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HAZARDOUS WASTE MANAGEMENT AT ABANDONED DUMP SITES — EVOLVING PERSPECTIVES*

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Summary

This paper traces some historical milestones of the environmental movement leading up to current focus on problems resulting from abandoned hazardous waste disposal sites. It briefly describes the magnitude of the abandoned waste site problem, and finally discusses remedies which could be applied during disposal site clean-up.

Introduction

Toxic and hazardous materials escaping into surface and groundwater from abandoned hazardous waste dump sites is recognized as a major environmental problem in the United States. Public concern regarding this problem culminated in passage by Congress of the "Comprehensive Environmental Response, Compensation, and Liability Act of 1980", better known as "Superfund". The Act will be funded in the amount of $1.6 billion. Approximately 86% of the funds are to come from taxes on chemical manufacturers, and 14% from general tax revenues.

This paper addresses three key questions regarding the problem of abandoned hazardous waste sites.

(1) How did attention come to focus on the problem?
(2) How bad is it?
(3) What can be done to help cure the problem?

Public awareness

During the early part of this century, and particularly up to the mid-1960's, public environmental concerns focused principally upon the provision of safe drinking water (free from pathogenic organisms), and to a lesser extent, upon treatment of wastewaters discharged to public waterways. Population growth and industrial expansion increasingly stressed the natural assimilative capacity of surface watercourses, and several well-publicized oil spills ("Torrey Canyon"

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in 1967, and at Santa Barbara in 1969) helped both to accentuate growing environmental problems, and to shift the emphasis of environmental remedial measures from primarily health-oriented concerns toward ecological and aesthetic considerations.

Environmental interest groups and the media used deteriorated water quality and the oil spill "disasters" to capture broadly-based public support for programs designed to protect the environment. Widely circulated publications ran lead articles entitled, "Fighting to Save the Earth from Man" (Time, February 2, 1970); "The Environment: A National Mission for the Seventies" (Fortune, February 1970); and "Ecology: a Cause Becomes a Mass Movement" (Life, January 30, 1970).

There were several significant outcomes of this dramatic increase in public awareness: strong and well-organized environmental interest groups having ready access to legislators; an apparent public willingness to pay for environmental protection programs; and sustained media coverage of problems affecting environmental quality. During the 1970's a link between ecological and public health concerns began to emerge. This linking of pollution and carcinogenicity and toxicity increasingly became possible because of two factors. Firstly, there was evidence, because of epidemiological research, that environmental insults played a significant role in the occurrence of cancer. Secondly, advances in analytical instrumentation revealed the presence of microcontaminants in the environment in the parts per billion, or even parts per trillion range. Moreover, health research concluded that microcontaminants, even in small concentrations, had an adverse impact on human health.

Several events helped to illustrate the dangers of toxins, carcinogens, and poisons entering the environment, and the direct or indirect impact on people. An insecticide manufacturer in Hopewell, VA, created serious health problems for workers and caused major contamination in the area surrounding the plant. Kepone from this plant was discharged to the James River where it concentrated in fish flesh, requiring closure of the river to fishing. Thus, there was a demonstrated linkage of detrimental human exposure and ecological damage because of pollution.

During 1973 in Michigan, a chemical manufacturer erroneously shipped PBB (a fire retardant) instead of magnesium oxide to be mixed with cattle feed. This resulted in the need to destroy hundreds of cattle poisoned by the toxic mixture. Nearly 90% of breast-feeding mothers in the lower peninsula of Michigan had detectable levels of PBB in their milk. In addition, farm families who owned "high-level" cows had high burdens of PBB in their body fat. This incident illustrated a demonstrated pathway for poisons to enter the human food chain.

A third incident involving the contamination of the Upper Hudson River by PCB (polychlorinated biphenyls) focused attention on the ability of microcontaminants to migrate great distances, and on the fact that the problem was generated over many years and was only discovered years later.

A major environmental "disaster" came in August 1978 at Love Canal in

Niagara Falls, NY. Residents in the area believed that material leaching from an abandoned waste site was causing serious health problems. New York State and EPA identified 82 chemicals in the leachate, 11 of which were suspected human carcinogens and one, benzene, was a confirmed human carcinogen. The decision was made to evacuate 239 families from the area bordering the canal. Their homes were purchased by the state, a school closed, and a six-block area was cordoned off by an 8 feet high chain link fence.

There was national outrage that such a problem could occur. Moreover, given the fact that synthetic chemical production had soared to 350 billion pounds in 1977 from only 1 billion in 1941, there was intense concern over how many other "buried" problems would emerge.

It soon became clear that Love Canal was not an isolated problem. Also during 1978, a disposal site in Bullitt County, Kentucky, was discovered to have tens of thousands of steel drums some of which were leaking their contents into a small creek. Sample analyses indicated the presence of such organic compounds as benzene, toluene, ketones, xylene, styrene, phthalates and PCB in surface runoff and sediment. Altogether 142 chemical compounds were identified in various samples collected at this place which came to be called the "Valley of the Drums".

Because of rising awareness of potential implications, reports of additional problem sites began to mount. Drinking water of Toone, Tennessee, was severely contaminated by chemicals leaching from a nearby landfill. More than 100 wells in the New Jersey Pine Barrens were contaminated by chemicals leaching from the 135 acre Jackson Township dump. Near Charles City, Iowa, 6 million pounds of arsenic and large quantities of other hazardous chemicals caused contamination of deep wells 30 to 40 miles downstream from a disposal site. In Massachusetts, 22 municipal water supplies were found to contain high levels of potentially hazardous chemicals.

These and other incidents did not go unnoticed by the media. Hazardous waste problems were the subject of numerous features. For example, Time entitled a cover story, "The Poisoning of America" (September 22, 1980). One of the people interviewed in conjunction with the article said, "Toxic waste will be the major environmental and public health problem facing the U.S. in the 80's." This opinion is shared by many observers and workers in the field.

Problem magnitude

As a result of the implications of Love Canal, and the growing list of other problem sites, the House Subcommittee on Oversight and Investigation of the Interstate and Foreign Commerce Committee conducted hearings designed to determine the magnitude of the hazardous waste disposal site problem. Subsequently, the subcommittee conducted a "Waste Disposal Site Survey" and issued their report in October 1979. The report is popularly known as the "Eckhardt Report", named after the subcommittee chairman.

The report found that the 53 chemical companies surveyed (1,605 plants)

produced approximately 66 million tons of process wastes in 1978. Since 1950, these companies had disposed about 762 million tons of chemical wastes in 3,383 locations. Additionally, 32% of these sites (1,099) are known to be closed, and another 9% (319) may be closed. The closed site inventory of wastes is about 100 million tons. Furthermore, 4.8 million tons were taken by private haulers to unknown destinations.

EPA, in a separate assessment, concluded that between 30 to 40 million metric tons of hazardous wastes would be generated in 1980. This is expected to double by the year 2000. EPA's Office of Solid Waste estimates that there may be as many as 32,000 hazardous waste dump sites throughout the country. Of these, 1,200 to 2,000 may present significant health or environmental problems.

State and local agencies joined in the search for abandoned sites. During October 1979, an Interagency Task Force on Hazardous Wastes (created by the Commissioner of Environmental Conservation of New York State) found 36 sites that definitely received large quantities of hazardous wastes, and another 116 sites suspected of having received significant quantities, in Erie and Niagara Counties alone. A statewide survey of groundwater contamination in Michigan released in December 1979 identified 131 sites known to be contaminated by hazardous pollutants, and another 274 suspected to be contaminated.

Currently, EPA is attempting to identify abandoned hazardous waste sites, and to assess the magnitude of the problem at each. Thus, although the magnitude of the problem cannot be precisely defined, preliminary results indicate that the problem is widespread and that the impact could be severe, particularly for groundwater supplies.

Remedies

Some of the technology developed to deal with hazardous material spills over the past ten or more years may have application in the clean-up of abandoned waste sites. However, abandoned sites pose more difficult and complex problems than spillage. Usually a spiller can be identified, generally only one or a few materials are spilled, and the acute problem can be discovered, confirmed, and handled more easily. On the other hand, responsibility for abandoned sites often is diffuse because the problem generator may be out of business, the problem may be widespread before it is discovered, and it usually is chronic and long-term. Frequently, there is groundwater contamination which is very difficult to clean up.

The most common technique in remedial action plans is containment. This action is taken to prevent further spread of contamination to the surrounding area. The usual first step is to remove any drums or other containers which may be present. This is a potentially dangerous task because the containers may be in varying stages of decay, and often their contents are unknown. Where large numbers of drums are present, they are emptied with the residuals being incinerated or taken to an approved chemical treatment facility,

or a secured landfill. Some drums are placed in overpacks for transfer to a permitted disposal facility.

Another containment measure involves the removal of contaminated soil. The purpose is to minimize the potential for leaching of the contaminants into the groundwater. Removed soil is transported to a secured lanfill.

Controls can be initiated to prevent intrusion of extraneous surface water onto the site. This is accomplished through grading, diversion, and the construction of dikes and berms. Where groundwater control is needed, the following remedial measures could be installed: slurry trench cut-offs, grout curtains, bottom and wall sealing, and groundwater pumping.

After initial containment measures are taken, sites then may be capped using impermeable clays. The caps then are revegetated to prevent erosion, desiccation, and breaching.

In cases of a contaminated surface impoundment, in situ treatment may be possible. This could involve neutralization of acids and bases, chemical precipitation for metal ion removal, or biological treatment.

In addition to source removal and containment aspects, subsurface migration of contaminants may be a major consideration. Groundwater contamination results from the leaching of hazardous constituents from disposed materials. In many cases, concentrations of leachate in groundwater are high enough so that decontamination is necessary. Assuming that this is the case, suitable treatment processes must be devised. Usually this is a difficult task because chemical compositions are variable from site to site, at different sampling locations within a given site, and at a given location over a period of time.

The following unit processes have been identified as having potential broad application to the aqueous contamination problems associated with hazardous waste disposal sites:

- biological treatment
- chemical coagulation
- carbon adsorption
- membrane processes
- resin adsorption
- stripping.

These, however, must be supplemented by ancillary processes such as sedimentation and filtration.

Conclusion

The problems created by abandoned hazardous waste sites are serious and could have significant adverse impact upon human health and the environment, both in the short and long-term. The magnitude of the problem still is emerging. Although technology exists to cure abandoned hazardous waste site problems, it would have been easier and less costly to manage society's residues thoughtfully in the first place. Perhaps this is the most important conclusion resulting from efforts to clean-up these sites.