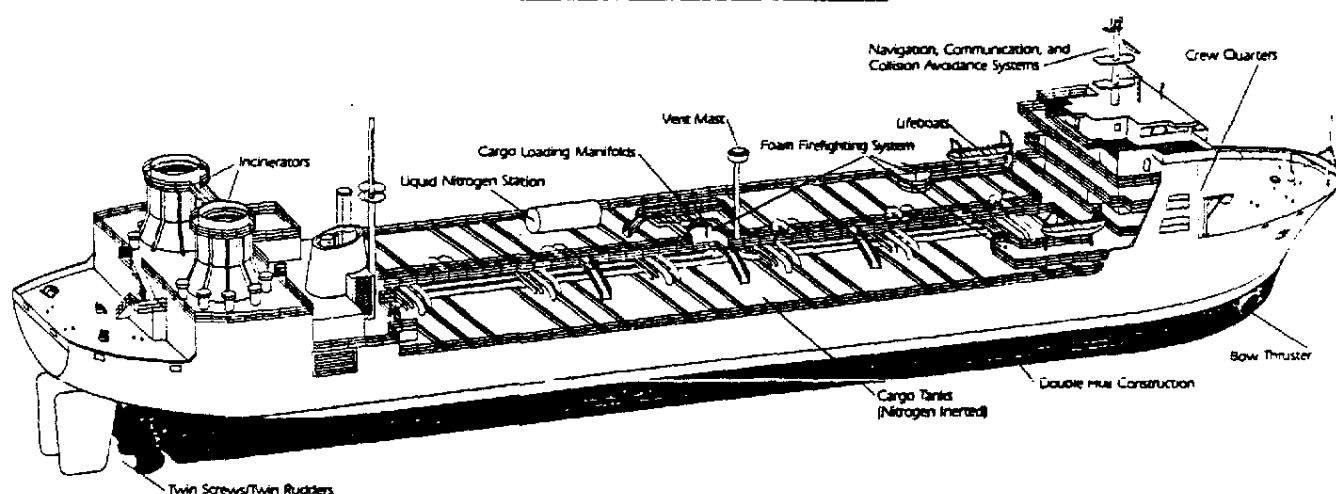




Managing Hazardous Waste: The Search for New Approaches

By FRANK E. HAARHOFF

Amid a crescendo of criticism about past policies for disposal of its toxic wastes and present dealings with environmental agencies; facing rising community opposition to the building of facilities for improved waste disposal systems; and hearing broad-gauge accusations of wrongdoing by a leading contract waste disposal company, the chemical industry is grimly trying to accomplish a twofold task: build facilities that employ proved disposal techniques, and search for new ways to handle wastes.

Incineration of wastes, currently a relatively minor disposal technique, is one of the most highly promising methods now, according to Michael Wallace, chemical and senior environmental engineer, Sandoz, Inc. "It's great if you can combine it with steam generation for resource recovery."

Biggest difficulty, however, is finding sites for burners, storage facilities, or trans-shipment stations, and for getting permission to carry out the incineration. Things are particularly difficult for those trying to set up land-based incinerators, but it is not easy for advocates of far-at-sea burning, who find

resistance to their construction of loading ports.

"Objections don't come from federal or state authorities, but from local governments," Wallace says. He feels the federal government will have to help the industry overcome that municipal resistance. If government doesn't step in, "costs will certainly keep spiraling up and many fly-by-night firms will go back to midnight dumping."

Meantime, industry is trying to expand use of thermal decomposition methods that have proved effective for even the most hazardous of materials. Particularly promising are the far-at-sea incineration methods, for which at least two companies have built or are building ships. But there is also progress in devising land-based burning equipment.

Industry is also looking into other, more sophisticated systems that can break down troublesome wastes—ion exchange, ozonation and microwave discharge techniques. They might be used with processes that can concentrate the wastes or take out the hazardous impurities. This would include such techniques as reverse osmosis,

electrodialysis and ultrafiltration. Such processing methods have been used on the manufacturing side for raw material preparation and product concentration; they are not unproved techniques. Their high costs, of course, are potential hurdles to wide use.

Incineration at sea appears to be a good bet for destroying the most toxic organic wastes, such as the polychlorinated biphenyls (PCBs) and dioxins. Still not widely used in this country, it has been the method of choice for disposing of nearly 1.5 million tons of toxics from West German companies. Ocean incineration requires special vessels. Two of the special ships will be available this year, and more are expected to be built. In service now is one ship for sea burning—the "Vulcanus", owned by Chemical Waste Management, a subsidiary of Waste Management, Inc.

CWM's 334.6-foot-long "Vulcanus" is equipped with two high-capacity Saacke incinerators. They burn liquid wastes at temperatures between 1,350° and 1,500°C. Onboard monitoring systems, with automatic data recording devices, measure stack effluent gases

Landfills will still be needed in the future.

and waste flow rates to the incinerators to permit checking on combustion and destruction efficiencies. More than 800,000 gallons of a liquid waste can be destroyed in eight or 10 days. A second ship, "Vulcanus II", is expected to go into service this year.

Another company, At-Sea Incineration, Inc., plans to launch two ships later this year or 1984 that are to be equipped with twin Coen burners. Their proposed burn site is about 140 miles East of the US coast.

What are some of the advantages of ocean incineration? Ships have greater throughput capacity than land-based systems, according to CWM vice-president Frank Krohn. Moreover, emissions end in the sea, where they are absorbed, buffered, neutralized and diluted by the ocean water.

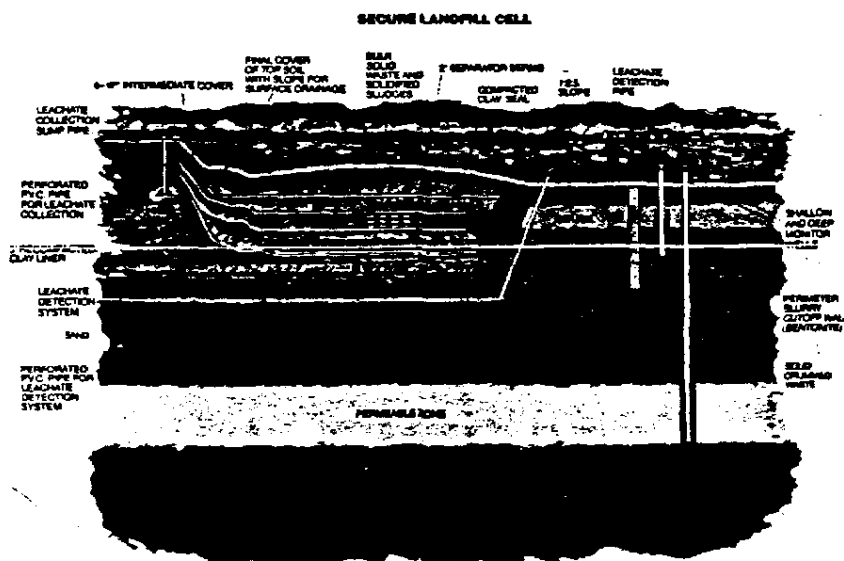
The ships don't need acid scrubbers, which must be used on 30 percent of land incinerators, says environmental control analyst Jeffrey Klein of Kidder Peabody & Co.

Mobile, on-land incineration is another development the chemical industry wants to use. Its major advantage in hazardous waste disposal is that it would eliminate the need to transport dangerous materials on public highways or rail lines to disposal-ship docks or to fixed installations.

So far there are only a few permanent facilities in this country authorized to handle the extremely hazardous wastes such as PCBs. One burner is in Arkansas and one in Texas. About 50 more permanent incinerators are operated by chemical manufacturers. These are exclusively for their own use. Land-based burners could allow operators to recover heat values from the incineration.

Going from a fixed installation to a mobile one is a "quantum jump", asserts Dr. John Brugger, a senior scientist at the Environmental Protection Agency. He has overseen the technical progress of a giant incinerator on wheels that destroys toxic materials onsite and then moves on to another job.

This big burner was demonstrated earlier this year at the EPA's oil and



Around a third of US industry hazardous waste now goes to landfills.

hazardous materials spill branch at Edison, New Jersey. The test site is only a mile away from the Kin-Buc landfill, a defunct, 30-acre dump where 70 million gallons of chemical wastes, industrial solvents and PCBs are buried. Brugger says the \$3 million mobile incinerator system will be used to clean up the mess at Kin-Buc and at other New Jersey chemical waste sites.

EPA's burner system consists of three major components, and is 155 feet long when assembled on several flatbed trailers. The first trailer holds the rotary kiln where materials are heated to 1,800°F. Organic materials break down in the kiln and are converted to gases that travel to the second combustion chamber, where 2,200°F temperatures complete the destruction of hazardous materials. Then a pollution control system removes acid gases, dust and particulates. Gases are cooled to 190°F before being released through the system's 40-foot stack.

"Mobile systems could ultimately replace fixed installations, which are unwelcome neighbors in most communities," Brugger predicts.

Meanwhile, however, what is claimed

to be the world's largest fixed incinerator has recently gone onstream at the Chicago plant of SCA Chemical Services, a subsidiary of SCA Services. It boasts a waste-handling capacity of between 30,000 and 40,000 gallons daily. The operating permit granted on December 30, 1982, however, does not allow SCA to burn PCBs.

The huge burner can be used with more than 400 combustible chemical wastes, from solvents, organic residues and halogenated hydrocarbons to many pesticides and herbicides. It operates at temperatures above 2,200°F. Residues are transferred to a secure chemical landfill. To meet emission standards, a system made up of two packed tower scrubbers and four ionizing wet scrubbers is constantly monitored.

The monitoring is important, as current EPA standards call for burners that can remove 99.99 percent of the principal organic hazardous compounds (POHCs).

"Companies from New York State and New Jersey, from far and wide, bring their waste to us," says Clark Rose, SCA vice-president. Price tag for the

whole system? "About \$20 million," says Rose.

Availability of these many improved burning systems should bring a revision of the current waste disposal pattern, which shows incineration to be used on only 6 percent of hazardous wastes. Landfill is used for about 38 percent, chemical treatment takes care of about 33 percent of the wastes, and deepwell injection, 11 percent. Land treatment/solar evaporation copes with 7 percent, and resource recovery with 5 percent.

Wet oxidation is another thermal decomposition technique, but it does not necessarily involve combustion. For this, Zimpro, the environmental control subsidiary of Sterling Drug, has developed a skid-mounted, portable unit that destroys cyanides, phenols and other toxic wastes in industrial sludges and waste water.

How does the process work? It is an aqueous-phase reaction between oxygen in air and the organic fraction of the wastes. The process is kept under high pressure, and the reaction occurs at fairly low temperatures, 450° to 600° F. Organic compounds are reduced to short-chain organics that are biodegradable. The unit can clean up more than 14,000 gallons of waste water per day.

Moreover, explains James M. Force, Zimpro's communications and marketing manager, "If the waste contains valuable materials, they can often be recovered after wet oxidation, and the process is intrinsically energy-saving."

Resource recovery and recycling is also the main goal at SCA's waste processing plant at Newark, New Jersey. Chemical waste streams are treated to extract materials such as organic fuels, alkalies and metals for reuse. The method is called catalytic regeneration. Scrubbers and absorption get rid of gases and pollutants generated by the reactions.

Another company, Fisher-Calo Chemicals & Solvents Corporation, runs a solvent recycling plant in Kingsbury, Indiana. Using basically a thin film evaporator (or still), its recycling in-

THE MAJORS IN CHEMICAL WASTE DISPOSAL		
Only a handful of the hundreds have made it big		
Company	Revenue (1982)	Special Services
Chemical Waste Management (subsidiary of Waste Management Inc.)	\$150 million	Multiple services including incineration, deepwell injection, etc.
BF/CECOS (Browning-Ferris Industries merged with CECOS Incineration)	\$80 million	LiqWaCon waste stabilizer service
EC Corp.	\$55 million	Operates many and industrial cleaning services in 20 states
Zimpro Inc. (subsidiary of Sterling Drug)	\$49 million	Recently added Durox developed PAC system using activated carbon to enhance biological treatment
Rollins Environmental Service	\$45-\$50 million	Has PCB burning plant in Houston
SCA Chemical Services	\$45-\$50 million	Has large-scale gas treatment
Encor Inc.	\$25 million	Has PCB burning plant in Michigan
Chem Clearing	\$7 million	Four plants in 20 states
ERT	\$25 million	Operates 20 plants

cludes strengthening of recovered solvents, specific blends of solvents and repeated recovery of spent solvents.

Chemical treatment of hazardous waste has also progressed. Browning-Ferris Industries (BFI) has developed a proprietary chemical fixation process. It is called LiqWaCon, an acronym derived from Liquid Wastes Converted to Solids, and combines chemical and physical stabilization.

The process consists of mixing a dry and a liquid reagent with certain inorganic waste streams. The waste materials are converted from a pumpable semi-solid to a solid material, usually within 72 hours. The resultant solid can be used as fill or secondary cover for sanitary landfills. The equipment used in the process is trailer-mounted to allow processing at the generator's site.

Deepwells handle about 11 percent of wastes.

Comments Robert Johnson, vice-president of chemical waste services of BFI, "This method is a cost-effective alternative to landfilling for many waste streams."

Others in the chemical treatment business are most of the broad-gauge waste treatment companies. Among them are Chemical Waste Management, Envirosafe Services, SCA Chemical Services and Rollins Environmental Services.

Where does that leave the landfill business, which has been the dominant waste disposal method for years? According to EPA, "In principle, it is better to destroy or recycle hazardous wastes than to landfill them. But the fact remains that for the foreseeable future, land disposal will be necessary because it's infeasible now to treat, recycle or destroy all hazardous wastes."

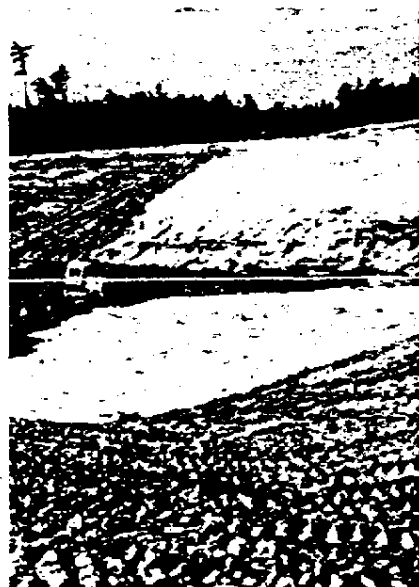
"But we are running out of secure industrial landfill sites," points out Sandoz' Michael Wallace. "You're really storing waste, not getting rid of it, and you're still responsible for it."

A case in point is Aluminum Company of America, which a couple of months ago agreed to pay \$1.5 million to clean up toxic wastes seeping out of an abandoned dump site in Olney, Illinois.

EPA says the agreement, submitted to federal district court in East St. Louis, Illinois, requires Alcoa to remove all liquids, sludges and other waste materials contaminated with PCBs, and to determine the extent of pollution of nearby underground water supplies. EPA contends that the company used the site to dispose of waste oil and other pollutants between 1975 and 1977.

Though there seems to be little to recommend it, landfill disposal of wastes at secure sites will be at least 10 percent of the business even in 1990 "because it cannot be handled in any other way," says BFI's Johnson. And it is not a cheap method.

Right now, estimates Wallace of Sandoz, landfill disposal costs run from \$40 to \$100 per 55-gallon drum, de-



Landfill cell under construction, showing clay liner being put in place.

pending on types and amount of waste. Securing landfill sites is a complicated job. The site must have a dumping basin that is thickly lined with clay to prevent run-off of liquids (including rainwater) into the natural soil. A catchment area is usually required. Some sites have facilities for treating or destroying hazardous elements in that run-off water. The land surrounding the sealed basin is monitored, with test wells drilled to the groundwater strata, so that intrusion of toxics can be noted.

Although many dump sites have been identified, EPA plans to provide nearly \$10 million to the 50 states and Puerto Rico to complete their lists of hazardous waste dumps. The money will come from the "hazardous substance response trust fund" set up under a law providing for cleanup of the country's worst toxic waste sites. The law demands that states develop inventories on the amount, nature and toxicity of the hazardous wastes at each site, along with names and addresses of the dump owners.

EPA, of course, has been severely criticized for its handling—particularly its carry-through—of waste dis-

posal matters. And the \$10 million inventorying of waste dumps will likely have to be followed up by corrective action. EPA has its \$1.6 billion Superfund to pay for cleanup actions, primarily at the 418 toxic dumps that have already been located.

Industry "strongly supports EPA implementation of the Superfund program to clean up inactive waste sites," stated Daniel McGrade of Stauffer Chemical Company last August before the Subcommittee on Environmental Pollution of the Senate Committee on Environment & Public Works.

Meantime, the chemical industry and industry in general are going to be spending more annually than the Superfund amount just to keep up with their waste disposal responsibilities, according to a number of industry studies. Frost & Sullivan, for one, projects a spending rate of \$3 billion by 1990. The rate is currently between \$800 million and \$1.8 billion.

Kidder Peabody suggests the off-site market for waste disposal services alone is in the area of \$500 million now. This would be the material generated at one point and allowed to leave the source site. According to industry reports, about 20 percent of the total of 60 million tons of hazardous industry wastes generated yearly by industry (as defined by the 1976 Resource Conservation & Recovery Act—RCRA) moves offsite.

Moreover, regulatory bodies are likely to be defining as hazardous waste materials those now excluded from the definition—mining wastes, and wastes generated in the search for energy or petroleum sources, even wastes from small producers.

One group trying to broaden RCRA's definition is the Institute of Chemical Waste Management of the National Solid Wastes Management Association. Says Reva Rubenstein of this organization, "We have a lawsuit on the small generator exemption."

Clearly, there will be a need for improved technologies to handle the increasing waste burdens. □