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EPA

A Citizen's Guide To Innovative Treatment Technologies

For Contaminated Soils, Sludges, Sediments and Debris

Technology Innovation Office _____ **Technology Fact Sheet**

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What Are Innovative Treatment Technologies?

Treatment technologies are processes applied to the treatment of hazardous waste or contaminated materials such as soils, sludges, sediments and debris to permanently alter their condition through chemical, biological, or physical means. Technologies that have been tested, selected or used for treatment of hazardous waste or contaminated materials but lack well-documented cost and performance data under a variety of operating conditions are called *innovative* treatment technologies.

Treatment technologies are able to alter, by destroying or changing, contaminated materials so they are less hazardous or are no longer hazardous. This may be done by reducing the amount of contaminated material, by recovering or removing a component that gives the material its hazardous properties or by immobilizing the waste.

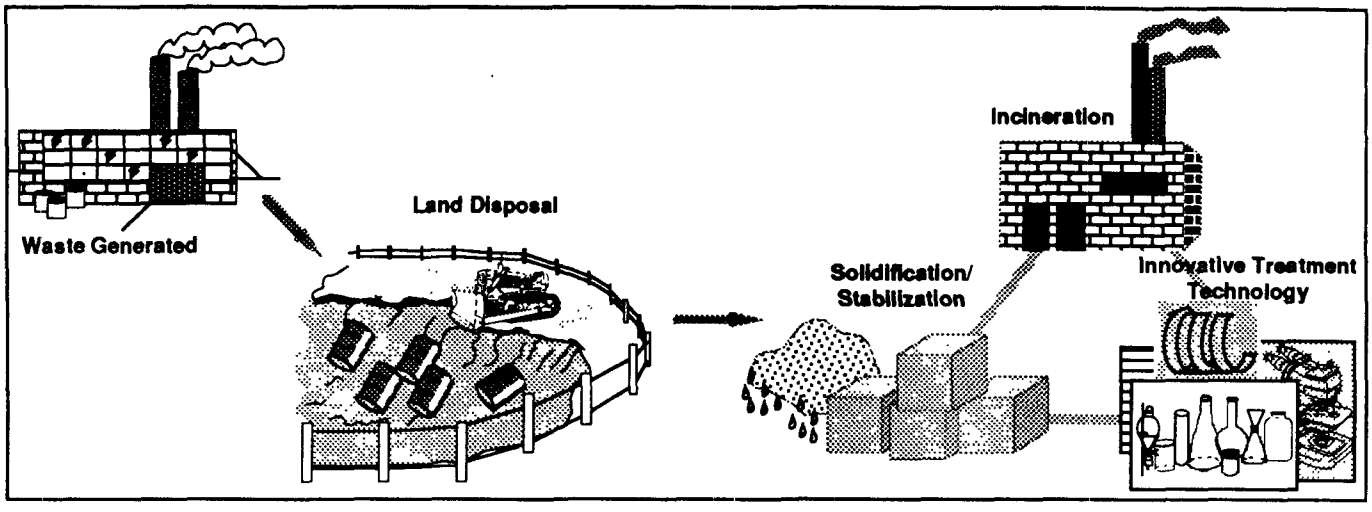
Why Use An Innovative Technology?

Treatment of contaminated sludges and soils is a new field of technology that has developed and grown with the advent of legislation for contaminated waste site clean-up in the past ten years. Initially, the only way to eliminate a hazardous waste from a particular location was to move it somewhere else, or place a cap on top, using land disposal as the solution to the problem. New landfill designs for disposal of contaminated material were required to meet new, stringent criteria under the Resource Conservation and Recovery Act, which provides protection to the environment. With an increasing amount of clean-up underway, a new demand for more permanent and less costly solutions for contaminated materials developed. In response, scientists and engineers began to develop and use more treatment technologies. Figure 1, on page 2, provides an illustration of the evolution of their thinking about how contaminated materials should be treated.

Why Use An Innovative Treatment Technology?

- **Offers the potential for cost-effective, long-term solutions to hazardous waste clean-up activities.**
- **May provide increased protection and more permanent solutions at contaminated sites.**
- **Provides alternatives to existing disposal methods such as land disposal or incineration.**

Figure 1
Progress In The Methods For Handling Hazardous Wastes



As knowledge about the clean-up of contaminated sites expands, scientists and engineers will be able to devise approaches for more effective, permanent clean-ups. Because the innovative treatment technologies that are being used to treat hazardous waste lack a long history of full-scale use, they do not have the extensive documentation necessary to make innovative treatment technologies a standard in the engineering/scientific community. Although innovative treatment technologies lack extensive documentation, many of these technologies have been used successfully at contaminated sites in the U.S., Canada and Europe. Some of the technologies were developed in response to the hazardous waste problem, others have been adapted from other industrial uses.

As shown in Figure 2, below, developing and perfecting treatment technologies is an on-going process. It begins with a **concept** — an idea of how to treat a particular hazardous waste. The concept usually undergoes a research and evaluation process to prove it is feasible. If the concept is proven, often the next step is to undergo bench-scale testing. During bench-scale testing a small-scale version of the technology is built and tested in a laboratory. During this testing it would be considered an **emerging** technology. If the technology is successful during the bench-scale testing, it is then demonstrated at small-scale levels at field sites. If successful under the parameters of small-scale field demonstrations, the technology will often be chosen for remediation and used full-scale at contaminated waste sites. The technology is continuously being applied at different sites and evaluated so that it can constantly be refined.

It is only after a technology has been used at many sites with varying conditions and the results fully documented, that it achieves the status of an **established** technology. Therefore, the majority of technologies in use today are classified as innovative.

Are Innovative Treatment Technologies Always The Right Choice?

Not every technology will be effective or appropriate at every contaminated waste site. Therefore, although innovative treatment technologies offer the opportunity to apply different methods, science and engineering professionals must determine which technology is most appropriate at a given site.

What Types of Treatment Technologies Are In Use?

Established technologies such as incineration and solidification/stabilization have been the most widely used at Superfund sites. By 1990, however, 40 percent of the treatment technologies selected and being used to treat soils, sediments, sludges and debris were innovative treatment technologies. The number of innovative treatment technologies being used increases every year.

Table 1 on page 3 describes some of the most frequently used innovative treatment technologies.

Figure 2
Developing Treatment Technologies

Concept	Emerging	Innovative		Established
• Idea • Research and Education	Bench-Scale Testing	Field Demonstration	Chosen for Remediation Limited Full-Scale Use	Common Full-Scale Use

Table 1
Descriptions of Some Innovative Treatment Technologies

Bioremediation: uses microorganisms, such as bacteria, to break down organic contaminants into harmless substances.

Solvent Extraction: separates hazardous organic contaminants from oily-type wastes, soils, sludges, and sediments, reducing the volume of hazardous waste that must be treated.

In Situ Soil Flushing: an in situ (in place) process that floods contaminated soils in the subsurface with a washing solution to flush out the contaminants.

Soil Washing: uses water or a washing solution and mechanical processes to scrub excavated soils and remove hazardous contaminants.

Thermal Desorption: heats soil at relatively low temperatures to vaporize contaminants with low boiling points. Vaporized contaminants are then captured and removed for further treatment or destruction.

Glycolate Dehalogenation: uses a chemical reagent (a substance used to react with and change another substance) to change the structure of certain contaminants, thereby rendering them less hazardous.

Air Sparging: injects air into the saturated zone (that part of subsurface that is soaked with groundwater) to remove hazardous contaminants.

How Is A Treatment Technology Selected For A Site?

The selection of a treatment technology for a Superfund site follows detailed site studies where the site conditions and contaminants are identified and assessed. This important information is the basis for analyzing possible remedies for the site problems based on evaluation criteria EPA considers. Finally, EPA selects a chosen remedy for the site based on the criteria and sets the remedy and clean-up standards.

A treatability study is often conducted to assess a treatment technology's potential for success. It is conducted either when the treatment technology is being considered or after selection of the remedy during remedial design, in order to compile additional performance information.

There are three kinds of treatability studies. The type chosen depends on the information available about the site and technology and the nature of information that is needed to assess the use of the technology at the site. The quickest, least expensive treatability study is the **laboratory screening**. It is typically done in a laboratory using small equipment such as beakers. It takes just a matter of days and generally costs from $10,000 to $50,000. It can indicate whether a technology has the potential to meet the clean-up standards. Successful laboratory screening may lead to more sophisticated treatability studies.

Another type of treatability study is the **bench-scale study** which can provide greater performance and cost data than laboratory screening. Although sometimes performed in a laboratory setting, it is on a larger scale than laboratory screening. Typically costs run between $50,000 and $250,000 and the study is intended to determine if clean-up goals can be met by the technology.

Pilot-scale treatability studies are usually conducted in the field and require the installation of the treatment technology. They are used to provide performance, cost and design objectives for the treatment technology, not to conduct the clean up. Due to the cost of this type of study, generally more than $250,000, it is used almost exclusively to fine-tune the design criteria following other treatability studies.

Does An Innovative Treatment Technology Pose A Greater Health Risk?

No, innovative treatment technologies must meet the same clean-up levels imposed on established technologies.

What Happens If A Technology Does Not Work?

In spite of the best engineering design there is always a possibility that a treatment technology, established or innovative, may not work once it is in full-scale operation. This is often because of unknown site conditions that could not be anticipated under the conditions of the smaller-scale studies done to support the technology's design. Natural conditions are far more complex than laboratory conditions.

If a technology does not work initially, engineers and scientists can work with the technology to adapt its design and, with time, correct the problems. In some rare cases the technology may not be able to be used and an alternate remedy may have to be designed and installed.

Hazardous waste clean-up is in its infancy. Experience with and increasing use of innovative treatment technologies will further the development of better and more efficient ways to clean up the environment.

Where Are Innovative Treatment Technologies Being Selected?

A number of the technologies that EPA has labeled "innovative" are being used by industry for containing and treating the hazardous wastes that they are currently producing. Innovative technologies are also being selected and used under many Federal and State clean-up programs, including those for leaking underground tanks (primarily petroleum), operating industries' past disposal areas under the Resource Conservation and Recovery Act, and at contaminated sites under Superfund. As more sites are documented with their cost and performance data, innovative treatment technologies will be increasingly recognized for their effectiveness.

Why Is EPA Encouraging The Use Of Innovative Treatment Technologies?

The Environmental Protection Agency is encouraging its scientists and engineers, as well as other agencies and industries involved in selecting treatments, to make innovative treatment technologies a priority consideration. EPA believes that innovative treatment technologies should be routinely considered as an option in addition to established remedies whenever possible. When considering factors such as increased protection and superior performance, innovative treatment technologies have the potential to be more cost effective, provide a better and more efficient clean-up, and often be more acceptable to surrounding communities than established treatment technologies.

How Is EPA Supporting The Use Of Innovative Treatment Technologies?

The mission of EPA's Technology Innovation Office (TIO) is to increase the government's and industry's application of innovative treatment technologies to contaminated waste sites. The Superfund Innovative Technology Evaluation (SITE) program sponsors field studies to obtain the information needed about an innovative treatment technology's effectiveness under varying conditions. The SITE program and TIO share the resulting information with Federal agencies, States, consulting engineering firms, responsible parties, technology developers, and the investment community.

For More Information

Additional information regarding the use of innovative treatment technologies can be obtained by contacting the Technology Innovation Office (TIO) at (703) 308-8800 or writing to:

U.S. Environmental Protection Agency
Technology Innovation Office
401 M Street, S.W. (OS 110W)
Washington, DC 20460

Among the documents available from TIO is the Innovative Treatment Technologies: Semiannual Status Report, EPA/154012-91/001.

TIO has also produced a series of ten Citizen's Guides, including this one, on topics relating to innovative treatment technologies. The others are on the topics of:

Innovative Treatment Technologies for Contaminated Soils, Sludges, Sediments, and Debris, EPA/542/F-92/001
Soil Washing, EPA/542/F-92/003
Solvent Extraction, EPA/542/F-92/004
Glycolate Dehalogenation, EPA/542/F-92/005
Thermal Desorption, EPA/542/F-92/006
In Situ soil Flushing, EPA/542/F-92/007
Bioventing, EPA/542/F-92/008
Using Indigenous and Exogenous Microorganisms in Bioremediation, EPA/542/F-92/009
Air Sparging, EPA/542/F-92/0010

Copies of these fact sheets are available by calling (513) 569-7562 or writing to:

Center for Environmental Research Information
26 West Martin Luther King Drive
Cincinnati, OH 45268

There may be a charge for some of these documents.

*U.S. Government Printing Office: 1992 — 648-080/60001