Rachel's Environment & Health News
#207 - Hazardous Waste Incineration -- Part 4: Real Alternatives To Incineration
November 13, 1990

Why is there so much technical disagreement about the incineration of hazardous waste? It is because different people emphasize different aspects of the problem. A combustion engineer, who appreciates how difficult it is to burn things completely with an open flame, is button-bursting proud that any large machine can successfully destroy 99.99% of the chemicals fed into it (even if for only one day, the day it's all tuned up for its trial burn, the outcome of which will determine whether or not it gets licensed to operate). On the other hand, a biologist looking at the same machine sees something completely different. A biologist is concerned about keeping strange chemicals out of the natural environment because such things tend to accumulate and concentrate as they travel through the food chain. Creatures that live at the top of the food chain become contaminated the most, and, in general, humans eat high on the food chain. This is why human breast milk is so contaminated with PCBs and pesticides that, if it were bottled, the sale of human breast milk would be subject to ban by the U.S. Food and Drug Administration (FDA). [See RHWN #193.] The breast milk of American women no longer meets minimum FDA health standards for human food. This is a direct result of releasing toxic PCBs and other chemicals into the natural environment. A biologist looking at the EPA (U.S. Environmental Protection Agency) plan to incinerate as much hazardous waste as possible sees not a remarkable combustion achievement but a real danger to humans and to the planet.

The U.S. presently produces at least 580 million tons of hazardous waste each year (and possibly 5 times as much as this--the EPA still doesn't actually know, according to the American Chemical Society [see RHWN #148]). If we assume that the smaller number (580 million tons) is true, and if we assume 99.99% of this were destroyed through incineration, the remaining 0.01% that wasn't destroyed (and which would inevitably enter the environment through air emissions or through disposal of residual ash) would amount to 116 million pounds of hazardous waste entering the environment each year, or about half a pound for each man, woman, and child in America. Since many of these chemicals are long-lived and are toxic in milligram or microgram quantities, half-a-pound per person released into the environment is substantial. Naturally, these toxics would not be evenly distributed; people and communities near incinerators would be exposed far more than the average.

It is worth pointing out that the 99.99% destruction goal is only assumed by optimists, such as officials in charge of incinerator permits at the EPA (U.S. Environmental Protection Agency). James Welch, a scientist employed by the U.S. National Bureau of Standards, studied the testing process whereby EPA decides that 99.99% destruction has been achieved in an incinerator. His conclusion: the same numbers that give the result 99.99% could with equal validity be shown to achieve only 79.23% destruction. As every scientist knows, no measurement is exact. Every measurement is approximate and has an upper boundary and a lower boundary; the true value lies somewhere between the two boundaries. To achieve a result of 99.99% you have to make an optimistic assumption at every step in the trial-burn process; if you simply change your viewpoint and make a pessimistic assumption at every point, you can conclude that the very same test burn achieved only 79.23% destruction of wastes. Thus, Welch concludes, the actual destruction of chemicals in an incinerator falls somewhere between 99.99% and 79.23%.[2] If all 580 million tons of U.S. hazardous wastes were incinerated and only 79.23% were destroyed, incinerators would emit nearly 21% into the environment, or 243 billion pounds (about 1000 pounds for every man, woman and child in America). Whatever number is correct (between 116 million pounds and 243 billion pounds), to many people, such a dousing of the planet with exotic toxic materials would simply be unacceptable, especially because it is not necessary. They reject incineration and they favor alternatives. What alternatives exist?

There are so many alternatives to the incineration of hazardous wastes that it is hard to know where to begin. The scientific and engineering literature is bulging with descriptions of existing technologies, available today, for managing wastes by means other than incineration.

The production and release of wastes into the environment is a direct result of inefficient management, careless housekeeping, and obsolete technology. Naturally, the most desirable option is to stop making toxic wastes in the first place. Is such talk merely the stuff of dreams? Hardly. The technical analysis unit of the U.S. Congress [the Office of Technology Assessment (OTA)] in 1986 looked carefully at the production of hazardous wastes in the U.S. and concluded that it would be possible for American industry to cut its production of hazardous wastes by 50% within 5 years using existing technologies.[1] To put it bluntly, half of all toxic wastes are produced only because our captains of industry are too unimaginative and too lethargic to do things in a new way. If OTA's ideas had been acted upon in 1986, the 50% cut could be well along at this point and the nation would need no new waste treatment capacity today.

But let's assume that America's industrial leaders will remain unimaginative and lethargic and will not reduce waste production using techniques that are readily available today. How could wastes be handled if not by incineration?

As with household waste, the key to successful management is source separation. Keep the wastes separate from each other, to keep them as pure as possible, and you've got a decent shot at being able to reuse them or recycle them through waste exchanges. Once they are mixed together, no one can find any use for them and then they can only be discarded or incinerated to recover their heat value (assuming everyone is willing to accept the environmental degradation inherent in this approach).

But let's assume that industry is run by people too unimaginative or too lethargic to keep their wastes separate so they might be reused or recycled through waste exchanges. What alternatives do such people have available to them, other than incineration?

There are four major classes of waste treatment processes besides incineration: phase separation, component separation, chemical transformation, and biological treatment; within each of these broad categories there is a large number of workable approaches;3 in addition, there is spectrum of high-temperature processes that are not, technically speaking, incineration but which achieve the same goal as incineration (breaking molecular bonds via heat), though a lot more cleanly.

What are phase separation techniques? Filtration, sedimentation, flocculation, centrifugation, distillation, evaporation, flotation, ultrafiltration, and precipitation, to mention only the better-known ones. Component separation techniques include ion exchange, liquid ion exchange, freeze crystallization, reverse osmosis, carbon adsorption, resin adsorption, electrodialysis, air stripping, steam stripping, ammonia stripping, ultrafiltration, solvent extraction, reverse osmosis, distillation, and evaporation. Chemical transformation processes include neutralization, precipitation, hydrolysis, oxidation, reduction, ozonolysis, calcination, chlorinolysis, electrolysis, and microwave treatment. Biological methods of treatment include too many possibilities to list: there are microorganisms in nature that can break down anything into its constituent elements and thus detoxify it (unless of course the elements themselves are toxic, such as mercury or thallium). Finding and cultivating such organisms is a matter of putting knowledgable and competent investigators to work with clear goals and adequate resources to accomplish those goals.

[More on alternatives next week.]

--Peter Montague

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[1] P.L. Ciriello and T. Goldberg, "Lead-Contaminated Soil Cleanup Draft Report" which appears as Appendix E in: Agency for Toxic Substances and Disease Registry, THE NATURE AND EXTENT OF LEAD POISONING IN CHILDREN IN THE UNITED STATES: A REPORT TO CON- GRESS (Atlanta, GA: Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services [1600 Clifton Rd. - Mail Stop E-33, Atlanta, GA 30333; phone (404) 639-0730], July, 1988). Free while supplies last.

[2] Deborah Wallace, IN THE MOUTH OF THE DRAGON (Garden City Park, NY: Avery Publishing Group [120 Old Broadway, Garden City Park, NY 11040; phone (516) 741-2155], 1990). $17.95.

[3] For example, see Yen-Hsiung Kiang and Amir A. Metry, HAZARD- OUS WASTE PROCESSING TECHNOLOGY (Ann Arbor, MI: Ann Arbor Science Publishers, 1982).

Descriptor terms: hazardous waste incineration; breast milk; toxic waste; james welch; health; national bureau of standards; studies; chemical waste industry; waste treatment technologies; alternative treatment technologies;

Rachel's Environment & Health News is a publication of the Environmental Research Foundation, P.O. Box 160, New Brunswick, NJ 08903-0160; Phone: (732) 828-9995; Fax (732) 791-4603; E-mail: erf@rachel.org; http://www.rachel.org. Unless otherwise indicated, Rachel's is written by Peter Montague.