ash from WTE facilities. Equally important are the effects that the choice of this option has on the simultaneous or subsequent development of alternatives. This introduces questions of flexibility and reliability in solid waste management planning.

At present, some two dozen WTE facilities with a combined capacity of almost 7 million tons per year are in various stages of planning in New York State. While it is impossible to predict how many of these will become operational, together they could handle about one third of the current New York State production of municipal solid wastes. The magnitude and complexity of the problems associated with solid waste management demand the attention of researchers on many fronts. The New York State Solid Waste Combustion Institute at Cornell University is committed to an agenda of research in combustion processes and technologies that will be critical to the development of long-term solutions.

Dr. Daryl Ditz is senior extension associate on the staff of the Waste Management Institute at Cornell University.

Existing Incinerators in NYS

Incineration of MSW is not new to New York State. There are a number of MSW incinerators in New York State that do not incorporate energy recovery. Generally, these facilities are older and were built for volume reduction, not supplemental generation of energy. Existing incinerators in Brooklyn and the town of Huntington, along with many smaller units in apartment buildings, fall into this category. It is the goal of New York State to phase out the use of these incinerators for the management of MSW by 1997.

Existing WTE Facilities in NYS

Unlike the incinerators built decades ago, waste-to-energy facilities generate electricity or steam. The eight WTE facilities currently operating in New York State are listed in Table 2 along

Table 1: Active Municipal Waste Incinerators in NYS (Source: LCSWM, 1988)

Facility	Tons Per Day	Design	Air Pollution Control
Huntington, Suffolk Co.	286	Mass Burn	Scrubber
Brooklyn (N. Henry St.)	1,000	Mass Burn	ESP
Brooklyn (Southwest)	750	Mass Burn	ESP
Misc. Non-Municipal	1,320	Mass Burn	None
Total	3,356		

Table 2: Active Waste-to-Energy Facilities in NYS (Source: LCSWM, 1988)

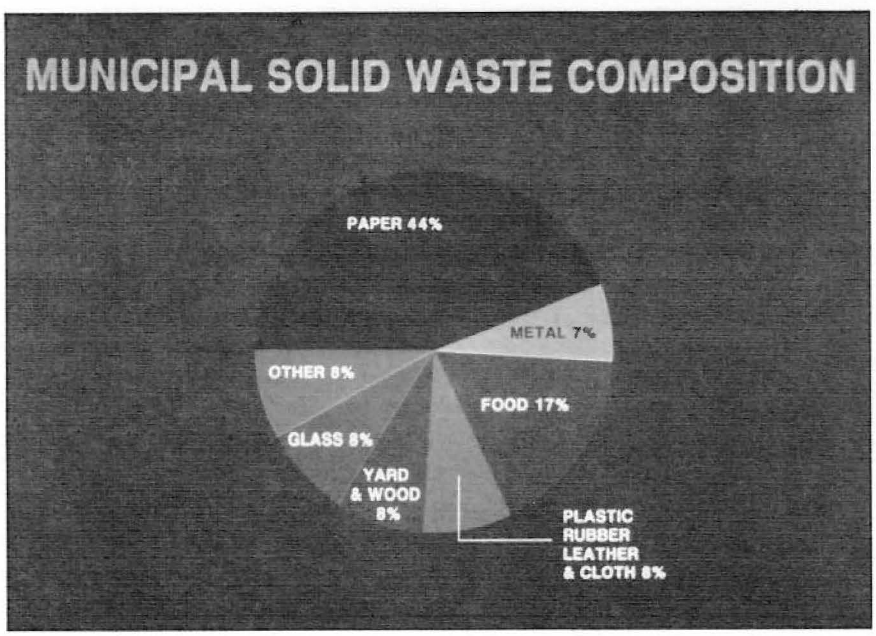
Facility	Tons Per Day (Units)	Design	Air Pollution Control
Albany, Albany Co	600 (2)	RDF	ESP
Cuba, Cattaraugus Co.	120 (3)	Modular	None
Glen Cove, Nassau Co.	225 (1)	Mass Burn	ESP
Niagara Falls, Niagara Co.	2400 (2)	RDF	ESP
Rome, Oneida Co.	200 (4)	Modular	ESP
Fulton, Oswego Co.	200 (4)	Modular	ESP
Peekskill, Westchester Co.	2,250 (3)	Mass Burn	ESP
Total	5,995 (19)		

with an indication of the plant design and air pollution control system.

Mass burn facilities, such as those at Peekskill in Westchester County and Glen Cove on Long Island, accept raw MSW as it would be delivered to a landfill. Mass burn facilities tend to be quite large with capacities on the order of several hundred to a few thousand tons per day. Such facilities are able to accommodate the waste produced by several hundred thousand people. In some respects, these facilities resemble coal-fired power plants in design and operation. Waste is fed to a combustion chamber and the energy released is used to generate steam for industrial use or to drive turbines for the generation of electricity.

Modular combustion units, such as those operating in Cattaraugus, Oneida, and Oswego counties, employ mass burn technology on a smaller scale. Modular incinerators are constructed off-site. Since capacities are often below 100 tons per day, it is common to find several units at a single facility. "Starved air" designs feature a two-chambered furnace. MSW is first burned in an oxygen-lean environment then exhaust gases are burned in the oxygen-rich or "excess air" secondary chamber. With this two stage design, less air is injected into the primary chamber and so fewer solids are entrained in the gas stream.

Almost half of all municipal solid waste is paper, as shown by graph below.



The WTE plants in Albany and Niagara counties rely on pretreated MSW known as refuse-derived fuel (RDF). Shredding and source separation provide a more uniform waste stream. To the extent that glass, metals, and other inorganics are removed prior to combustion, RDF facilities produce lower quantities of ash per unit of waste input. RDF can be co-fired with fossil fuels in some industrial and utility boilers.

Emerging Combustion Technologies

Emerging combustion technologies that offer better performance eventually may play a role in MSW management. Two of particular note are fluidized bed combustors and pyrolysis units. In fluidized bed designs, waste is suspended in a gas stream during combustion rather than lying on a grate. Pyrolysis technology is designed to produce gaseous compounds like methane which can be used for fuel. In both cases, considerable research has been performed for coal-fired boilers. There is some interest in applying these to agricultural and used tire wastes. None of the proposed facilities in New York State are expected to employ such technology.

Ash Residues from WTE Facilities

No matter which combustion or air pollution control technologies are employed, solid residues remain which must be managed. Traditionally, facilities have disposed of mixed fly and bottom ash in conventional landfills. In 1988, DEC issued new regulations on the management of ash from WTE facilities (Part 360-3.5). All new facilities must include a management plan that details the generation, handling, transportation, storage, and disposal of ash residue. Untreated fly ash, which has the higher metals concentrations, can be disposed only in approved "monofills"—special dedicated landfills that feature double liners, leachate collection systems, and monitoring wells to guard against groundwater contamination. Mixed fly and bottom ash and treated fly ash may be co-disposed with MSW in lined landfills. There is considerable interest within New York State and elsewhere in the stabilization or beneficial use of WTE ash.

The classification of ash is a controversial issue. Extensive data collected by the Environmental Defense Fund on fly ash, bottom ash, and combined ash have shown that the majority of samples meet the criteria for hazardous wastes. Some have questioned whether the leaching test used (EP toxicity test) is appropriate for ash. In any event, EPA maintains that since these materials originate from household waste, they are exempt by regulatory definition and therefore need not be sent to more expensive hazardous waste landfills. Legislation was introduced last year in Congress to clarify and tighten testing and management requirements for WTE ash. Changes could be forthcoming in the near future.

Health Risk Assessments of WTE Facilities

Increasingly, health risk assessments—estimates of the likely impacts of the facility on the health of the surrounding community—are a standard element in WTE facility evaluation. To estimate the risks to human health from a proposed facility, information must be obtained on the toxicity of the emissions and level of exposure through inhalation, food and water consumption, and direct contact. Each of these items is very uncertain. For toxicity data, we are frequently forced to extrapolate human health effects from laboratory studies of animals. The calculation of exposure is based on emissions and the distribution of specific pollutants geographically and over the course of time. Obviously, estimates of health risks require many simplifying assumptions.

Quantifying the health risks of MSW combustion was a major part of EPA's 1987 Combustion Study. For each of four types of combustion facilities (incineration without energy recovery, mass burn WTE, RDF, and modular), EPA estimated the cancer risk faced by the hypothetical "most exposed individual." For carcinogenic risks, the results are summarized for both metals and organic species in Table 3. These calculations were performed for existing facilities as of 1985 and repeated for a set of proposed facilities expected in operation by 1993. These results consider only risks by direct inhalation and exclude other pathways of exposure such as drinking water and food chain contamination.

While the data and methods used in EPA's risk assessment are rather crude and incomplete, several conclusions can be drawn. First, human cancer risks are generally about 10 times greater from organic emissions than from metals. In fact, because of their high toxicity, risks from exposure to dioxins and furans tend to dominate all other carcinogenic emissions risks. However, many metals are responsible for non-carcinogenic health impacts as well. Second, on a national basis the risks from the existing facilities are higher than those of the proposed facilities. For the proposed facilities, the lifetime risks of cancer to the most exposed individual vary from about 10 to 100 in a million. These levels are far below the average background risk of cancer about 1 chance in 3, but they are somewhat higher than the 1 to 10 in a million threshold often used by EPA and other regulatory agencies in setting levels of "acceptable risk."

Even with all the weaknesses inherent in these calculations of carcinogenic risks from direct inhalation, it is even more difficult to quantify the risks resulting from landfilling of MSW or WTE ash. For one thing, future exposure to ground water contaminants depends on the long-term integrity of new landfill designs and maintenance. Furthermore, landfills often pose environmental hazards rather than human health risks. Our inability to place the risks of landfills and WTE facilities on a common scale has two direct consequences in the consideration of WTE facilities. On one hand, any risks arising from the management of ash cannot be easily incorporated. On the other, the positive effect of reducing the overall volume of waste disposed in landfills escapes estimation.

Combustion Facilities and Recycling Programs

In addition to these concerns about environmental and health impacts, combustion technologies raise important strategic issues for communities developing MSW management plans. The decision of whether and how to pursue a waste-to-energy facility should take into account its impact on the achievement of long-term waste management goals.

Many communities are wary of the impact of a WTE facility on their ability to recycle MSW.

Table 3: Individual Lifetime Cancer Risks from MSW Combustion Due to Direct Inhalation by the Most Exposed Individual (Source: EPA Report to Congress, 1987)

	Organics	Metals	Total
Existing Facilities (1985)			
MSW Incinerators	10^{-4} - 10^{-3}	10^{-5}	10^{-4} - 10^{-3}
Mass Burn WTE	10^{-4} - 10^{-3}	10^{-4}	10^{-4} - 10^{-3}
Refuse Derived Fuel	10^{-5} - 10^{-3}	10^{-5}	10^{-5} - 10^{-3}
Modular	10^{-6} - 10^{-4}	10^{-4}	10^{-4} - 10^{-4}
Total (1985)	10^{-4} - 10^{-3}	10^{-4}	10^{-4} - 10^{-3}
Projected Facilities (1993)			
Mass Burn WTE	10^{-6} - 10^{-5}	10^{-6}	10^{-6} - 10^{-5}
Refuse Derived Fuel	10^{-5} - 10^{-4}	10^{-7}	10^{-5} - 10^{-4}
Modular	10^{-6} - 10^{-5}	10^{-6}	10^{-6} - 10^{-5}
Total (1993)	10^{-5} - 10^{-4}	10^{-6}	10^{-5} - 10^{-4}

Increased recycling of metals, glass, and paper products, a major goal of New York State, is likely to affect the technical, environmental, and economic performance of existing and new combustion facilities. There is some evidence that recycling and source separation programs can complement incineration. One experiment involving mass burn facilities in Nashville and Gallantin, Tennessee, and a modular facility in Salem, Virginia, indicates that both the quantity and the metal content of ash can be significantly reduced. Reductions in the emissions of carbon monoxide and total hydrocarbons were also reported along with improved boiler efficiencies when metals were separated for recycling prior to incineration.

Many important questions remain, however. In this particular case, paper and paperboard were not removed prior to incineration. Furthermore, while glass contributes nothing to the energy content of MSW, taking it out of the waste stream may undermine efforts to vitrify ash. There are important economic consequences of pursuing one or another MSW management alternative. Obviously, the financial and human resources devoted to WTE projects are not available for pursuing alternatives. Clearly, planning is the key to the development of workable long-term solutions to municipal solid waste management.

While current decisions will not wait for a complete resolution of the many uncertainties, continuing research will play an important role in providing information on the safe and effective operation of WTE facilities and clarifying the nature of the alternatives. Through their combined research, outreach, and training missions, the Waste Management Institutes at Cornell, SUNY-Buffalo, and SUNY-Stony Brook, are committed to this goal.

Air Emissions from WTE Facilities

Combustion involves chemical transformations of paper, plastic, and other organic matter to

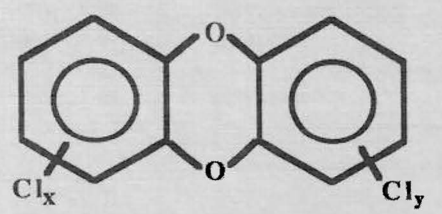
Focus on Dioxins and Fu

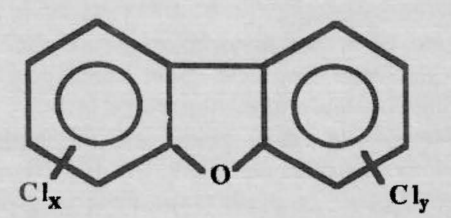
Dioxins and furans, two classes of organic compounds illustrated in Figure 1, contain dozens of specific compounds. Combustion chemistry, toxicity and environmental fate of polychlorinated dioxins and furans depends on the number and location of chlorines.

Data collected at over a dozen MSW combustion facilities in the U.S. and abroad provide an indication of the magnitude and variability of dioxin and furan emissions. Figure 2, based on nearly eighty samples from several facilities, demonstrates that even among similar designs, emissions of polychlorinated dioxins vary by over 1000 times. Mass burn facilities, which included new as well as antiquated facilities, achieved both the lowest and the highest emissions. Stack concentrations of all tetra-chlorinated dibenzo-dioxins (TCDDs) ranged from 0.1 to over 1,000 nanograms per cubic meter at 12 percent CO_2.

Currently, there are no federal regulations limiting the emissions of dioxins or furans from municipal solid waste combustion. EPA has indicated its intention to establish New Source Performance Standards for these facilities under the Clean Air Act by late 1989. WTE facilities in New York State undergo a detailed review, including the development of environmental impacts statements, under the State Environmental Quality Review Act. Emissions standards

Figure 1: Chemical structures of polyclorinated dibenzo-p-dioxin and polychlorinated dibenzo-p-furan.





simpler gaseous compounds such as carbon dioxide and water. However, this conversion is never complete. Regardless of the design, all combustion processes produce a variety of residues with the potential for air quality and human health impacts. Many of these emissions, like particulates, carbon monoxide, and acids, have been the focus of air pollution control for decades. Others, like heavy metals and certain organic chemicals, are more recent concerns. This relatively newfound awareness of trace contaminants is due in part to advances in our ability to detect very low concentrations and also to greater concern over more subtle, chronic efffects on health and the environment.

Air Pollution Control Equipment

A number of fairly common air pollution control technologies are employed at WTE facilities. Bag houses use mesh filters to trap particulates and other solid materials in the exit gas stream. Electrostatic precipitators or ESPs remove fine particles as the gas stream passes over a series of electrically charged plates. The neutralization of acid gases, which would otherwise corrode equipment and contribute to acid precipitation, is accomplished by the use of scrubbers. Many Japanese WTE plants inject dry powdered lime to neutralize acid gases. More common in the U.S. are so-called wet-dry or semi-dry scrubbers that introduce a lime-water slurry into the hot exhaust gases before removing solids. Generally, the efficiency of acid removal is higher at lower temperatures.

Dioxins and Furans

Dioxins and furans are two classes of organic compounds that have figured prominently in debates over waste incineration in New York State, elsewhere in the U.S. and abroad. These chemicals are very persistent in the environment, and several chlorinated forms are known to cause serious biological effects in a variety of animals at extremely low exposures. Since dioxins and

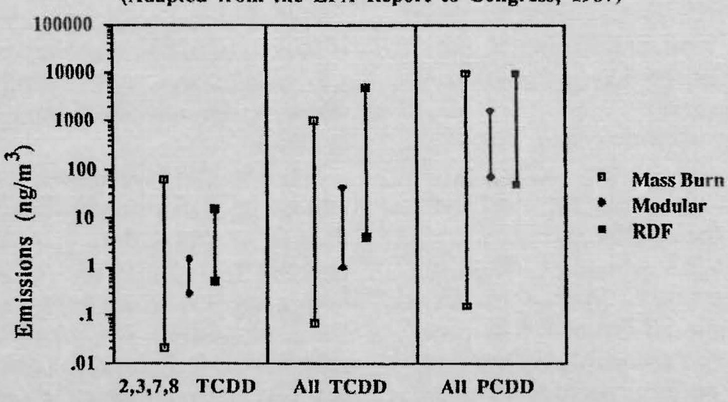
rans from WTE Facilities

for existing facilities are set by New York State through the permit process of the Department of Environmental Conservation (DEC). Any WTE facility that is permitted under the new DEC regulations will have to meet strict standards on dioxin and furan emissions.

Despite existing research and the obvious practical importance of the answer, there is no consensus within the scientific community on just how these chemicals are formed in combustion processes. Originally, conventional wisdom held that these chemicals were present in the waste input and were passing through the combustion zone unreacted. This raised the possibility of "cold spots" which permitted incomplete combustion within the burn zone. Subsequent research has indicated that dioxins and furans can be created after the gases exit.

Some studies have probed the relationship between plastics in the waste stream and dioxin emissions. Experiments conducted on a mass burn facility in Pittsfield, Massachusetts, indicate that dioxin and furan emissions are essentially independent of polyvinyl chloride content of the waste provided that higher operating temperatures and lower carbon monoxide levels are maintained. Still, there is a pressing need for a more detailed understanding of the mechanisms of chemical decomposition and reformation in full-scale MSW combustion facilities.

Figure 2: Emissions of Selected Dioxins from MSW Combustion Facilities (Adapted from the EPA Report to Congress, 1987)



Additional Reading

New York State Department of Environmental Conservation, Phase I Resource Recovery Facility Emission Characterization Study, May, 1987.

New York State Department of Environmental Conservation, Municipal Energy Recovery Facilities Handbook, New York State Environmental Facilities Corporation, 1988.

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New York State Joint Legislative Commission on Solid Waste Management, Resource Recovery in New York State: The Dioxin Controversy, November, 1985.

U.S. Environmental Protection Agency, Municipal Waste Combustion Study: Report to Congress, EPA/530-SW-87-021A, June, 1987.

U.S. Environmental Protection Agency, The Solid Waste Dilemma: An Agenda for Action, Office of Solid Waste, September, 1988.

furans have been detected at every MSW combustion facility tested, there has been considerable attention to the significance of emissions from both existing and proposed WTE facilities. (See the *Focus on Dioxins and Furans* below.)

New DEC regulations (Part 219-2.2) establish a maximum limit on emissions of 2,3,7,8-TCDD equivalents (an average that takes into account the relative toxicity of all chlorinated dioxins and furans) at 2 nanograms (billionths of a gram) per cubic meter adjusted to standard conditions at 7 percent O_2. Studies of emissions from five WTE facilities in New York State found levels of 2,3,7,8-TCDD equivalents between 4.16 and 66.1 ng/m^3 at 7 percent O_2.

Metals

A wide variety of metals are found in MSW, but unlike organic compounds they cannot be destroyed. Any metal that is present in the waste feed to a WTE facility will exit the plant in the flue gas, fly ash, or bottom ash. Bottom ash is the material that remains on the burning grate after waste combustion. Fly ash refers to those solids that are carried out of the combustion chamber with the exhaust gases. For each metal, partitioning among these three effluents depends on operating conditions (particularly temperature and chlorine content) and design features. Over the fast few years, considerable attention has been devoted to mercury, lead, and cadmium, three metals that are common in MSW and potentially harmful to those exposed.

Mercury can cause nervous system disorders in humans. Because it has a low boiling point (around 675°F), mercury is readily volatilized. It is necessary to cool the exhaust gas to condense this metal onto particles which can then be trapped by ESPs or bag houses. Mercury can also react with chlorine in the gas stream to form compounds which are more water-soluble than the metallic form. MSW contains roughly 10 times more mercury than do fossil fuels. It is estimated that about one half of the mercury in MSW can be traced to household batteries.

Lead is another metal about which much is known. It has long been recognized as a poison and recent research on health effects of lead have identified neurological impairment from concentrations found in some urban environments. Lead, one of the most plentiful metals in MSW, can account for as much as 0.15 percent of MSW by weight. Unlike mercury, approximately 95 percent is found in the dust and slag. Cadmium is a third metal of concern. European research suggests that MSW combustion is either the largest contributor to atmosperic cadmium or else second behind metallurgical operations. Depending on operating temperature, moisture and chlorine content of the waste, about half of the cadmium exits in the flue gas as $CdCl_2$.

Criteria Pollutants

The remaining category of air emissions is known as "criteria pollutants" under the Clean Air Act. Oxides of nitrogen (NO_X), carbon monoxide, sulfur dioxide and particulate matter are common pollutants from a variety of industrial, utility and transportation sources. Unfortunately, while higher combustion zone temperatures favor destruction of organic chemicals, they also lead to increased NO_X emissions. Research is underway to develop ammonia injection, flue gas recirculation, and catalytic reduction processes to diminish NO_X emissions from WTE facilities.

The new DEC regulations establish a particulate matter standard of 0.01 grams per dry standard cubic foot (g/dscf). It is expected that WTE facilities bound by these guidelines will need both a semi-dry scrubber and a bag house. Such designs have been employed with success overseas, but the facilities in Marion County, Oregon, and City of Commerce, California, are the only U.S. examples to date.

Incineration One Alternative To Land Burial of Waste

By James D. Felske

Thermal destruction of hazardous waste by incineration is one of several technologies being employed as an alternative to the waste management practice of land burial. This technology is presently being applied in several forms, the most popular of which are:

- liquid injection incineration (analogous to the oil furnace for domestic heating).
- fixed hearth incineration (analogous to the coal furnace for domestic heating),
- rotary kiln incineration, and
- fluidized bed incineration.

The selection of incinerator type is based on the quantity and physical, chemical and thermal properties of the particular hazardous waste to be burned. Currently, only about 4 percent of the hazardous wastes generated nationally is incinerated. A listing of operating commercial hazardous waste incinerators in the United States is provided in Table 1.

Federal regulations that govern the incineration of hazardous wastes have been promulgated under the authority of the Resource Conservation and Recovery Act (RCRA) (pertinent to incineration of organic-solvent wastes) and the Toxic Substances Control Act (TSCA) (applicable to incineration of polychlorinated biphenyls, PCBs).

Incinerator performance standards include requirements for:

- the destruction and removal efficiency (DRE) of each of the principal organic hazardous constituents (POHCs) present in the waste (at least 99.99 percent removal)
- restriction on hydrogen chloride emissions (less than 1.8 kilograms per hour or one percent of the hydrogen chloride in the stack gas before entering the air pollution control equipment)
- restrictions on particulate emissions (less than 180 milligrams per dry standard cubic meter of stack gas)

James D. Felske

The permitting of a hazardous waste incinerator is a lengthy process involving trial and test burns under controlled conditions. The findings from these test burns must be in accord with RCRA (or TSCA) requirements and other applicable air quality requirements.

Although New York State does not have a permitted commercial hazardous waste incinerator at the present time, there are two generator-owned incinerators that are permitted to burn company-generated hazardous wastes and two other generator-owned facilities nearing the end of the permitting process. (See Table 2)

Research and development in incineration technology is needed in order to improve incinerator performance and achieve more cost-effective operation. The New York State Center for Hazardous Waste Management is presently supporting two projects whose goals are to provide a better understanding of the complex phenomena associated with the combustion of liquid hazardous wastes.

Dr. Nasser Ashgriz and Dr. James Felske, State University of New York at Buffalo, are conducting analytical and experimental studies of the decomposition, vaporization, ignition, and combustion of single and multi-component liquid hazardous waste drops. Occidental Chemical Co. is an industrial partner in this project.

Dr. Thomas Avedisian, Cornell University, is conducting an analytical and experimental study that is exploring blending strategies which will improve the destruction efficiency of hazardous waste liquids within rotary kiln or spray-fired incinerators. Droplet experiments are being conducted at Cornell and spray experiments will be conducted cooperatively using facilities at the National Bureau of Standards.

The long-term goal of these studies is to establish a reliable base of fundamental knowledge upon which rational design principles can be formulated. It is only through a better understanding of the essential combustion mechanisms that a new generation of incinerators can be designed and constructed to operate in an efficient, reliable and environmentally acceptable manner.

James D. Felske is a professor in the department of mechanical and aerospace engineering at State University of New York at Buffalo.

Table 1 **Operating Commercial Incinerating Facilities in U.S.***

OWNER	LOCATION	TYPE OF UNIT	TYPE OF WASTES
Environmental Systems Company	El Dorado Arkansas	Rotary Kiln	PCB, Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
International Technology Corporation	Martinez California	Liquid Injection	Acids, Non-Halogenated Solvents & Organics, Metallic Inorganics
Chemical Waste Management Inc.	Sauget Illinois	Liquid Injection & Fixed Hearth	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
Chemical Services, Inc.	Chicago Illinois	Liquid Injection & Rotary Kiln	PCB, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Non-Metallic Inorganics
LWD, Inc.	Calvert City Kentucky	Liquid Injection	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics
LWD, Inc.	Clay Kentucky	Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics
Rollins Environmental Services	Baton Rouge Louisiana	Liquid Injection & Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics, Metallic and Non-Metallic Inorganics
Rollins Environmental Services	Bridgeport New Jersey	Liquid Injection & Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics, Metallic and Non-Metallic Inorganics
Rollins Environmental Services	Deer Park Texas	Liquid Incineration & Rotary Kiln	PCB, Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics, Metallic and Non-Metallic Inorganics
Caldwell Systems, Inc.	Lenoir North Carolina	Liquid Injection & Solid Incineration	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic & Non-Metallic Organics
Ross Incineration	Grafton Ohio	Liquid Injection & Rotary Kiln	Acids, Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
Stablex South Carolina Inc.	Rock Hill South Carolina	Fixed Hearth	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics, Metallic Organics
GSX Thermal Oxidation Corp.	Roebuck South Carolina	Liquid Injection	Halogenated & Non-Halogenated Solvents, Halogenated & Non-Halogenated Organics
B.D.T., Inc.	New York	Not Available	Metals

* In addition, there are four TSCA commercial incinerators permitted to burn PCB wastes. They include: Pyrochem (Coffeyville, Kansas), Pyrotech Systems—mobile unit, U.S. EPA incinerator—mobile unit, and General Electric (Pittsfield, Massachusetts).

Source: EPA, Office of Solid Waste and Office of Toxic Substances.

Table 2 **Generator-owned Incinerators in New York State**

Facility Names	Incinerator Type	Status
General Electric Co. Noryl Products Div. Selkirk, NY	Fluidized Bed	permitted
Occidental Chemical Co. Buffalo Ave. Niagara Falls, NY	Liquid Injection	permitted
General Electric Co. Silicones Div. Waterford, NY	Rotary Kiln and Fixed Box Liquid Injection	permit pending
Eastman Kodak Co. Rochester, NY	Rotary Kiln	permit pending

Notes and Announcements

New York and other states require deposits on bottles and cans.

ESF Shortcourse Set For Managers

State University College of Environmental Science and Forestry (ESF) will offer a 13-week, non-credit shortcourse, "Integrated Hazardous Materials Management," for supervisors and managers of RDRA-regulated facilities. Classes will meet each Tuesday, February 21-May 6, from 7 to 10 p.m. in 215 Bray Hall on the ESF campus in Syracuse.

The course meets or exceeds the training requirements of the federal Occupational Health and Safety Administration (OSHA) 29 CFR 1910.120 standards. Topics will include:

Developing a Hazard Communication Program
Industrial Health and Safety
Community Right-to-Know
Waste Management

The 13-week format will allow participants to apply classroom information about hazardous materials management to their workplaces and to receive extended feedback.

Interested persons may call the ESF Office of Continuing Education at (315) 470-6891.

Superfund Report Available Now

New York State Senator John B. Daly (R-Niagara Falls), chairman of the Joint Legislative Commission on Toxic Substances and Hazardous Wastes, recently released his staff's 1988 report, *New York State Superfund: Achieving Clean-up by the Year 2000?* Senator Daly represents the 61st Senate District in the State Legislature.

According to David L. Whitehead, former executive director of the commission, the state Department of Environmental Conservation (DEC) has made progress toward remediation of the state's inactive hazardous waste sites, but progress lags far behind the Year 2000 targeted completion date. The DEC's 13-year remediation plan, announced in 1986, gained the support of the state's voters who approved an Environmental Quality Bond Act in November, 1986.

The commission, now led by David Sterman as executive director, recommends that the DEC:

- Make site investigation and classification top priorities.
- Prepare a realistic long-term forecast with achievable goals if remediation by 2000 is impossible, or explain the means it will use to reach the original goal if the target date is unchanged.
- Compel responsible parties to provide complete and accurate data in "a timely fashion."
- Make clear the status various sites have reached in the investigation process.
- Monitor the effect of federal Superfund slowdowns on the state's remediation program.

Interested persons may receive a free copy of *New York State Superfund* by writing:

Legislative Commission on Toxic Substances and Hazardous Wastes
Legislative Office Building
Albany, New York 12247

Stony Brook Sponsors Beach Symposium

The Waste Management Institute at Stony Brook will sponsor a scientific symposium, "Floatable Wastes in the Ocean: Social, Economic, and Public Health Implications," March 21-23 at State University of New York at Stony Brook.

The symposium responds to growing public concern over the accumulation of floatable wastes on the beaches of New York, New Jersey, and Connecticut. The conference will focus on the economic impact of floatable waste on the fisheries and tourist industries as well as on the public health and safety implications of the problem.

Interested persons may call (516) 632-8704.

Recycling Workshop

The Cornell Waste Management Institute will sponsor a spring, 1989, workshop, Reducing the Wastestream: Making Recycling Work. Tentative dates are May 31-June 2. Interested recycling practitioners may call Ellen Harrison at (607) 255-8576.

ESF Researchers Investigate Ash Construction Blocks

Richard McClimans knows a way to make $1,500 a day in small change. Operators of the suspension-fired, refuse-derived-fuel, waste-to-energy incinerator at Rochester, MA, recover approximately 70 cents in coins from the incinerator's ash for every ton of refuse burned. At design capacity of 1,800 tons per day, the total in redemption checks from the federal Treasury would come to more than $500,000 per year.

Small change is a mere footnote to McClimans' basic trash- to-ash-to-cash thesis. A civil engineer and senior research associate at State University of New York College of Environmental Science and Forestry in Syracuse, McClimans is convinced that processed incinerator ash can serve as a substitute for sand and gravel in the construction industry.

The use of processed incinerator ash to make masonry products "alleviates the costs of mining and disturbing land (for sand and gravel pits) and the need to bury ash in landfills," the ESF researcher says, "and it complies with the state Department of Environmental Conservation (DEC) hierarchy for waste management."

The New York State Solid Waste Management Act of 1987 ranks recycling and reuse higher than landfills in waste management guidelines. Refuse-derived-fuel plants typically burn only those materials which cannot be recycled. To the extent practicable, paper, glass, and metal are removed before and after burning takes place.

Dr. James M. Hassett, left, and Richard McClimans test construction blocks made from incinerator ash.

The Southeast Massachusetts (SEMASS) Project at Rochester, MA, where the small fortune in small change turns up every day, is a co-generation plant which produces both electricity and steam. Energy Answers Corporation of Albany, NY, developed the plant. ANSWERS (Albany, New York, Solid-Waste Energy Recovery Systems) also operates a waste processing plant in the Albany area. The plant provides fuel to a co-generation incinerator operated by the New York State Office of General Services (OGS). That plant produces both electricity and steam for heating and operating state buildings.

McClimans uses processed ash from the OGS facility for his masonry products research on the ESF campus. Over the past two years he and ESF faculty members Dr. James M. Hassett, Dr. John P. Hassett, and Dr. Robert W. Davidson have tested both bottom ash from the OGS incinerator and construction blocks made with the ash. A manufacturer of masonry construction materials makes the prototype bottom-ash blocks.

The researchers and their students subject the blocks to a laboratory version of life outdoors in the Northeast—synthetic acid precipitation as well as cycles of freezing and thawing and refreezing. The ash-based blocks seem to hold up as well as the familiar cement ones, McClimans says, and they look the same.

Energy Answers Corp. recently applied to the DEC for a permit under Section 360 - 3.5 of 6 NYCRR (New York Code of Rules and Regulations). The permit would allow Patrick F. Mahoney, company president, to set up a plant for processing incinerator ash produced by the OGS facility. The processed ash could be used as road fill material or to make masonry products like the ones McClimans and his colleagues are testing on the ESF campus. The bottom ash from refuse-derived-fuel incineration is non-hazardous even before processing, McClimans says. The ESF researchers' tests for lead, cadmium, and other heavy metals in processed ash consistently register below widely accepted thresholds for characterization as hazardous waste.

McClimans says that communities with waste

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Research Programs Aim For Improved Combustion

By Frederick C. Gouldin

Frederick C. Gouldin

In the last several decades significant advances in waste combustion facility design have resulted in reduced air pollutant emissions and improved operations. Many of these developments have occurred abroad where, relative to the United States, combustion of waste materials is much more widespread. Modern waste combustion facility designs, when properly implemented, are viable options for the solution of certain waste disposal problems. On the other hand, continued research and development will lead both to design improvements and to new incinerator concepts which will reduce environmental impact of waste combustion at the lowest cost.

The objective of the SWCI research programs is to contribute to the improvement of waste combustor designs in order to make them more reliable and less expensive, and to reduce their potential impact on the environment. The Institute's staff, in consultation with both its Executive Committee and its Technical Advisory Committee, has developed a set of research priorities. The major research priority areas are combustion processes, ash properties and stabilization, and air pollutant emissions and control. These priorities will form the basis for developing the Institute's research program which will be carried out by researchers throughout New York State.

Combustion Processes

Important combustion processes are chemical reactions, heat and mass transfer and fluid flow. During the combustion of waste these processes occur simultaneously, transform the solid waste feed into simple chemical species, ash and trace contaminants, and release chemical bond energy as heat energy. In addition, these processes determine the quantity and quality of air pollutants formed and the characteristics of the ash residues.

Individually these processes are complex. For example, over a hundred chemical reactions involving several ten's of different chemical species are required to characterize the chemistry of waste combustion. Together these processes form an extremely complicated process which is difficult to understand. As a consequence, combustor design is highly empirical and design improvements have developed slowly.

Research on combustion processes that improves our understanding of these processes promises several practical benefits including better understanding of the relationship between waste composition and resulting air emissions and ash composition, and the development of combustion control systems and of innovative combustion technologies. Specific research projects might examine the chemical kinetics of dioxin and furan formation, the fate of heavy metal compounds during combustion, fly ash transport, and the mechanisms of ash deposition on, and erosion and corrosion of, boiler tubes.

Ash consists of the several components of waste which do not burn and of solids formed by the combustion of other waste components, mostly metals. Heavy metal species which are present in the waste prior to combustion, and which concentrate in the ash during combustion, are a primary concern. If leached from the ash, these metals can be an environmental and human health hazard.

Research on the potential for ash toxicity and on methods to stabilize ash is a high priority. The results of this research will help in determining whether ash might be used for practical purposes such as aggregate in road surfaces, or whether it must be disposed of in specially designed landfills to avoid leachate problems.

Regulatory Constraints

Recently enacted DEC regulations place constraints on air emissions from the combustion of waste. Research on air emissions control technology is needed to achieve these standards at the lowest cost. Of special concern to the Institute is research leading to the development of continuous monitoring devices for pollutant emissions and of processes which can be used to reduce the emission levels of air pollutant species such as dioxins, furans, fly ash and oxides of nitrogen.

Combustion in general, and waste combustion in particular, is the combination of many different, multifaceted processes. It is the interaction between these different processes which makes combustion such a complex phenomenon. The research program outlined above emphasizes the study of individual processes. There is also a need to integrate knowledge of these individual proc-

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Dr. Frederick Gouldin is director of the Combustion Simulation Laboratory of the New York State Solid Waste Combustion Institute at Cornell University.

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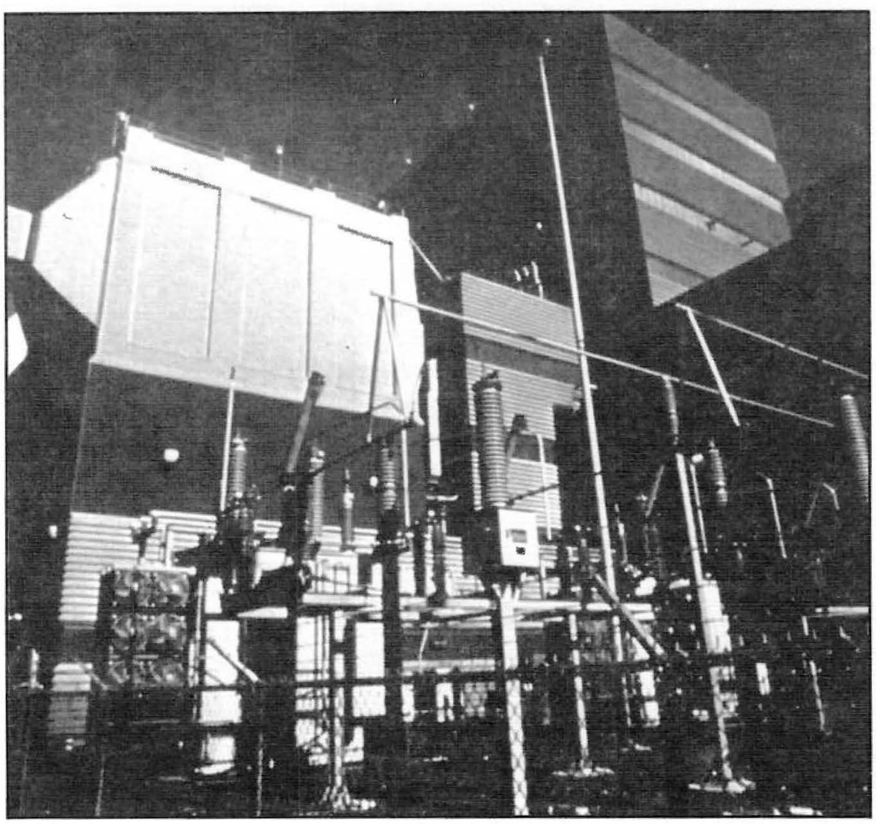
esses to gain a quantitative understanding of the whole.

This objective is being met by the development of numerical simulation models for the combustion of waste. This work is being performed by researchers at Cornell using the state-of-the-art computing facilities of the Theory Center, a national supercomputer center, to create an accurate mathematical description of this highly complex phenomenon.

A successful simulation code can be used for many purposes, such as simulation of the influence on plant operations and performance of changes in design, waste composition, and in operating parameters. The development of such a simulation code is a very ambitious project that is best pursued in stages. Initial work on simulation will focus on processes in the combustion chamber. Processes to be considered for modeling include fluid mixing and turbulence, fly ash transport, carbon monoxide oxidation, nitric oxide formation and destruction, and heat transfer.

There can be little doubt that with time and effort useful simulation codes can be developed. Highly useful simulation models have been developed for automotive engines and gas turbines, and models for coal combustion are being developed. Where possible the results of this work will be incorporated in the waste combustion model. Later efforts may focus on the heat transfer sections and gas cleaning equipment.

Below, an incineration facility in Peekskill, NY.



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disposal problems should seriously consider alternative technologies before they devote all their waste management resources to new landfills or old technologies. Innovative technologies such as the SEMASS facility can be more cost effective than older ones that must be adapted to meet new standards of performance, the researcher says.

The SEMASS plant is designed to convert to energy, or recover for beneficial use, more than 98 per cent of the volume of waste it receives. The figure includes more than 32,000 tons of recyclable metals (not counting the small change) and more than 380 million kilowatt hours of electricity per year.

SEMASS charges a tipping fee of about $20 a ton. Tipping fees at mass burn incinerators or landfills can be as high as $100 a ton, McClimans says. The Massachusetts plant accepts solid waste from more than 30 towns as well as from private waste disposal companies.

Seminars Scheduled

Environmental Resource Center of Fayetteville, NC, will sponsor a series of seminars on Hazardous Waste Management and Superfund Amendment and Reauthorization Act (SARA) Title III throughout the United States beginning in April.

Each two-day seminar will cover "How to Comply with Hazardous Waste Management Regulations" the first day and "How to Comply with Current SARA Title III and OSHA (Occupational Safety and Health Administration Regulations" the second day. New York State sessions will be Sept. 11 and 12 in Rochester and Sept. 13 and 14 in Albany.

Interested persons may call Maryel Tomter at 919-822-1172 or 800-5-ERC-ERC or write: Environmental Resource Center, 608 Fairview Circle, Fayetteville, NC 28311.

The hazardous waste seminars will cover Resource Conservation and Recovery Act (RCRA) regulations, Department of Transportation (DOT) requirements that apply to hazardous waste management, and emergency repsonse procedures. The SARA/OSHA seminars will explain the law, who is covered by it, and how to comply with current regulations; Material Safety Data Sheets (MSDS) requirements; chemical release notification requirements and inventory forms; trade-secret confidentiality; penalities for noncompliance, and new requirements of the Hazard Communication Standard.

Floatable Waste Litters Beaches Of Northeast

By R. Lawrence Swanson

R. Lawrence Swanson

Another summer beach season has come to a close, and like the summers of 1976 on Long Island and 1987 in New Jersey, this one will be remembered for the beach closures, the faltering tourist trade and perhaps reduced sales at the fisheries' markets. For the most part, buoyant waterborne waste materials and debris, euphemistically called floatables, were the root of the problem.

The beach closures along coastal New Jersey in 1987 and the south shore of Long Island in 1988 have focused on a totally different set of waste products than in the past—hospital and infectious waste. As with sewage wastes, concern centers around the issue of public health. People's sensitivity to floatable wastes is indeed heightened. While the total volume of floatables in 1988 was quite large, there were only about six bags of medical wastes found.

The Hudson-Raritan estuary serves as the greatest general source of floatable waste to the Bight since the bulk of the individual sources tend to be located around the periphery of the estuary. Floatables are effectively flushed from the estuary during the time of the spring freshet, typically from March to May in the upper Hudson. The impact of the freshet on the Bight is apparent about one month later. Therefore, large quantities of floatables can be expected to be flushed into coastal water at or near the time of the commencement of the summer beach season.

Heavy Rain

Other than at the time of the spring freshet, the floatable load at any one time in the estuarine plume is largely a consequence of the relatively recent rainfall history. A heavy rain following an extended dry period such as in late July 1988 will most likely produce the heaviest volume of floatable material; streets will be cleansed, sewage treatment plants bypassed, and the garbage transfer points and landfills flushed by runoff and perhaps higher storm waters. Occasionally accidental spills and illegal discharges will add to the normal heavy floatable load.

The floatables are carried with the Hudson-Raritan estuarine plume along the New Jersey coast where they can be periodically transported shoreward. This is why the beaches at Sandy Hook are so often cluttered with undesirable materials. Once floatable materials make their way into the Bight they are subject to the physical oceanographic and meteorological processes operating on Bight waters.

Effect of Wind

The general flow of surface waters over the continental shelf is from the northeast to the southwest running parallel to the trend of the coast. Floatable materials in the surface layers are transported with these currents and are also influenced by wind driven transport.

During summer months, prevailing winds have a pronounced effect on the distribution and fate of floatables. Typically the prevailing wind is from the south to southwest but intermittently shifts to other directions. These winds tend to transport the floatables to the north and east. When the southerly wind field intensifies and is exceedingly persistent out of the south, the likelihood of a

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Collectors of shells and beach stones often find more trash than treasure along the tide line.

Dr. R. Lawrence Swanson is director of the Waste Management Institute of the Marine Sciences Research Center, State University of New York at Stony Brook.

major floatable event occurring on Long Island is increased. Such was the case in 1976 and 1988. In 1987 the winds were quite variable, often out of the east, thus washing floatables ashore on New Jersey.

Medical Waste

Floatable waste is ubiquitous in the New York Bight, and Long Island's beaches are particularly vulnerable. Illegal disposal has probably been the major source of floatable medical wastes during the 1987 and 1988 events, as a result of deliberate dumping by some medical facilities for the sole purpose of avoiding the high cost of appropriate disposal. Some medical wastes probably are also mixed in carelessly with domestic solid wastes by small medical offices, including dentists and veterinarians and chronic home-based patients. The recent rise in the costs of

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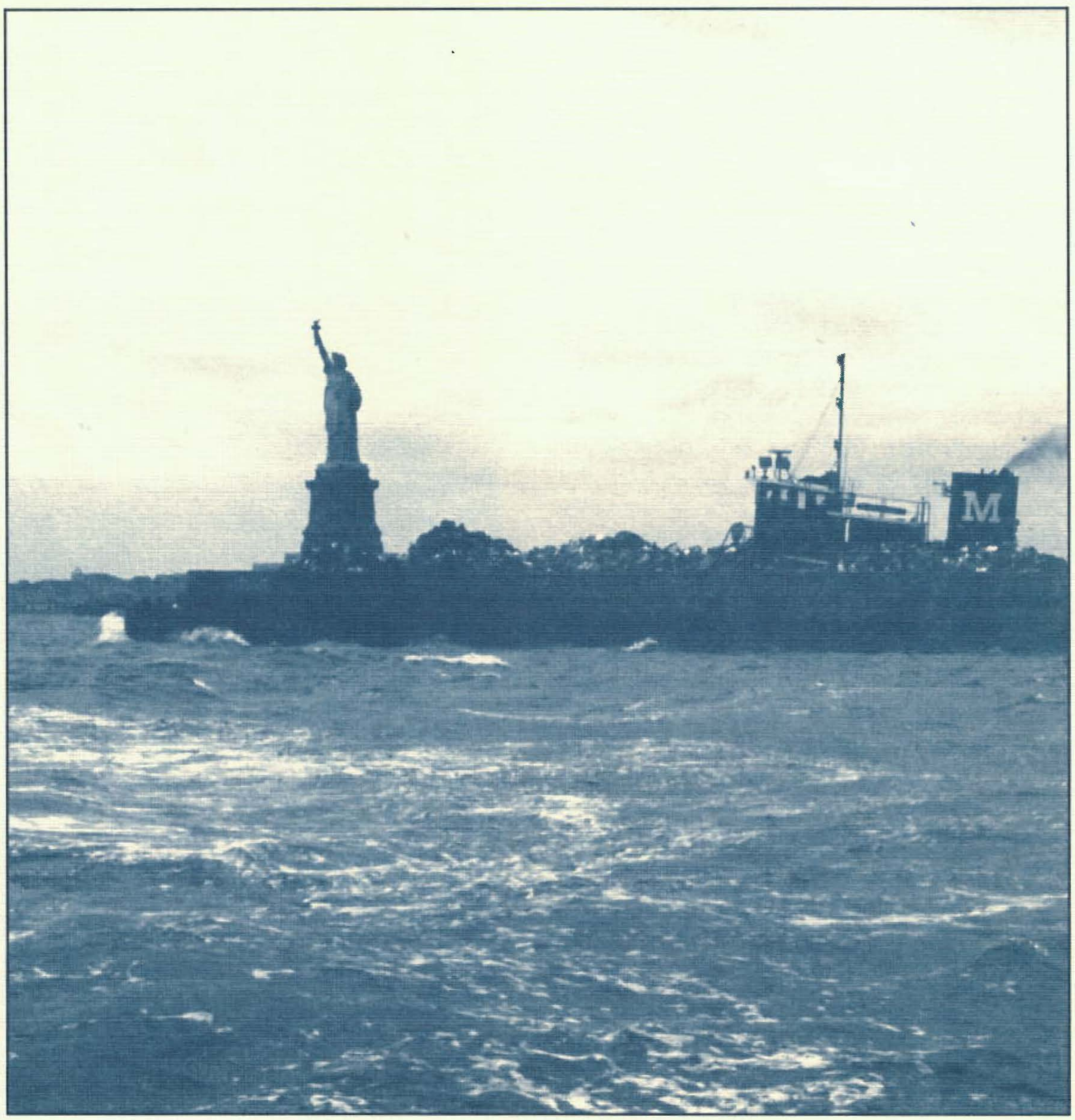
disposing of medical or infectious waste is an incentive to dispose of such wastes illegally.

Until fewer potential floatables are manufactured, controlling their dispersal will be increasingly costly and uncertain. Until source control is more effective, intensive beach cleaning efforts remain the only solution. The present levels of source control will continue to cause reductions in beaches near most of the metropolitan region's users, resulting in unprecedented pressures upon beaches further to the east and south, and heightening frustrations of those unable to reach the more distant beaches.

On Labor Day, 1976, we put the floatable problem out of our minds hoping that it would disappear. It is important not to let the passage of summer dim our memories, if we want our politicians and public agencies to initiate action to reduce the problem. We must also realize that these improvements will be costly.



Garbage barges carry tons of New York City refuse out to sea every day.

Guest Comment

Progress Requires Academic Research

By Sen. Kenneth P. LaValle

Kenneth P. LaValle

When the average citizen thinks of trash and garbage, he or she usually thinks of getting bags or cans of it to the curb in time for the hauler to pick it up, take it away, and do something with it. Policymakers think in bigger terms—such as the 20 million tons of solid waste generated in New York State each year. But, they too think in terms of taking it somewhere and doing something with it.

The "where" and "what" of solid waste management is taking on new importance in the state. The sheer volume of waste is worrisome, not to mention the potential hazards to health and the environment.

Some of us have long recognized that recycling is the best answer to the problem.

Long before the voyage of the infamous garbage barge thrust the issue into the national consciousness, I was looking for ways to assist local governments in the collection and marketing of recycled materials. I sought to overcome two major obstacles: the high cost of starting a recycling operation and the difficulty of finding suitable markets for recycled goods.

I wanted the state to provide financial and technical resources to address the situation and introduced legislation in 1987 to create the New York Statewide Recycling Corporation. (We refer to it as NYSWRC because you have to pronounce it "nice work.") The corporation would set up waste reduction and recycling programs statewide, with the goal of reducing the state's solid waste output by 60 percent in 10 years and by 90 percent in 20 years.

Creation of NYSWRC has not happened, but I continue to promote many of its specific provisions. The Legislature took a major step with passage of the Solid Waste Management Act of 1988, which included many of my original proposals.

Such actions by the Legislature are only part of our effort to attack the solid waste problem. As chairman of the Senate Committee on Higher Education, I believe that our postsecondary institutions hold the key to discovering how modern technology can alleviate some of the major problems we face today and will face in the future.

Solid waste management is an area where the potential for long-term solutions lies in the academic community. We have set in place three university-based projects in this area, and it is gratifying to see progress in drawing researchers together in a concentrated effort to solve the problem.

Each project—drawing individually upon the strengths of Cornell University and the State University of New York at Buffalo and at Stony Brook—could make significant progress on its own. By banding together in a joint effort, their strength is amplified far beyond a mere factor of three. Their cooperation fuels our hope for finding new technologies and applying them to solutions for the future.

The environmental, public health, and political issues surrounding the management of waste occupy several minutes of television news programming each week and become front-page stories in our local newspapers almost daily. "Guest Comment" provides a forum for lively debate of the complex subject. The opinions expressed are those of the authors. The editors reserve the right to edit for length.

State Senator Kenneth P. LaValle (R - Port Jefferson) represents the 1st District in the New York State Senate and is chairman of the Senate Committee on Higher Education. He has taken an active role in addressing waste management issues in the state, with particular emphasis upon the need for academic research into new waste management technologies.

Waste Management Research Report

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