Rachel's Environment & Health News
#306 - New Alternatives To Incineration
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A new industry is growing up to replace hazardous waste incineration. Incineration isn't dead by any means, but it is expensive and it has aroused citizen opposition everywhere. Citizen opposition, in turn, has forced the government to investigate incineration carefully, and the evidence indicates that incineration is a dirty, dangerous technology that creates at least as many problems as it solves. [See RHWN #283, #281 and #280.]

One candidate for replacing incineration is called "bioremediation" and it uses bacteria to "eat" hazardous waste. Specialists within EPA [U.S. Environmental Protection Agency] are promoting bioremediation for getting rid of wastes, particularly at Superfund sites (old chemical dumps), and the marketplace is filling up with companies advertising that their bugs (bacteria) will eat more waste faster and cheaper than the other guys' bugs.

Is bioremediation a good idea?

Bioremediation IS a good idea, at least in principle. But, like anything else, bioremediation can be done badly, or carelessly, or even dangerously. A new report, THE OVERSELLING OF BIOREMEDIATION: A PRIMER FOR POLICY MAKERS AND ACTIVISTS, tells the story well.

The bulk of hazardous wastes are "organic molecules"--relatively large molecules containing many atoms strung together, with carbon atoms as the glue. These molecules are made up of simple elements like hydrogen, nitrogen and sulfur which are not, by themselves, very toxic. But strung together into big molecules, and particularly when a halogen (chlorine or bromine or fluorine) atom is attached, these organics can interfere with living things like humans. In short, they become toxic. Some organic molecules are millions of times more toxic than any of the elements from which they are formed.

The goal of an incinerator is to break the chemical bonds that hold large organic molecules together, to break them down into their constituent elements, thus detoxifying them.

Now it happens that some natural microorganisms (bacteria, fungi, and algae) have the ability to break certain chemical bonds. In principle, if the right bugs could be placed in contact with wastes, they would break the chemical bonds, thus detoxifying wastes.

The trick, then, is to find the right bugs and put them into contact with the hazardous wastes you want to detoxify. In theory, the microorganisms will absorb the wastes, break them down, and excrete less-toxic by-products.

This has in fact worked at some locations. For example, the City of San Francisco has successfully bioremediated soils contaminated with hydrocarbon fuels (gasoline, jet fuel, kerosene, diesel, and bunker oil) at a cost of $16 to $22 per cubic yard--more than 10 times cheaper than an incinerator could have done the job. In Oakland, California, the Pacific Renaissance Plaza was successfully bioremediated. Ten thousand cubic yards of gasoline-contaminated soil were successfully decontaminated over a two-year period at a cost of $130 per cubic yard.

But for every success story, there's another kind of story in which someone has tried bioremediation and claimed a success but has based the claim on questionable data. For example, a highly-publicized oil spill in the Gulf of Mexico in 1991 was treated with microorganisms. A hundred pounds of bugs were spread over a 40-acre patch. The company that did the job claimed 30% of the oil disappeared the first day but their experiment lacked any controls, so their findings lacked scientific validity. One microbiologist said it would take weeks to months to achieve a 30% reduction and what probably happened, he said, was that the oil merely sank. The point is, without a proper experiment, including controls, the results cannot be interpreted. But proponents of a new technology need to claim success so they do.

Using bacteria to degrade waste isn't new. Composting uses naturally- occurring bacteria to degrade wastes. Sewage treatment plants have been using bacteria to degrade sewage since 1914.

The simplest bioremediation technique is so-called "land farming" in which wastes are plowed into the soil and, with luck, degraded. A more complex scheme involves some kind of enclosure (ranging from a lined lagoon to a completely-enclosed vessel) called a reactor vessel, where wastes and bugs are mixed together under controlled conditions.

The simplest bioremediation scheme provides nutrients and oxygen to bacteria that are already present at a site, thus helping them grow so they can degrade a waste.

A somewhat more complex scheme involves finding bacteria elsewhere that can do the job, growing them in a laboratory, then putting them on the site and enhancing their growth.

The most complicated scheme envisions genetic engineering, taking genes from one creature and implanting them in another. The goal of genetic engineering is to add the survivability of one bug to the pollutant- grading abilities of another, or to add several pollutant-degrading abilities to one bug, thus creating a superbug.

The U.S. Supreme Court ruled in 1991 that companies can patent new forms of life (such as genetically engineered microorganisms), so there is great incentive to create a superbug. But there are obvious dangers in releasing new forms of life into the environment. Suppose someone creates a superbug to degrade creosote wastes but the bug degrades telephone poles treated with creosote. Or suppose a bug is created to degrade oily wastes but the bug degrades the oil that most mammals carry in their skin.

There are no federal regulations controlling the design, testing and release of genetically-engineered microorganisms for waste-degradation, so there is considerable opportunity for something to go wrong.

Even the simplest bioremediation cannot be considered a proven technology. It should all be approached as an experiment. Although more than 100 chemicals have been degraded by bugs under laboratory conditions, this has not readily translated into field successes. And success at one site does not guarantee success at another. Local conditions make all the difference.

Questions about the hazards remain:

1) What are the effects of adding trillions of non-native microorganisms to a site--will native organisms be displaced with adverse consequences for the local environment?

2) What is the effect of creating conditions for enhanced growth of microorganisms?

3) Little is known about the fate of the chemicals that are remediated. How do we know by-products won't be as toxic as, or more toxic than, the original chemicals? How complete can degradation be? How do we know there aren't hot spots remaining after a cleanup?

These are questions that citizens should ask when bioremediation is proposed at a site. Bioremediation is a good idea and it should be tried, but it should be tried carefully and with proper controls.

Joel Hirschhorn, a private consultant, says, "The most important thing to do in the near term is to apply biological cleanups to simple problems in ways that build public confidence and a reliable database. This means biological application chiefly on sites where: there are only one or two chemical contaminants (e.g., spills, leaking underground storage tanks, and simple manufacturing sites); materials are easily transferred to closed treatment systems;

naturally occurring microorganisms from the site are used; and complete information is made public on exactly what living organisms and other materials are used and, possibly, produced. It seems inappropriate at this time to attempt to apply biotechnology to chemically complex sites such as landfills and open dumps where there are also many physical obstacles to effective biotreatment."

GET: Doreen Stabinsky, THE OVERSELLING OF BIOREMEDIATION: A PRIMER FOR POLICY MAKERS AND ACTIVISTS (Sacramento, California: California Biotechnology Action Council, 1992). Available for $5.00 from the Council at: 1912 F Street, Suite 100, Sacramento, CA 95814. Phone (916) 446-3350.

To keep abreast of bioremediation and other non-incineration technologies for cleanup of Superfund sites, you should know about four sources of information:

The EPA's SITE [Superfund Innovative Technology Evaluation] program, which has been publishing reports on alternative treatment technologies for several years. To get a free list of SITE publications, request a copy of COMPENDIUM OF SUPERFUND PROGRAM PUBLICATIONS, [Publication No. PR-881], which is free from National Technical Information Service (NTIS): (703) 487-4650]. If you get your name on the SITE mailing list, you can receive notice of new cleanup technologies as they become available. This is a good idea because new reports are often available free for a period of time before they are handed off to NTIS, which then sells them. To get your name on the SITE mailing list, write to: ORD Publications, 26 West Martin Luther King Drive (G72), Cincinnati, OH 45268. Or phone SITE at (513) 569-7758.

EPA operates two free computer bulletin boards that contain current information on alternative treatment technologies. The ATTIC system (Alternative Treatment Technology Information Center) can be reached at (301) 670-3813 (1200 or 2400 baud, 8N1), or at (301) 670-3813 (9600 baud, 8N1). To talk to a human, call (301) 670-6294. The ATTIC system has a database of 2200 abstracts of articles and reports on alternative treatment technologies; after you find something interesting, call them and request a free photocopy of the full document. The ATTIC system also contains a database of experts on various cleanup technologies, and a SIG (special interest group) on bioremediation, plus a lot more. There is a great deal of information on alternative treatment technologies available from this source. A user's manual can be downloaded from the board.

The second EPA bulletin board is called CLU-IN, the Cleanup Information Bulletin Board; phone (301) 589-8366 (1200, 2400 or 9600 baud, N81). To talk to a human: (301) 589-8368. CLU-In has at least 6 SIGs (special interest groups) open to the public, including one on "innovative technologies"; each contains a dozen or more relevant documents available for downloading. A user's manual can be downloaded as well.

On both these systems the software is somewhat clunky, cryptic and idiosyncratic, but it's better than nothing and if you need information you'll probably find it worth your time (and telephone money) to explore these sources.

Another source of information is EPA's Vendor Information System for Innovative Treatment Technologies, or VISITT. This is a diskette containing descriptions of companies that sell innovative cleanup technologies. To get a free copy, call the VISITT hotline: 1-800-245- 4505 or (703) 883-8448. It gets updated annually. Companies wishing to have their technology listed must request an official entry form from: (513) 569-7562.

--Peter Montague

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