SOLID WASTE: NEW PROBLEMS FACING THE ELECTRIC UTILITY INDUSTRY

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ABSTRACT

Under provisions of the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency (EPA) is charged with the responsibility of establishing guidelines for identifying and handling hazardous solid wastes. To implement the Act, EPA has devised a series of chemical, biological, and environmental tests to which wastes will be subjected. Any waste failing any one of the many parts of the test will be classed "hazardous" and be subjected to strict handling and disposal practices. These practices could add up to $90/ton to the cost of disposing of utility wastes. If utility waste is declared a hazard, the additional disposal cost would, conservatively, amount to $3 billion in 1979, rising to over $10 billion by 1985. A key element in the EPA test procedure is the Toxicant Extraction Procedure (TEP), a procedure for leaching waste to yield a liquid extract that can be used for the chemical and biotic measurements. Neither the reproducibility nor the sensitivity of the TEP has yet been fully evaluated, hence its reliability is open to question. Further, the question of defining a representative sample from a complex industrial process has yet to be addressed. The usefulness of the TEP in defining a hazard is open to question. The full effect of RCRA on the electric utility industry cannot yet be assessed.

INTRODUCTION

The electric utility industry has always been concerned about the large volume of solid waste which it produces -- waste mainly in the form of ash and now with the introduction of scrubbers, sludge. In 1978, the industry generated about 60 million tons of such waste. Disposing of it is no small problem. Attempts to use ash for building materials and concrete have been undertaken, but commercial utilization of ash accounts for, at most, 10 to 15 percent of the amount produced. Disposal is still the major problem. Recent federal legislation in the United States, however, has added a new dimension to the problem of solid waste disposal. Under a mandate from the Congress through the Resource Conservation and Recovery Act (RCRA), the Environmental Protection Agency (EPA) is charged with the responsibility of establishing guidelines for the handling of solid waste and for developing procedures to identify waste that might be considered hazardous. Under these new guidelines, many sites which had been used for disposal will no longer be considered suitable. Furthermore, if the waste should fail the EPA hazard identification tests, strict handling and disposal procedures will be mandated. The effect of the new regulations will have a tremendous financial impact on the industry. Disposal costs for wastes which are not classed as hazardous will jump from the present $2-3/ton to as much as $10/ton. If the wastes fail the EPA tests, they will be considered "hazardous", and disposal costs will rise to $50-$90/ton. A priori, we anticipate that much utility waste may fail the test. For an industry which produced 60 million tons of waste in 1968, the cost of having its waste classed as a hazard could add $3 billion/year to the price of electricity -- using a conservative incremental disposal cost of $50/ton. By 1985, when waste production will reach 200 million tons/year, the incremental cost will be a least $10 billion if the waste is considered hazardous. And if none of the waste is considered hazardous, the added disposal cost will still amount to about $2 billion in 1985. Some RCRA regulations are already in effect; others were published in draft form in early 1978.

HAZARDOUS WASTE

The main concern of the industry is the possibility that much utility solid waste may be classed as hazardous. EPA has established a chemical and biological test procedure to which solid waste will be subjected. If a waste fails any one of the many parts of the procedure, it will be considered hazardous, thus becoming subject to strict handling and disposal practices. Under proposed EPA regulations, hazardous waste may be disposed of only in carefully constructed landfills or ponding systems. The site must be underlain by two impervious liners which are separated by a recommended 10 feet of low-permeability soil. In addition, a routine program of monitoring the groundwater must be maintained. The draft regulations also call for use of barriers to keep people or animals out of the site and for a contingency plan, copies of which go to the police and fire departments, in the event of an accident at the site which results in discharge of waste to the environment.

A key factor in the RCRA program is the test procedure, particularly the Toxicant Extraction Procedure, commonly referred to as the TEP. The TEP, as applied to waste, basically involves: (1) leaching the solid waste with water to which acetic acid is added to maintain a pH of 5.0, and (2) separating the solid from the liquid phase by some combination of filtering and centrifugation. Following the extraction, the leachate is then: (1) analyzed for those trace metals for which drinking water standards have been established and for six specific pesticides, (2) subjected to certain biological tests, and (3) subjected to certain ecological tests. Although not yet specified, the biological tests will probably include the Ames test plus measurements of mutation in yeast and primary DNA damage in bacteria. The ecological procedures will probably call for 48-hour LC_{50} tests on daphnia, measurement of growth reduction on radish, and seed germination measurements. Both the leachate and a highly concentrated organic extract from the leachate will probably be required for the biotic tests.

As of January 1979, only the TEP and the required chemical tests (for trace metals and pesticides) have been published in proposed form. We cannot, therefore, evaluate either the biological or ecological parts of the test procedure, We can, however, discuss the TEP and chemical tests. The usefulness of the TEP in identifying an environmental hazard has been questioned by the utility industry and by many members of the scientific community. Concern focuses on three aspects of the procedure: (1) the reproducibility of the procedure, (2) the representativeness of samples to be tested, and (3) the validity of the conclusions in terms of hazard definition.

The reproducibility of trace element analytical data, based on the TEP procedure, has not been evaluated. A priori, we anticipate that reproducibility (even within a given laboratory) may present serious problems, particularly inasmuch as trace quantities (on the ppm level) of metals are involved. A number of factors lead to problems in reproducibility. They include: (1) sample size: The procedure calls for grinding the sample to pass a 9.5 mm sieve. Because of that large a sieve size, replicate grindings are highly unlikely to yield samples with similar grain-size distributions and, inasmuch leachability is in large part a function of grain size, we cannot expect similar amounts of trace components to be leached from samples with different grain size distributions. (2) solid/liquid separation procedure: Following extraction, the solid and liquid fractions are to be separated by some combination of filtering (through a 0.45 μm in diameter.

These small particles typically carry the highest concentrations of trace components, yet the filtering and centrifugation procedures have such a high degree of inherent variability that we can rightly suspect that different aliquots of the same sample will contain different amounts of the <0.45 μm solids in the liquid phase. (3) agitation: Extraction will be carried out by a 24-hour agitation in a stainless steel device. We see two problems with this step. Firstly, the agitation will break up some of the particles into smaller ones -- but not necessarily uniformly from aliquot to aliquot -- and, as pointed out in problem #1 (above), leachability is very much a function of particle size. Secondly, the abrasion of particles by the steel may introduce trace metals into the liquid phase. (4) chemical analysis of leachate: Analysis will be by atomic absorption spectroscopy and, on the ppb or ppm level, 100-200% differences are not uncommon.

The problems enumerated above could easily lead to differences, even within a single laboratory, which would result in one aliquot of a sample being classed as a hazard, another not. Already some preliminary data on iron and calcium show intra-laboratory differences of 30 percent and interlaboratory differences of 200 percent. ASTM, EPA, and EPRI all have projects underway which address the question of reproducibility. The EPRI program is, by far, the most comprehensive with regard to utility wastes. It involves a number of laboratories, each using identical equipment and procedures to extract and analyze a large number of aliquots from different types of samples. The project should yield a rigorous statistical evaluation of the sensitivity of the EPA procedure with regard to changing certain steps in the procedure. For example, it will evaluate the effect of different types of agitators, centrifuges, and filtering systems. It will assess the effect of different leaching times and different pH environments on the final analytical results. It will also attempt to evaluate the human component, i.e., the effect of using different individuals for the same procedural step. Results from the EPRI project should be available by the fall of 1979.

As mentioned above, a second concern is the ability to use samples which are representative of utility waste. We know that the chemical composition of ash, for example, varies from day to day and from hour to hour, hence from place to place in a disposal site. The time of collection is also an important consideration. At present, we do not know the statistics of the variability of ash composition, hence we are unable to sample ash from a power plant in order to get truly representative material. We do not know where to sample, how many samples to take, or with what frequency to sample. Added to this is the problem of individual sample inhomogeneity -- again, a serious concern when dealing with elements present at the trace level. EPRI also has underway a study addressing the general problem of the statistics of sample variability. The study, the results of which will be available in the fall of 1979, focuses on identifying the hourly, daily, weekly, and monthly variability in chemical composition of ash, and the effect of the variability on results of the EPA hazard identification test.

A final concern relates to the validity of declaring a waste a hazard based on the results of the test procedure (aside from problems of reproducibility and representativeness). For the eight elements of concern (As, Ba, Cd, Cr, Pb, Hg, Se, Ag), the waste will be declared a hazard if the leachate (from the TEP) contains any one of the eight at a concentration which is 10 times (or greater) the drinking water standard. As an example, for cadmium, for which the drinking water standard is 10 ppb, the leachate can contain no more than 0.1 ppm without the precursor ash being classed as a hazard. Using such a basis assumes, of course, that cadmium will eventually reach a water supply without suffering more than a 10X dilution. Considering the complex soil-water-trace element reactions which are possible, that assumption is certainly open to question. A further problem relates to the use of acidifying the leachate to a pH of 5.0. Such a procedure does not allow for the natural buffering capacity of many solid wastes, hence the amount of trace metal leached in the TEP may be quite unrelated to that which would be leached in a natural setting.

NON-HAZARDOUS WASTE

Even if a waste should pass the EPA test procedure (and the burden of proof rests with the industry), disposal practices will still be strictly regulated under RCRA. Such practices will probably add about $10 to the cost of disposing of each ton of non-hazardous utility waste. Under the new regulations, which wnet into effect in early 1978, any utility waste (including non-hazardous waste) cannot be disposed of in wetlands, flood plains subjected to a once-in-a-hundred-year flood, or in environmentally sensitive areas. Flood plain is defined;

however, neither a wetland nor an environmentally sensitive area are clearly defined.

Many power plants (over half of those east of the Mississippi) are located on flood plains or in what may be considered wetlands. As a result, the new regulations under RCRA preclude disposal of waste on the site of the power plant. Waste would, therefore, have to be transported to some other site and it is this transportation requirement which adds considerably to the cost of disposal.

CONCLUDING COMMENTS

The total effect of the new RCRA regulations on the utility industry are, admittedly, difficult to assess. For one thing, the full test program as related to the Toxicant Extraction Procedure has not yet been officially proposed. We do not yet know, for example, exactly what form the biological and ecological tests will take. And, even though the TEP and chemical test procedures have been issued in draft form, we have no firm basis for knowing what the final form will be when published in January of 1980. Finally, and most importantly, too few samples of utility waste have been subjected to the TEP and associated analyses to allow us to estimate the extent to which utility wastes will be declared a hazard. Based on published data on ash composition and on characteristics of many leachates, Hart and Delaney (1978) have suggested that much of the waste now being produced by electric power plants will, in fact, fail the EPA tests, hence be classed as hazardous. At the least, the new siting requirements will add $10/ton to disposal costs even if the waste is not classed as a hazard. At worst, the public will be faced with billions of dollars per year in added cost for electricity because of the necessity to handle "hazardous" waste according to strict procedures.

WORK CITED

Hart, F. C. and B. T. Delaney (1978), The impact of RCRA (PL 94-580) on utility and solid wastes: Electric Power Research Institute Report EPRI FP-878, 133 p.