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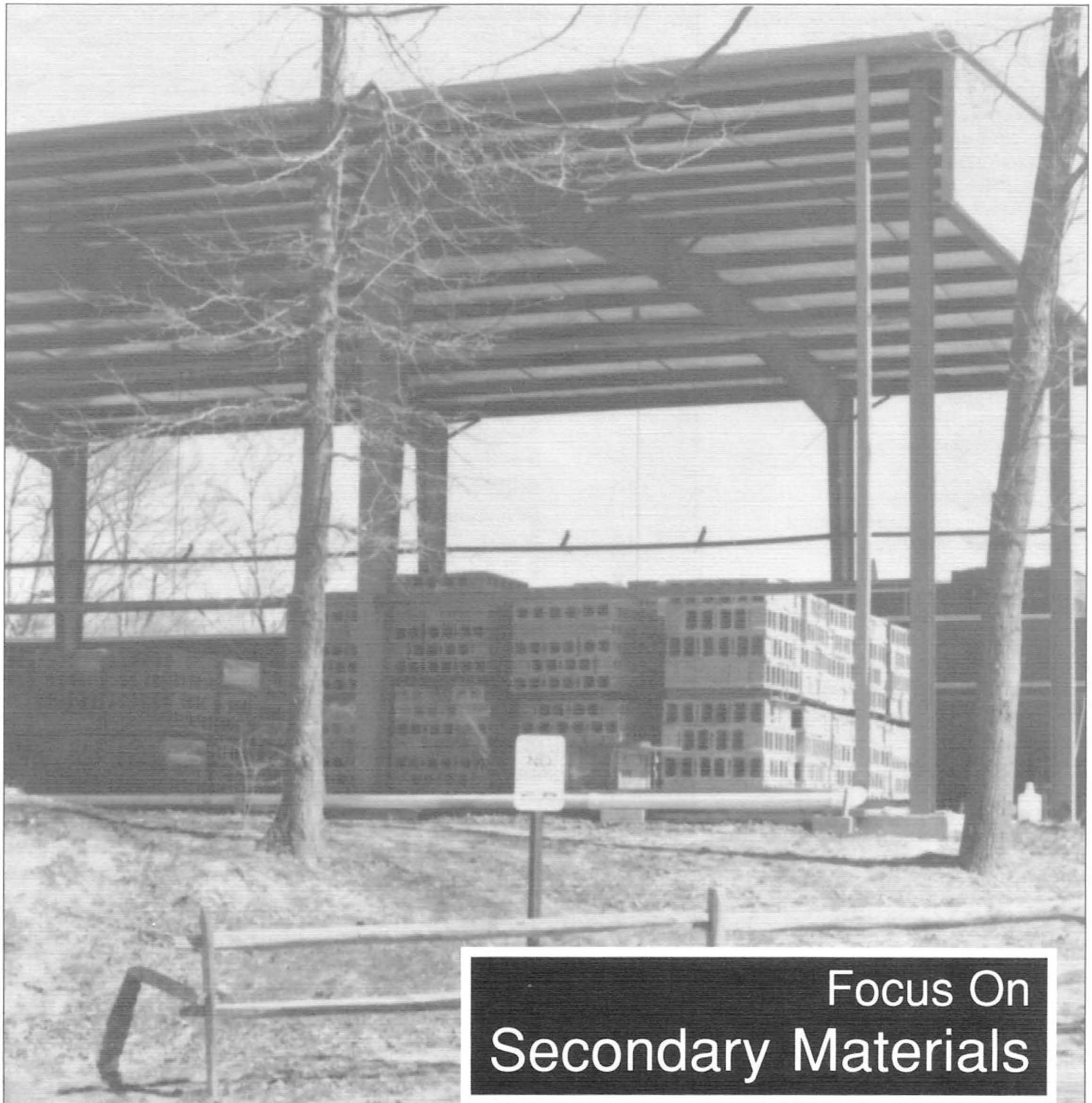

Focus On Secondary Materials

Waste Management Research Report

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About This Newsletter

Waste Management Research Report appears three times a year in order to share research from the publication's contributing institutions. Each issue focuses on one major area of waste management and highlights the contributing institutions where researchers investigate the featured topic. The Solid Waste Management Institute of the Marine Sciences Research Center at State University of New York at Stony Brook is responsible for this Report, with the emphasis on secondary materials. The New York State Center for Hazardous Waste Management at State University of New York at Buffalo will be responsible for the fall, 1990, issue. The focus will be on remediation.

On the Cover

Blocks containing stabilized incinerator ash will be used to construct the walls of the pictured boathouse at the Marine Sciences Research Center, State University of New York at Stony Brook.

Director's Comment

Secondary Materials Deserve a Chance

By R. Lawrence Swanson

R. Lawrence Swanson

"Secondary materials" is the theme for this issue of *Waste Management Research Report.*. Governments, industries, and environmental groups throw out the term as a partial solution to our solid waste management problems, often in the same breath with recycling. But what are secondary materials? What do they promise? What are their drawbacks? How should we, as government officials, industrialists, environmentalists, and citizens react to them?

Secondary materials are made primarily from one or more waste materials or by-products that have been diverted or recovered from the solid waste stream and converted to a new physical form. The new products serve end-uses other than those of the original materials. "Secondary" implies some degree of contamination, and the materials cannot be "recycled" as virgin materials in a manufacturing process nor "reused," as in the refilling of a bottle. Examples of secondary materials include plastic lumber made from mixed plastic residues; reinforcing bars made from mixed scrap metals, and insulation materials made from newspapers.

Secondary materials are different in several ways from products made of virgin materials. Impurities in materials, the potential for less desireable engineering properties, the possible presence of environmental contaminants, and reduced aesthetic properties mean that products made from secondary materials may be of lesser quality, in lower demand, and of greater environmental concern than those made from virgin materials. Secondary materials also can present disposal problems. The farther residue materials move from their initial introduction into the manufacturing process to the final product, the greater such problems are likely to be. And, the more the materials have been recycled, the greater is the chance for impure, contaminated, secondary materials with undesirable engineering and aesthetic properties to enter the marketplace.

It is extremely important to be particularly thoughtful in the development of secondary materials. Products with utility, that consistently meet engineering specifications, must be developed. Their potential health and safety hazards and their environmental threats must be well known. Their expected durability, recycling or re-use potential, and appropriate disposal strategy must be understood and spelled out to the consumer.

It is reasonable to expect that government may at some time develop standards and criteria for testing and labeling, perhaps by specifying limits for use and mandating materials identification and the inclusion of disposal suggestions. In the meantime, manufacturers must lead with rigorous testing programs for health and safety, engineering soundness, and environmental protection.

It is extremely important that manufacturers not exploit the public's enthusiasm for overall waste reduction and waste management endeavors by touting products that may prove to be poor investments or environmentally undesirable. Manufacturers must not overstate the potential benefit of any product.

Equally important, government and environmental organizations must be cautious not to condemn inappropriately the initiative and financial risks taken by

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R. Lawrence Swanson is director of the Marine Sciences Research Center at State University of New York at Stony Brook.

Secondary Materials

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entrepreneurs and by businesses that develop secondary materials. In their very important role as protectors of the environment, government and environmental groups must take care not to hinder real progress by acting with insufficient information.

Innovation, development, experimentation, and marketing are imperative if society is to make a success of reuse, recycling, and the use of secondary materials. Secondary materials must be free to find their niche in the marketplace, as do other products. Some will fail when subjected to environmental scrutiny; some will fail for a variety of other reasons. But, in order to help reduce the overall waste stream, let's encourage the development and testing of these secondary products.

Letters

Editor's note: Herbert R. Pahren of Mt. Healthy, OH, a scientist who has worked for the U.S. Environmental Protection Agency and in the field of municipal solid waste, responded to Ellen Harrison's article on plastics in the waste stream which appeared in the Spring, 1989, issue of this publication. We print here Pahren's questioning of Harrison's sentence, "Whether degradable or not, disposable diapers from both infants and incontinent adults pose potential health problems," and her response to his letter. Harrison is senior extension associate and associate director at the Cornell Waste Management Institute, Cornell Center for Environmental Research, Ithaca, NY. We must edit letters to meet space limits.

Pahren writes: Several years ago, I made a thorough evaluation of the source, fate, and public health issues associated with microorganisms in municipal solid wastes. Disposable diapers contributed a surprisingly small percentage of the total fecal bacteria present and do not add any viruses and bacteria which are not already present in the landfill from other sources. A properly designed landfill will itself prevent the escape of viruses and bacteria (because of) high temperatures generated after the initial landfilling of solid wastes, the hostile (acidic) environment, leachate toxic to microorganisms, and the solid waste/soil barrier that filters pathogens before they reach any water supply. The only polio isolates ever found have been of the Sabin strain which is intentionally given to children to build immunity to a wild strain. A university epidemiological study of sanitation workers found no higher levels of infection or disease than in controls. The EPA and the Center for Disease Control exclude urine and feces as infectious waste unless from people isolated to protect others from infectious disease. The U.S. Department of Health and Human Services and the American Hospital Association agree that disposable diapers should not be classified as infectious waste. There is no scientific data to support a charge of public health concern from pathogens in landfills.

Harrison replies: Thank you for your letter concerning my article on degradable plastics that appeared in the Spring, 1989, *Waste Management Research Report*. I would like to follow up on the point you raised concerning the potential for health problems (or lack thereof) resulting from the presence of disposable diapers in the regular trash stream. Please send me copies of the data and studies you mention or a reference as to where I may obtain them. They sound quite relevant. The issue was not central to my article and is not one I researched extensively. If my statement was misleading, I would like to correct it.

Stony Brook Researchers Investigate Uses For Incineration Residues

By Vincent Breslin

Vincent Breslin

Introduction

Many communities are implementing integrated solid waste management strategies that may include recycling, composting, waste-to-energy incineration, and landfilling to handle the ever increasing amounts of solid waste. Because of scarce landfill space and soaring disposal costs, one goal is reduction of waste that requires disposal in landfills. Efforts are underway to divert materials from the waste stream and use them for the manufacture of new, or "secondary," products.

Secondary products are made primarily from one or more waste materials or by-products that have been recovered or diverted from the solid waste stream and converted into new physical forms. The new products are intended for end uses other than those of the original materials. Excluded by this definition are materials or by-products generated from or commonly reused in an original manufacturing process. Conversion of waste materials to a secondary product can occur via shredding, grinding, heating, extrusion, or the addition of chemicals or additives. The definition does allow for the addition of waste materials or by-products to virgin materials to form a secondary material. The process should, however, result in a product with enhanced quality. Primary recycled products such as paper products from paper, glass from glass, and cans from cans are not considered secondary materials. Numerous products now manufactured using materials diverted from the waste stream may be classified as secondary materials. Plastic lumber made of commingled plastic waste and insulation materials manufactured using collected newspapers are examples of true secondary products.

Long Island communities have turned to energy recovery incineration as a major component of their overall waste management strategy. Five waste-to-energy facilities operate in Nassau and Suffolk Counties in the communities of Glen Cove, Oyster Bay, Hempstead, Long Beach, and Babylon. The facilities produce approximately 1000 tons of incinerator residues per day (Koppleman and Tanenbaum, 1990), and construction of proposed facilities in other towns could significantly increase residue production. The need to manage incinerator residues properly has led to investigations of the potential for using them in the manufacture of secondary products. This paper focuses on results of research at the Waste Management Institute (WMI) of the Marine Sciences Research Center, State University of New York at Stony Brook, into the use of particulate incineration residues in the manufacture of secondary products.

Secondary Residue Products

Incineration of municipal solid waste produces particulate residues that are often rich in metals such as lead, cadmium, copper, and zinc (Roethel *et al.* 1987). Laboratory leaching studies show that metals of environmental concern may be released from the particulate residues, making it necessary to develop environmentally acceptable residue disposal methods. Research shows that particulate incineration residues can be combined with cement and stabilized to form a solid block. The stabilization process can effectively prevent the release of metals, and the manufacture of stabilized incinerator residue blocks may provide an alternative method for the disposal or reuse of incineration residues (Roethel *et al.*, 1987).

A research program at the Stony Brook WMI examines the feasibility of using stabilized incineration residues in a variety of applications. Results of laboratory studies show that stabilized incineration residues possess strengths that would allow for their use in numerous applications. The stabilized residues were subjected to several regulatory extraction protocols. In no instance did the metal concentrations in the leachate exceed regulatory limits for toxicity (Park, 1987). Bioassays using marine phytoplankton revealed no adverse impacts to communities exposed to

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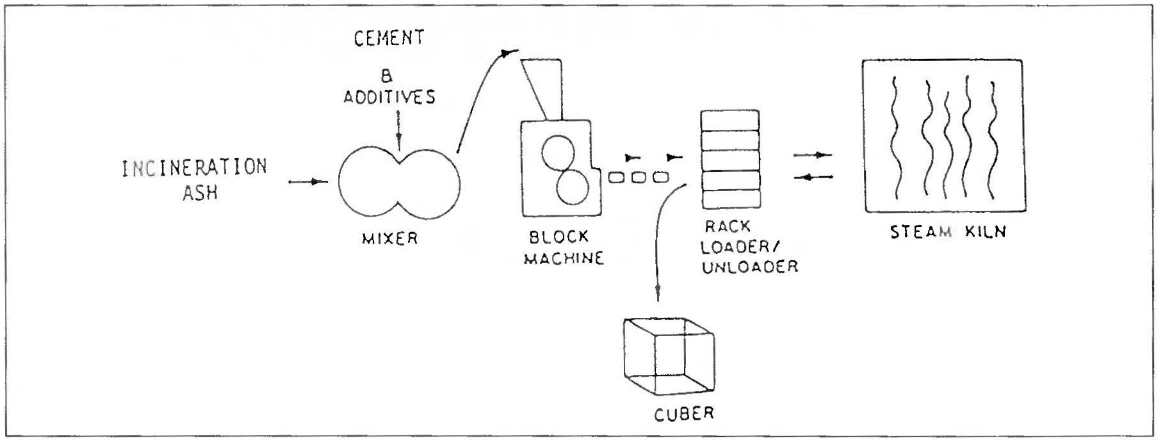
Vincent Breslin is a senior research scientist at the Waste Management Institute, Marine Sciences Research Center, State University of New York at Stony Brook.

Figure 1: Schematic of block manufacturing process.



Incineration Residues

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elutriates prepared using the stabilized incineration residue blocks.

The success of laboratory studies led to the development of field demonstration programs designed to evaluate the potential for using stabilized incineration residues in secondary products. This paper provides an overview of the results to date of programs designed to determine the suitability of using incineration residues to manufacture blocks for artificial reef construction; the development of ready-mix, residue-concrete mixtures for use in shore protection devices, and using incineration residues as a substitute for natural aggregate in the manufacture of construction blocks.

Successful use of incineration residue secondary products requires that the products meet or exceed existing engineering and environmental standards prior to use. Engineering criteria for materials used for artificial reef development, shore protection devices, and construction blocks are shown in Table 1. These well-established strength criteria provide a minimum strength required for the successful performance of a product used for each application.

The environmental criteria are not so well established. Several regulatory leaching protocols such as the E.P. toxicity test and the TCLP leaching protocol were not designed to evaluate the leachability of metals from a product destined for marine use. Seawater or freshwater tank leaching studies or modified ASTM leaching techniques using seawater or synthetic acid rain are more useful techniques for determining the leachability of metals from stabilized products for marine or terrestrial use. Since one test may not be sufficient, several leaching protocols were employed to evaluate the leachability of metals from incineration residue secondary products.

Block Making Technology

One objective of the research is to manufacture incineration residue products using existing technology. In the case of block making, for either reef or construction quality blocks, the technology is well established. A simplified schematic of the block manufacturing process is shown in Figure 1. The details of this technology are described in a previous paper (Roethel and Breslin, 1989).

Reef Construction

The methods and results of the incineration residue reef construction study are described in detail in the Spring 1989 issue of the *Waste Management Research Report*. Therefore only the more recent project results are described here.

Thirty stabilized incineration residue blocks have been submerged in Conscience Bay, Long Island Sound, NY, for three years. The various physical and chemical analyses of the blocks show that they maintained their physical and chemical integrity over this time. Recent analysis of the dioxin and furan content of blocks

Table 1. Engineering criteria for residue block secondary products

Secondary Product	Strength Criteria	Strength Achieved
Artificial Reef Blocks	300 psi[a]	800-1200 psi
Shore Protection Devices	3000 psi[b]	3100-4200 psi
Construction Blocks	1000 psi[c]	1600-2570 psi

[a]Woodhead et al., 1984
[b]US Army Corps of Engineers
[c] Underwriters Laboratory Specification 618

Both the recommended criteria and achieved values are obtained using a 28-day inconfined compressivestrength test according to ASTM C39 testing protocols.

prior to and following submersion in the sea show that these organic components are also effectively retained within the residue reef blocks (Roethel *et al.*, 1990).

The reef structures were rapidly colonized by a wide variety of marine organisms and continue to support a diverse population of organisms (Figure 2). Metal analysis of digested tissues of organisms removed from the residue reef structures shows that metals of environmental concern are not elevated in tissues of organisms removed from the residue reef structure (Breslin *et al.*, 1988). Recently, similar results were obtained using mussels as an indicator organism.

To date, no adverse environmental impacts have been observed at the Conscience Bay reef site due to the presence of the stabilized incineration residue blocks. Continued monitoring of the reef site is planned to obtain data that will more clearly define the long-term effects of stabilized incineration residue blocks in the marine environment.

Construction Block Manufacturing

The favorable physical and chemical properties of the stabilized incineration residue blocks used for artificial reef construction led to an investigation to determine if incineration residues could be used in lieu of natural aggregate in the manufacture of concrete masonry blocks. During September, 1988, block-making activities again took place at the Besser Company's research facilities at Alpena Community College, Alpena, MI. The primary goal was to use conventional equipment to produce construction-quality blocks in which incineration residues replaced natural aggregate.

Construction Block Mix Design

Combined incineration residues were collected from the RESCO facility in Baltimore, MD. The combined residues were processed at the Alpena facility to obtain screened and crushed ash. Five incineration residue construction block mixes were tested to determine their suitability for fabricating construction blocks (Table 2). For all five mixes, a 3:1 (vol:vol) ratio of the screened residue to crushed residue was used to form the combined ash sample. The 3:1 ratio reflects the volume of the screened and crushed components of the total unprocessed combined ash sample. Three sand contents (25, 33 and 50 percent) for the mixes were investigated. Fifteen percent by weight portland cement, Type IP, was added to each of the combined residue and sand mixtures. Type IP portland cement is a pozzolan cement containing between 15 and 40 percent coal fly ash. The moisture content of the 33 percent sand mixes (mix A, B, and C) was varied to determine an optimum moisture content for block making. Acme-Hardesty superplasticizer was added to the mixes to facilitate flow.

The unconfined compressive strengths of the construction blocks were determined after one and 28 days (Table 2). According to Underwriters Laboratories specification 618, concrete masonry units produced with incineration residues as an aggregate require an average unconfined compressive strength of 1000 psi and a minimum strength of 800 psi (Table 1). The 28-day unconfined compressive strengths of the incineration residue blocks easily exceeded the average strength criteria.

During October, 1988, 32 construction grade incineration residue blocks were shipped to Underwriters Laboratories, Inc., Northbrook, IL, to undergo fire resistance testing. The Underwriters Laboratories standard UL 263, Fire Tests of Building Construction and Materials, evaluates the length of time a wall assembly will contain a fire and retain structural integrity, and also tests its resistance to a hose stream. Results of this test showed that flame did not pass to the unexposed surface of the wall assembly constructed using the incineration residue blocks during the two-hour fire exposure. In addition, transmission of heat through the wall assembly did not raise the temperature of the unexposed surface at any one point more than 325°F above

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Table 2. Compressive strengths of Alpena 88 construction blocks [a]

Sample	Moisture % [b]	Sand %	Unit weight (lbs)	1-day strength (psi)	28-day strength (psi)
A	8.3	33	37.8	1010 ± 330	2190 ± 40
B	8.7	33	39.5	1330 ± 260	2570 ± 40
C	6.4	33	36.5	830 ± 15	1620 ± 150
D	5.6	50	39.4	1680 ± 12	2570 ± 100
E	8.7	25	38.1	1080 ± 18	1990 ± 30

[a]Construction blocks (8" X 8" X 16") were fabricated on 8/24/88.
[b]Moisture contents were measured after heating the sample to 110°C for 24 hours.

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the initial temperature and the average temperature did not exceed 250°F above the ambient temperature during the initial two-hour fire exposure. Finally, the wall assembly withstood the hose stream test without developing through openings or allowing penetration of the water stream.

The physical properties of blocks produced using incineration residues as a substitute for natural aggregate meet or exceed existing standards for use as a construction material. Further physical evaluation of the construction quality incineration residue blocks is continuing in the Department of Civil Engineering at the State University of New York at Buffalo. Further investigations of the chemical and environmental properties of the blocks are are presently being performed at the Waste Management Institute, SUNY at Stony Brook.

In order to evaluate more fully the potential for using residue blocks as a building material, a boathouse will be constructed at the WMI using masonry blocks fabricated with incineration residues. Recently, more than 10,000 incineration residue blocks were manufactured using bottom and combined residues at Barrasso and Sons, Inc., Islip Terrace, NY, for use in the boathouse construction (Figure 3). Unconfined compressive testing of the blocks shows strengths exceeding 1200 psi after seven days' curing. Once construction is complete, a comprehensive monitoring program will be initiated to further evaluate the environmental acceptability of residue blocks as a construction material.

Table 3. Compressive strengths of mix designs incorporating Chloranan.

Mix	Cement %	Water/Cement	Strength (psi)
I 1	33	0.40	4020
I 2	28	0.70	2880
I 3	23	0.69	1900
I 4	23	0.60	2110
I 5	23	0.51	2860
I 6	20	0.72	1260
I 7	17	1.00	690
I 8	23	0.49	4200
I 9	20	0.50	3190
I 10	17	0.50	2680

The Chloranan to cement ratio was held constant at 1:10.
The compressive strengths were determined after 28 days curing.

Shore Protection Devices

Concrete, because of its physical properties and adaptability to various designs and shapes, is widely used in coastal and waterfront construction. Applications include docks, piers, and wharves at port facilities; bridges, outfall structures, and erosion control structures. The durability, strength, and economy of concrete make it ideal for the marine environment. Although concrete is already one of the most popular materials for coastal construction, its unique properties will result in increased use in the future (Moffat and Nichols, 1983).

Marine uses of concrete will increase even if conservative estimates for sea level rise are assumed. A rise in sea level would necessitate gradual shoring or reconstruction of port and waterfront facilities and stepped-up efforts in erosion control (NRC, 1987). The greatest level of construction activity in response to rising sea level would most likely occur in the highly-developed and populated coastal urban centers (Titus, 1986). Areas experiencing the greatest difficulty in disposing of incineration residues would require the largest volume of construction materials suitable for marine applications. Development of secondary materials using incineration residues for marine construction would provide a needed resource and, at the same time, alleviate the problem of disposing of particulate incineration residues.

The Stony Brook WMI is conducting research, funded by the Center for Hazardous Waste Management, SUNY at Buffalo, to design and evaluate incineration residue shore protection devices. The objective is to develop ready-mix material using incineration residues that meet design criteria established by the Army Corps of Engineers (COE) for erosion control concrete armor units. The ready-mix material can be poured into molds and cured, allowing a wide variety of products to be manufactured. The concrete armor units require the highest standards in terms of strength and durability because they are most often used in high energy wave environments.

The first phase of this program shows that combined incineration residues can be mixed with cement and additives to form a product that exceeds the COE strength criteria for use in the manufacture of tetrapods and pilings (Figure 4). Working with our industrial partner, Hazcon, Inc., Brookshire, TX, we evaluated the effects of adding their patented additive, Chloranan, to the mix. Chloranan alters the morphology of the bonding crystals that form when the cement cures. The result is a denser material with enhanced strength.

A series of mix designs was developed incorporating Chloranan at a constant cement-to-admixture ratio of 10:1. Table 3 shows the compressive test results for a variety of residue/cement/Chloranan/water mix designs. Three of the mix designs tested exceeded the recommended compressive strength criteria of 3000 psi (Table 1). The optimum mix design had an unconfined compressive strength of 4200 psi using a cement addition well within the range used in commercial applications.

The chemical properties of the mixes which exceed the COE physical requirements are currently being evaluated. If the optimum mixes show favorable chemical properties, a second phase of the program will evaluate the performance of a piling and shore protection devices placed in coastal waters.

Summary

Long Island communities are limited in their options for managing incineration residues. Landfilling is constrained by new landfill siting difficulties and the law that mandates the closing of existing Long Island landfills during 1990. Currently, the majority of the ash produced on Long Island is exported, most often out of state. A shift in state regulations or cancellation of out-of-state contracts could disrupt solid waste management for many Long Island communities.

An estimated 250,000 tons per year of ash generated on Long Island is available for potential use as a aggregate substitute material. (Koppelman and Tanenbaum, 1990). Table 4 shows the estimated quantity of aggregate use on Long Island and the potential quantities of incineration residues which could be substituted for natural aggregate in secondary products. On the basis of these estimates, the reuse of incineration residues in secondary products can be expected to reduce, but not to eliminate, existing ash disposal problems. Factors such as environmental suitability of the residues, engineering restrictions, and the length of the construction season could further limit the use of the residues in secondary products. Economic benefits may be realized by substituting incineration residues for natural aggregate in the manufacture of secondary products. Economic benefits associated with residue reuse in secondary products are primarily derived from the avoidance of disposal costs rather than from the market value of the residue. Estimates of potential savings from using residues as an aggregate substitute in secondary products range from $50 to more than $80 per ton. Such savings could amount to a total annual cost savings for Long Island communities ranging from $20 million to $40 million (Koppelman and Tanenbaum, 1990).

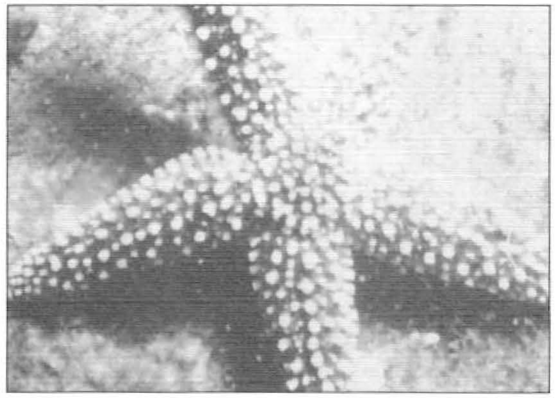

Figure 2: Seastar on ash block

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Table 4. Current aggregate use and potential for residue reuse in lieu of natural aggregate on Long Island[a].

Application	Estimated Aggregate Use	Estimated Ash Market Capacity
Portland Cement Concrete	1,800,000 tpy[b]	85,000 tpy[c]
Artificial Reefs	7,000,000 tons[b]	4,900,000 tons[c]

[a] *Data from Koppelman and Tanenbaum, 1990*

[b] *Quantities reported in tons per year (tpy) or tons. Portland cement concrete figures are based on annually recurring consumption based on a 1986 survey and estimate quantity. The artificial reef market is a fixed quantity market based on an estimate of reef capacity using 20% of available permitted reef space.*

c Portland cement concrete estimate based on the potential market and a 25% blend of ash with other aggregate materials and a 25% application rate (i.e., percentage of construction application using ash). Artificial reef estimate based on the total potential market and a 70% blend and a 100% application rate.

Figure 3: Incinerator residue blocks stacked ready for use in boat-house construction at the Marine Sciences Research Center, State University of New York at Stony Brook

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Simulation Models Review Available

The New York State Center for Hazardous Waste Management will publish a review of mathematical simulation models for evaluating *in situ* bioremediation of organic contaminants in groundwater. Authors are Stewart W. Taylor and Mary T. Panek, Department of Civil Engineering, State University of New York at Buffalo. The report will help hazardous waste professionals identify a bioremediation model that is appropriate for specific site conditions and commensurate with available data.

The authors review several recently proposed predictive models, giving a qualitative description and highlights of salient features for each. The descriptions identify model authors and dimemsions and summarize the formulations for contaminant, nutrient, and microbial transport. The authors also summarize the physical, chemical, and biological parameters required for data input and the kinetic models governing microbial growth and contaminant metabolism. To receive a copy of the report, write: New York State Center for Hazardous Waste Management, State University of New York at Buffalo, 207 Jarvis Hall, Buffalo, NY 14260, or call the center at (716) 636-3446.

New York State Solid Waste Combustion Institute at Cornell University

Combustion Projects Approved

The New York State Solid Waste Combustion Institute (SWCI) recently awarded three grants totaling approximately $300,000 to support research projects in the field of municipal solid waste combustion. The institute solicited proposals to conduct both basic research into combustion processes and technologies and commercial-scale experiments on existing facilities. Current research priorities include experimental studies, the development of sampling protocols, and innovative technologies.

The three awards represent the second round of research grants awarded by the SWCI at Cornell University. In 1989, the institute awarded five grants totaling $1.1 million under the first cycle of its research awards program.

Abstracts of the Three Awards:

"Combustion of Chlorinated Ingredients of Municipal Solid Wastes." C. Thomas Avedesian, Cornell University. (Two-year project).

The research addresses fundamental problems associated with the combustion of solids which contain chlorinated compounds: ignitability, particle burning rates, and the products of combustion produced. The goal is to expand the base of fundamental data on polyvinyl chloride (PVC) combustion with a view toward model development on incineration of municipal solid wastes. Two parallel research efforts are proposed. One will involve fundamental experiments on the combustion of individual PVC particle arrays, and the other will concern burning of unsupported particle streams and fluidized particle beds within an environment closely allied with practical incinerators.

A cooperative research effort is proposed between Cornell University and the National Institute of Standards and Technology (NIST). The individual particle experiments will be carried out at Cornell, and the particle stream experiments will be performed at NIST. The Cornell experiments will measure the evolution of mass, particle structure, and composition over a range of ambient gas temperatures and initial particle mass. The experiments at NIST will focus on measuring the intermediate and final combustion products, ignition delay, and combustion times of unsupported particles and particle beds for a variety of inlet gas velocities, temperatures, and particle diameters more characteristic of practical conditions.

"Oxidation Kinetics of Chlorinated Hydrocarbons at the Temperatures of Municipal Solid Waste Incineration." Dr. Arthur Fontijn, Rensselaer Polytechnic Institute. (Two-year project).

The kinetics of the reactions of a number of individual chlorinated hydrocarbons (CHCs) with O atoms and OH radicals will be measured over wide temperature ranges. The unique high-temperature photochemistry (HTP) technique, already extensively used for similar hydrocarbon oxidation reactions, will be used for the rate coefficient measurements. These studies will be complemented by mechanistic, i.e., product analysis, studies.

Theoretical interpretation will yield fundamental information, suitable for predictions on further CHC oxidation reactions. The investigations will start with reactions of chloromethanes. Suitable CHCs for study after these include polychlorobenzenes, polychlorophenols, and chloro-olefins. Reaction selection for these latter stages of the program will be based on models which include detailed chemical kinetics, to the extent that these are then available from studies by others.

"Mechanism of PCDD/PCDF-Formation for Incinerators: A US/Sweden Collaborative Study." Dr. Elmar Altwicker, Rensselaer Polytechnic Institute, and Dr. Christoffer Rappe, University of Umea, Sweden, (Two-year project, supplementary award to initial 1989 grant).

Supplementary funds were requested for additional 13C-labelled compounds to conduct experiments with greater emphasis on spouted bed and fly ash reactors. Because of a shift in the plug flow microreactor from one Swedish laboratory to another, work with that reactor was slowed somewhat. Also, the supplementary funds will cover additional PCDD/F analyses and inclusion of the in-house GC/MS-system (in terms of modest maintenance contribution) to enhance overall analytical capability and flexibility.

Kulick Joins Cornell Staff

Steve Kulick joined the staff of the Cornell Waste Management Institute in April, 1990. As Research Coordinator, he administers the Institute's awards program. He also will assist with the development and coordination of interdisciplinary research projects on the Cornell University campus.

Before accepting the position at the Cornell Waste Management Institute, Kulick worked with the Atlantic States Legal Foundation in Syracuse, NY. He also has been employed by the City of Syracuse. Kate Skelton, who accepted a position in Albany the first of the year, previously held the position Kulick now fills at Cornell.

Managing Risks Topic Of Satellite Broadcast

The American Society of Mechanical Engineers (ASME), with Stone and Webster Management Consultants, Inc., will sponsor a live, interactive satellite broadcast, "Strategies for Managing Environmental Risks," 11 a.m. to 5 p.m. December 6. A panel of environmental, risk management, legal, and financial consultants will discuss environmental issues facing businesses in the 1990s.

Interested persons may contact Julie Lee, Technical Program Manager, ASME, 345 E. 47th St., New York, NY 10017, telephone (212) 705-7797, facsimile (212) 705-7674.

Waste Tires Present Environmental Problem Of Increasing Magnitude

Michael E. Ryan

Introduction

The generation of solid wastes in the United States has resulted in a critical shortage of solid waste disposal capacity. Many states have adopted ambitious goals to reduce the volume of their solid waste streams. They intend to meet their objectives through a preferred hierarchy that encompasses reduction of the amount of solid waste generated at source, removal of materials from the waste stream for reuse or recycling, and combustion of part of the waste stream to recover energy in the form of steam or electrical power. Wastes that cannot be eliminated, reused, recycled, or incinerated would be landfilled as the final and least desirable alternative.

The Waste Tire Problem

Waste tires, a ubiquitous component of the waste stream, are of increasing environmental concern. Inadequate disposal of waste tires and unsound disposal practices took place in the past and continue now. An estimated 200-to-240 million automobile and truck tires are disposed of annually in the United States, an estimate consistent with production statistics for domestic passenger and truck tires. Approximately 15 million scrap tires are generated annually in New York State, requiring more than 1.5 million cubic yards of landfill space.

Increasingly fewer landfills accept waste tires, either through voluntary restriction or because of legislative initiative. The construction of a tire makes it a difficult, or impossible, item to compact. In addition, buried tires tend to work their way to the surface. Many states, among them New York, Connecticut, New Hampshire, Minnesota, and Wisconsin, have developed, or are in the process of developing, specific guidelines and regulations for the disposal of waste tires. Some regulations prohibit the disposal of tires in landfills.

In addition to the annual generation of scrap tires, there may be as many as two billion waste tires stockpiled in the United States. The 20-acre Smithfield landfill in Rhode Island contains an estimated 60 million waste tires, and Ed's Tire Disposal in Westley, CA, is estimated to hold approximately 35 million. There are more than 1000 tire piles or dumps in the United States, and New York State has its representative share, including several sizable tire dumps.

Tire stockpiles pose a variety of environmental and health hazards. Exposed tires collect shallow pools of rainwater, creating warm, moist breeding grounds for several important types of disease-carrying mosquitoes. The proximity of discarded tires to vegetation and wind-blown pollen permits the accumulation of sufficient nutrients for the mosquitoes within the tire carcasses. Rodent vectors also constitute a health problem.

Tire stockpiles pose a significant fire hazard because of their high energy content (15,000 BTU/lb as compared to 12,000 BTU/lb for coal). The shape of a tire enables it to carry a self-contained supply of oxygen for combustion, making it extremely difficult to extinguish burning tires. One well-known tire fire occurred in Winchester, VA, in September, 1983. The fire burned until the following spring. Burning tires generate considerable pollution in the form of toxic, pungent, black smoke and sulfur oxides because of the sulfur content of the rubber. One tire can generate two gallons of toxic oil, making uncontrolled oil runoff a significant threat to local groundwater. The recent tire fire in Hagersville, Ontario, could have generated twice as much oil as the Exxon Valdez oil spill in Alaska if the 14 million tires at the dump had burned and liquefied. The fire burned for 17 days at the 12-acre Tyre King dump before a combination of firefighting planes, chemical foam, snow, and freezing rain successfully extinguished it. The toxic smoke generated by the fire forced evacuation of the area, and more than 150,000 gallons of oily residue have been recovered.

Alternative Strategies

Unlike many other components of the solid waste stream, tires possess a well-defined collection and "source separated" infrastructure, making them easy to separate or segregate. Technology for the reclamation and recovery of rubber has been extensively studied and developed. Despite these considerations and the associated benefits in eliminating potential environmental damage, relatively minor success in the recovery, reuse, and recycling of scrap tires has been achieved to date. The major reasons for this lack of success stem from a highly competitive market for rubber, low profit margins, and insufficient economic incentives and markets for recycled scrap rubber. Other institutional barriers also exist and many ventures have failed.

Tire Burning

Tires may be burned to recover some of their energy content. Whole tires can be burned to generate industrial steam, or shredded tires can be used as a tire-derived fuel that can be added to conventional fuels and burned in industrial boilers, cement kilns, etc. Oxford Energy Corporation operates a waste-to-energy facility in Modesto, CA, which burns approximately 4.5 million waste tires per year and generates about 14 megawatts of electricity from the high temperature steam produced by hot combustion gases from the burning tires. Oxford Energy is developing a second tire-to-energy facility with twice the capacity of the Modesto facility in Sterling, CT, and also has proposed a 30-megawatt tire-to-energy facility in Lackawanna, NY.

The process Oxford uses first conveys tires over a scale that regulates the amount of fuel entering the boilers. The tires enter the boilers through special air locks to prevent exhaust gases from escaping. Temperatures in the boilers are in excess of 2500° F, causing the tires to ignite and burn rapidly. The molten steel slag from the belts is quenched in water and removed for recycling. The hot combustion gases rise through the boiler and produce steam which is used to generate electricity from a turbine generator. The condensed steam is then returned to the boiler.

The combustion gases from the boilers are subjected to a thermal DeNO process developed by Exxon Research and Engineering Company in 1972 and made available for licensing in 1974. This process, which requires no catalyst, involves injecting a small amount of ammonia or urea into the hot flue gases at a specific temperature zone to reduce the nitrous oxides to nitrogen and water vapor. The important process conditions are the composition of the gas, the temperature, and the contact time of the ammonia. The process is effective between 1300° F and 2200° F and works best at 1700° F to 1800° F. If the temperature is too high the ammonia will generate more nitrous oxides (NO_x). The process requires less than one second for maximum reduction which can exceed 80 percent in some systems.

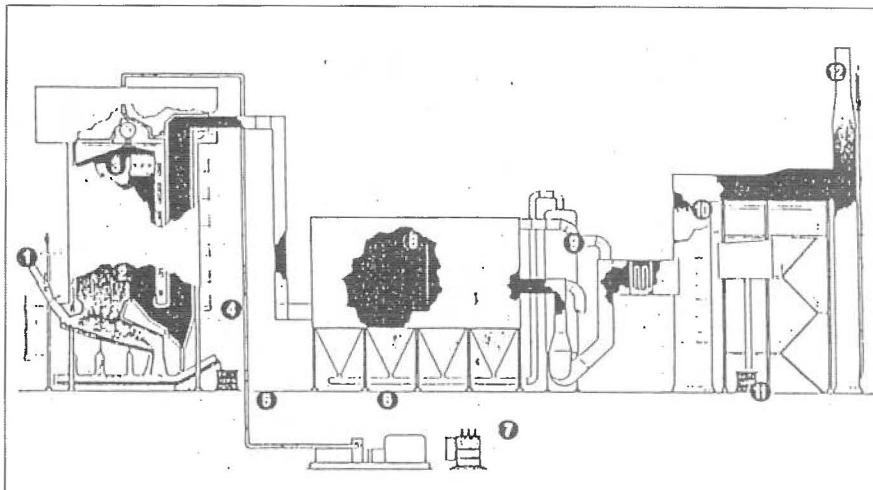
The Oxford process runs at approximately 60 percent removal. The gases then go to a fabric filter baghouse to remove solid particulates and to a lime mist scrubber to remove the sulfur compounds. Steel slag, baghouse ash (primarily composed of zinc calcine), and gypsum are the major by-products of the process. Although waste-to-energy tire incinerators are economically viable, most community and public interest groups are generally opposed to any kind of incineration process. More than 100 million BTUs of energy are expended in the production of one ton of finished tires and slightly less than 30 percent of this energy can be recovered by whole tire burning or from tire derived fuel.

Pyrolytic Combustion

Pyrolysis entails the thermal degradation of the tire in the absence of oxygen to produce some combination of gas, oil, carbon black, steel, and ash. The major products of interest are the gas and/or liquid oil fuel components. The products produced can be influenced by the presence of catalysts or other additives. Pyrolysis does not pose the same emissions problems associated with tire combustion or incineration. However, like combustion, a substantial capital investment is necessary and the economics of pyrolysis appear to be only marginal at the present time. The New York State Energy Research and Development Authority (NYSERDA) sponsored a project to assess the availability of

Continued on page 12

Schematic diagram of Oxford Energy's Modesto Tire-to-Energy Plant



1. Tire infeed lockhoppers 2. Boilers 3. Thermal De-NOx 4. Slag removal 5. Steam pipe 6. Turbine-generator 7. Step-up transformer 8. Fabric filter baghouse 9. Zinc calcine silo 10. Sulfur scrubber 11. Gypsum collection 12. Stack with continuous emission monitors

Waste Tires

Continued from page 11

scrap tires for a proposed tire pyrolysis plant in Geneva, NY, which would use the "Tyrolysis" process of Foster Wheeler Power Products, Ltd. The viability of the process is sensitive to transportation costs, tipping fees, and the size of the facility. Additional concerns relating to safety arose after serious operational problems at a 150-ton-per-day tyrolysis plant near Birmingham, England.

Above right, Mobile tire-shredding system in operation. Photo courtesy of Gordon C. Lockhart, Columbus McKinnon Corporation. Below, section of Belgian highway indicating faster draining of rubberized asphalt, right, compared to traditional asphalt. Photo courtesy of "The Lamp," Exxon Corporation.

Using Tires in Asphalt

Asphalt-rubber was developed by Charles H. McDonald, a former materials engineer with the Federal Highway Administration. The pioneering research and development work began in the early 1960s. Asphalt-rubber is a mixture consisting of 16-to-25 percent shredded reclaimed tires and 75-to-84 percent selected asphalt cement. Several different processes have been devised, and three of them are indicated in Table 1.

Asphalt-rubber has been used in many product applications, including pavement seal coats, pavement interlayers, binders, subgrade seals, lake liners, lagoon liners, roofing materials, crack sealing compounds, and joint sealing compounds. The material is essentially a tough elastomeric product capable of absorbing stresses created by pavement contraction and able to withstand the abuse of heavy traffic.

The departments of transportation in most states have evaluated the performance of asphalt-rubber paving materials. Since 1974, the city of Phoenix, AZ, has paved a significant percentage of its major roads with asphalt-rubber. More than 50,000 tons of rubberized asphalt have been used in Europe (equivalent to 260 miles of four-lane highway). Every lane-mile of rubberized asphalt will consume approximately 1000 scrap tires. Asphalt-rubber provides several advantageous characteristics, including better fatigue and wear resistance (thereby extending the life of the paved surface), good adhesion and cohesion, better traction, and a potential reduction in noise level of 5 db for passenger cars and 8 db for trucks.

Despite these positive attributes, asphalt-rubber has not been extensively adopted by most states. Its effectiveness as an aggregate binder, its economic feasibility, and some of its other benefits still need conclusive demonstration. Capital investment in specialized spraying or surfacing equipment is also necessary. Although the cost of asphalt-rubber is higher than that of regular asphalt, economic comparisons based on the life-cycle cost appear favorable.

Rubber Products

Scrap tires have been recycled or reused in a wide variety of applications, including playground surfaces, livestock fencing, playground toys, shoe soles, and as floating breakwaters to dissipate wave energy in harbors and marinas. Despite these innovative and useful ideas, the impact on the overall waste tire problem has been and will undoubtedly continue to be minimal.

The possibility of utilizing high loading levels of recycled crumb rubber from tires in rubber compound formulations has been partly demonstrated with some success by a Minneapolis company, Rubber Research Elastomerics, Inc. A proprietary surface treatment process is applied to recycled vulcanized particulate rubber in order to formulate rubber compounds containing high loading levels of the recycled rubber while maintaining end-use properties and performance characteristics comparable to products made from virgin rubber formulations. Their "Tirecycle" product encountered economic difficulties because the company was unable to develop realized markets matched to their production capacity. Other potential product applications include the incorporation of the crumb rubber into a binder for use as a coating material for corrosion protection of surfaces such as storage tanks, boat hulls, bridge abutments, etc.

Reclamation of Rubber

Reclaiming rubber involves the grinding, shredding, and/or pulverizing of recycled rubber by means of a thermochemical reaction. The material is treated with chemicals and plasticizers under heat and pressure and worked mechanically in order to devulcanize the recycled rubber. Most reclaim rubber is generated from tires, and approximately 10 million tires per year are used in the reclaim process. The tire industry consumes approximately 60-to-65 percent of reclaim rubber. Historically, reclaim rubber has been extensively used, but the market has declined significantly in recent years because of economic and environmental concerns about the nature of the solvents and chemicals required by the process.

Repair, Retreading, Recapping

Although retreading or recapping returns tires to service, the process cannot be classified as recycling. Sooner or later the tire casing wears out and must be dealt with as a scrap tire. Approximately 40 million passenger and truck tires are retreaded each year, but the number of passenger tires being retreaded has diminished by more than 50 percent in the past decade to fewer than 15 million per year. Although some industry experts believe that up to 40 percent of all scrap passenger tires could be repaired, the economic opportunity or incentive simply does not exist under current conditions. Retreading and recapping operations for truck tires are viable and will continue to prosper.

Future Prospects

The management of waste tires poses a formidible challenge but also constitutes a tremendous opportunity and potential. The absence of suitable markets for recycled crumb rubber has been a major obstacle. Currently, the only viable potential options for utilizing scrap tires in very large quantities are waste-to-energy tire burning facilities to generate electric power and the use of crumb rubber in asphalt-rubber applications. Recycling of waste tires will become feasible only when the cost of recycling is less than the cost of disposal (barring legislatively mandated practices).

The recycled product, in any form, must compete economically with virgin materials and have large potential markets and well-defined specifications. Economic success also will depend on low process energy requirements, low capital cost, and economics or returns that are not dependent on tipping fees. Stable supply contracts and an efficient collection infrastructure are also important. The successful processing or management of waste tires should use technology that generates little or no residues or emissions. Alternative approaches to the disposal of waste tires have been extensively studied, but many scientific and engineering problems require resolution. More effective management of scrap tires poses an important challenge to government, industry, and the scientific research community.

Michael E. Ryan is director of the Business-Industry Affiliates Program of the New York State Center for Hazardous Waste Management, State University of New York at Buffalo.

A portion of the 35 million waste tires in Westley, CA, used by Oxford Energy to generate electricity. Photo, courtesy of "The Lamp," Exxon Corporation.

Table 1: Asphalt-Rubber Processes

McDonald Process:	25% crumb rubber (25-40 mesh) and 75% asphalt cement heated to 375 F for 20 minutes and diluted with kerosens to lower viscosity
ARCO Process:	hot asphalt cement mixed with 18-22% ground rubber and diluted with an oil extender for ease of application
EXXON Process:	rubberized asphalt composed of 18% finely pulverized rubber reclaim

Twelve Projects Receive Approval

The Executive Board of the New York State Center for Hazardous Waste Management, State University of New York at Buffalo, approved 1990 research and development awards to 12 projects:

"A Demonstration Project for *in situ* Remediation of a Contaminated Aquifer: A Field Test of Surfactant Flushing," (Continuation) J. Fountain and D. Hodge, Department of Geological Sciences, State University of New York at Buffalo

"Anaerobic Biodegradation C1 Chlorinated Hydrocarbons in Methanogenic Systems," J. Gossett, School of Civil and Environmental Engineering, Cornell University

"Combustion Characteristics of Hazardous Liquid Wastes Part 3: Transfer of Technology from Lab-scale to Full-scale," (Continuation) N. Ashgriz and J. Felske, Department of Mechanical and Aerospace Engineering, State University of New York at Buffalo

"Combined Chemical/Biological Oxidation for the Reduction of Hazardous Waste Toxicity," J. Jensen and A. Scott Weber, Environmental Engineering Research Laboratory, State University of New York at Buffalo

"Effects of Environmental Factors on Biodegradation and Dechlorination of PCBs in Anaerobic Sedimants," (Continuation) G-Y.Rhee, New York State Department of Health and School of Public Health Sciences, State University of New York at Albany

"Enhancement of Anaerobic Biodegradation of Chloroalkanes for *in situ* Bioremediation of Contaminated Soil and Groundwater," (Continuation) S.Pavlostathis, Civil and Environmental Engineering, Clarkson University

"High-rate Biodegradation of hazardous Wastes *in situ*," H. Bungay, Department of Chemical Engineering, Rensselaer Polytechnic Institute

"Measurement, Characterization and Treatment of Cyanide Wastes at Manufactured Gas Plant Sites," T. Theis, Department of Civil and Environmental Engineering, Clarkson University

"Mechanisms of Aromatic Pollutant Degradation by Immobilized Cultures of the Ligninolytic Fungus *Phanerochaete Chrysosporium*," (Continuation) K. Hammel, Faculty of Chemistry, SUNY College of Environmental Science and Forestry

"Microbial Degradation of Polynuclear Aromatic Hydrocarbons Associated with Coal Gasification Sites," H. Sikka, Great Lakes Laboratory, State University College at Buffalo

"Research Needs in Hazardous Waste Reduction," M. Ryan, Department of Chemical Engineering, State University of New York at Buffalo

"Vitrification of Ash from Waste-to-energy Incinerators," M.G. Alexander, Senior Research Scientist, Corning Incorporated

The Center received 33 proposals from 11 universities, five industries, one government agency, and one individual. The total cost of the proposed projects was $4,991,084, with 48 percent requested from the Center. The 12 approved projects call for Center funding of $1,202,990,

Applications Due By October 15 For EPA Funding

October 15 is deadline for applying to the "Pollution Prevention By and For Small Business" grant program of the U.S. Environmental Protection Agency (EPA) for funding that will help small businesses demonstrate pollution prevention technologies and techniques.

The Center for Hazardous Materials Research (CHMR) at the University of Pittsburgh administers the $800,000 EPA awards program. Small businesses are eligible for grants of up to $25,000 each, funded by the EPA's Two-percent Pollution Prevention Set-Aside Program.

Karen V. Brown, EPA Asbestos and Small Business Ombudsman, is the EPA official responsible for the grants program, with which 18 major trade associations cooperate. Dr. Edgar Berkey of the CHMR manages the program, assisted by Angel Martin. The CHMR was formed in 1985.

Interested persons may obtain application packages from Martin at the Center for Hazardous Materials Research, University of Pittsburgh Applied Research Center, 320 William Pitt Way, Pittsburgh, PA 15238, (800) 334-CHMR or (412) 826-5320. Grant winners will be announced November 15.

Funding Recipients Outline Buffalo-Sponsored Projects

The New York State Center for Hazardous Waste Management earlier this year sponsored a presentation at the State Capitol in Albany to demonstrate progress in establishing an effective research and development program and meeting the other charges in the 1987 law that established the Center. Attending the presentation were state legislators, legislative staff, state budget staff members, and representatives of key state agencies.

Several researchers who receive Center funding made presentations: Dr. A. Scott Weber, Environmental Engineering Research Laboratory, State University of New York at Buffalo; Dr. Jody G. Redepenning, Department of Science, Rensselaer Polytechnic Institute; Dr. John C. Fountain, Department of Geological Sciences, SUNY at Buffalo; Dr. Kenneth E. Hammel, Faculty of Chemistry, SUNY College of Environmental Science and Forestry; Dr. Lawrence L. Tavlarides, Department of Chemical Engineering and Materials Science, Syracuse University; and Dr. Joseph V. DePinto, Director, Hazardous Waste and Toxic Substances Research Management Center, Clarkson University.

Present to underline the collaboration among related centers and institutes in New York were Dr. Richard E. Schuler, Director, Cornell Waste Management Institute, and Dr. R. Lawrence Swanson, Director, Waste Management Institute at SUNY at Stony Brook. Dr. Ralph Rumer directs the Buffalo center.

Project Summaries

Weber reported on an anaerobic biological activated carbon process for treating high organic strength hazardous wastes. Tested with wastes containing phenol, formaldehyde and methanol, with equivalent strength 100 times that of domestic waste water, the process commonly showed removal efficiencies greater than 95 percent. Daily off-gas production from the process contains methane equivalent to 5 million BTUs for a 10,000 gallon per day waste stream.

Redepenning outlined an RPI study of productive uses for solid waste generated by the General Electric Silicone products division at Waterford, NY. In addition to support from the New York State Center for Hazardous Waste Management, the project receives GE support of more than $400,000 over two years.

The studies focus on using the waste material in glass products and cement and concrete. The material can be added successfully to cement, and it seems to add advantageous properties. Some cement formulations including the wastes show increases in the strength of the final product by over 150 percent, compared to samples containing none of the waste. Projects designed to optimize the strength of these materials while reducing their permeability are underway.

Fountain discussed development of an *in situ* process for restoring aquifers containing organic contaminants, using an aqueous surfactant solution to extract the contaminants through a modified pump-and-treat system. In lab-scale experiments, the process successfully removed pools of contaminant, leaving residual concentration of less than 1 ppm. Field tests began this summer at the Canadian Forces Base in Borden, Ontario, a collaborative effort with the University of Waterloo Centre for Groundwater Research.

Tavlarides reported developments in the use of novel inorganic chemically active membranes (ICAMs) to remove metal ions from industrial aqueous waste streams. Aluminum oxide/silica membranes impregnated with solutions of an oxime organic chelation acid (2-hydroxy-5-nonylacetophehone oxime) provided copper ion removal rates comparable to or better than those of polymer impregnated membranes, suggesting that ICAMs show promise for industrial use. ICAM research, including bench-scale tests on a prototype modular unit, continues.

DePinto reviewed research into using a rule-based expert system to minimize hazardous waste generation at the ALCOA-Massena (NY) facility. Clarkson personnel work with ALCOA employees to learn the operation and to conduct a waste minimization audit. Researchers will develop a "generic" Waste Minimization Management Advisory System (GAMMAS), an intelligent tutoring system intended as a training/reference tool on industrial waste minimization in general. Based on the materials balance concept, GAMMAS will apply to industrial generators of any size. In addition to showing how university/industry cooperative effort can minimize waste generation at a specific site, the project could produce a unique technology transfer tool for waste minimization techniques.

Thermal Treatment Topic Of Fall Conference

The New York State Center for Hazardous Waste Management, the Northeast Hazardous Substance Research Center of the U.S. Environmental Protection Agency (EPA) at the New Jersey Institute of Technology, the New York State Joint Legislative Commission on Toxic Substances and Hazardous Wastes, and the New York State Department of Environmental Conservation (DEC) will sponsor the first Hazardous Waste Treatment and Prevention Technologies Conference October 9 and 10 at the Radisson Hotel in Niagara Falls, NY.

The conference will focus on thermal treatment and destruction of hazardous wastes. Sessions will address developments and innovations in the areas of combustion processes, emissions control, and residue management. The concluding panel discussion will address public policy issues and concerns about incineration. The conference includes a tour of the Occidental Chemical Corporation liquid hazardous waste incineration facility. The limited tour space is available on a first-come, first-served basis.

Speakers will include Ralph Rumer, director of the New York State Center for Hazardous Waste Management; NY Sen. John B. Daly, chairman of the Joint Legislative Commission on Toxic Substances and Hazardous Wastes; Clyde B. Dempsey, Theodore G. Brna and Shiva Garg of the EPA; C. Thomas Avedesian, Cornell University; Joseph Bozzelli and Henry Shaw, New Jersey Institute of Technology; Kun-Chieh Lee, Union Carbide Corporation; Paul S. Farber, Chemical Waste Management; David S. Kosson of Rutgers, the State University of New Jersey; Thomas Fiesinger, New York State Energy Research and Development Corporation; Vincent T. Breslin, State University of New York at Stony Brook.

Dinner speaker October 9 will be Michael R. Greenberg of Rutgers. Panel leader October 10 will be Richard S. Magee of the EPA Center at the New Jersey Institute of Technology. Other panelists will be Shiva Garg, Richard Cook of Kalamazoo College, and Ronald Bastian of Eastman Kodak Co. and the Coalition for Responsible Waste Incineration. Interested persons may contact the NY State Center for Hazardous Waste Management, State University of New York at Buffalo, 207 Jarvis Hall, Buffalo, NY 14260.

Cornell Waste Management Institute To Sponsor Source Reduction Workshop

The Cornell Waste Management Institute will sponsor Precycling: A Workshop on Source Reduction, from noon until 9 p.m. Oct. 23 in the Hotel Syracuse, 500 S. Warren St., Syracuse, NY. Ellen Harrison, associate director of the institute, will moderate the workshop, which precedes the second annual statewide recycling conference sponsored by the State Department of Environmental Conservation (DEC) to take place in the hotel Oct. 24 - 26.

Following noon registration Oct. 23, Dr. Richard Schuler, director of the Cornell Waste Management Institute, will give an overview of source reduction. Speakers will represent the U.S. Environmental Protection Agency (EPA), the New York Public Interest Research Group (NYPIRG), the Environmental Action Foundation, the Pennsylvania Resources Council, and waste management groups in the states of Minnesota and Washington.

Interested persons may call Ellen Harrison or Carin Rundle at the Cornell Waste Management Institute, (607) 255-7535, for information about the Oct. 23 precycling workshop. Those interested in the DEC recycling conference may contact Debbie Jackson at the DEC Division of Solid Waste, 50 Wolf Road, Albany, NY 12233.

Institute Develops Teaching Materials

Jean Bonhotal of the Cornell Waste Management Institute assists with developing teaching tools with an emphasis on solid waste management for use in the schools of New York State. Among the new materials will be a video on secondary materials manufacturing and a bibliography of existing youth educational materials in the field of waste management.

Bonhotal has prepared slide sets on recycling for children and a workbook on composting. A series of exercises for all grades will be available on computer disks so that individual communities may tailor the waste management curriculum to conditions and requirements in their own localities. Working with Bonhotal are members of the Cornell Extension staff and several teachers.

Buffalo Center Publishes Summary Of Meeting

The New York State Center for Hazardous Waste Management and the state Department of Environmental Conservation co-sponsored a workshop on problems and issues surrounding the use of alternative technologies in the remediation of inactive hazardous waste disposal sites in New York.

Present were participants from state and federal agencies, industry, public interest groups, engineering consultants, lawyers, technology vendors and legislative staff. Goals were (1) to identify obstacles to the use of appropriate alternative technologies and methods and (2) to determine measures that will facilitate the use of alternative technologies. The Center has published a summary of the discussions.

RPI Sponsors Conference

Rensselaer Polytechnic Institute, Environmental Engineering and Environmental Science, will sponsor its fifth annual Conference on Hazardous Waste, Science and Management, October 2 and 3 at Canoe Island Lodge, Diamond Point, NY.

Guest Comment

Senators Support Innovation

By Caesar Trunzo and Kenneth P. LaValle

Increasing quantities of municipal solid waste and decreasing landfill space mean that innovative strategies for handling waste will be necessary. The New York state plan encourages a hierarchy: waste reduction, recycling and reuse, composting, incineration, and landfilling. As our population continues to grow and generate more and more waste, additional strategies must be found. Development of secondary materials shows promise."Secondary materials" has several definitions, but a precise definition is less important than the general thrust of the idea. Secondary materials are products made from waste materials and intended for end uses different from those of the original material. Plastic lumber made from discarded plastics is a secondary material; paper made from waste paper is not.

Caesar Trunzo

A review of the issues surrounding secondary materials is underway at the Waste Management Institute (WMI) of the Marine Sciences Research Center, State University of New York at Stony Brook. The $100,000 project, established and funded by the New York State Legislature, assesses the engineering and environmental properties of secondary materials and their market suitability, focusing on construction materials made from used plastics and from composites of ash residues from incineration of municipal solid waste.

We consider this an especially important project for Long Island because we face closure of our landfills in December, 1990. We support the development of secondary materials of suitable engineering quality that will be accepted in the market place. Government may need to confront secondary product consistency, stability and product labeling.

Kenneth P. LaValle

Communities on Long Island, and elsewhere, have experienced a glut of materials collected for recycling, newspapers, for example. Many Long Island towns have mandatory recycling programs that collect newspapers, but the market for them is weak. The development of secondary materials made from newspapers might provide markets and help to stabilize the price of used newsprint.

Waste plastics, on the other hand, are in great demand by manufacturers who use them to produce secondary materials, but difficulties in collecting plastics (light weight and high volume) mean that many towns do not include plastics in recycling programs. Companies on Long Island that use waste plastics in secondary products must import from as far away as Nova Scotia. The WMI study will examine the economics of collecting plastics, define markets and their fluctuations, and determine potential environmental impacts of these secondary products. Plastic lumber is a secondary material now manufactured and used. Towns on Long Island are exploring its use for fishing piers, floating docks, park benches, and trash receptacles. Plastic lumber may have advantages over wood in the marine environment because it will not rot and marine borers will not attack it. The WMI program will determine the social acceptability of the products and their environmental impact.

Considerable research has focused on the development and testing of safe secondary products made from the ash generated by municipal solid waste incineration. The public, industry, and government are reluctant to encourage use of such materials because of concern over very long-term effects, liability, and impacts on existing businesses. Does this reluctance portend problems for secondary materials in general? Are we erecting artificial barriers to the potential success of innovative recycling/reuse endeavors? We as legislators must be in front of these issues to assure that programs are effective and that closure of our landfills, required by law to protect groundwater, will not have adverse economic impacts.

Caesar Trunzo (R-C, Brentwood) represents the 3rd District in the New York State Senate and is co-chairman of the Legislative Commission on Water Resource Needs of Long Island. Kenneth P. LaValle (R-C, Port Jefferson) represents the 1st Senate District and is chairman of the Legislative Commission for Higher Education.

Waste Management
Research
Report

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