



# Superfund Alternatives for Managing Hazardous Waste

In 1980, Congress passed a law aimed at protecting us, and our environment, from the effects of disposing of hazardous waste illegally or improperly. This law is known as SUPERFUND because it provides a special pool of money to be used just for the purpose of helping clean up hazardous waste sites around the country. The Environmental Protection Agency (EPA) is in charge of making SUPERFUND work.

At most Superfund sites, the EPA must deal with not just one type of hazardous waste but with many. Often the waste is not in containers but is mixed with the soil or the water. Also, at the time a hazardous waste site is discovered, no one may know what kind of hazardous waste is present, how much there is, or how long it has been at the site.

For these reasons, managing hazardous waste at Superfund sites has proven to be a difficult job. The EPA has found that there are several methods which can be used to clean up hazardous waste, depending on the particular situation. One of the most common methods is LAND DISPOSAL. Land disposal means that the hazardous waste is placed in a pit or landfill that has been lined and covered to prevent waste from

leaking out and water from getting in. Land disposal also includes disposing of liquid hazardous waste in specially lined ponds called "surface impoundments."

But, although land disposal is common and appears to be inexpensive, it is not always the best technique. The waste in the landfill may still be hazardous and may, in some cases, eventually leak out.

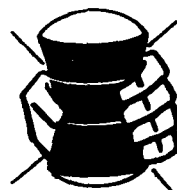
Recently, scientists, citizens, and government officials have expressed a desire to see hazardous waste managed in a manner that is more permanent than land disposal. In response, Congress passed a law in 1984 that will, by 1990, severely limit how much and what type of hazardous waste can legally be placed in the ground or put in surface impoundments. Also, the Superfund Amendments and Reauthorization Act of 1986 states that permanent cleanup methods are to be favored over land disposal. In preparation for the future, EPA has started new programs to find, test, and encourage ALTERNATIVES to land disposal.

The purpose of this fact sheet is to present some ALTERNATIVES to land disposal, describe how they work, and explain why they are better choices for dealing with hazardous waste in some cases.

## THREE BASIC OPTIONS



**DESTROY**



**IMMOBILIZE**



**SEPARATE**

## THREE BASIC OPTIONS

When an engineer or scientist is faced with a hazardous waste problem at a Superfund site, there are three basic treatment options to choose from.

- Option 1. **DESTROY** the waste to get rid of it completely or **CHANGE** the waste chemically to make it harmless.
- Option 2. **IMMOBILIZE** the waste so that, even though it may still be hazardous, it will be less likely to move into the air, soil, or water.
- Option 3. **SEPARATE** the waste from the soil, water, or other waste so that the contaminants are easier to destroy or immobilize. Decide if any of these wastes can be reused.

In studying these options, the engineer or scientist examines **ALTERNATIVE** ways

to manage hazardous waste. Some of these alternatives are described below. It is important to remember that not all techniques can be used in all situations because of the variety and complexity of Superfund sites. Often many techniques must be used together to thoroughly treat the hazardous waste, and even when alternative techniques can be used, land disposal may still be necessary to safely handle the residues, or what is left after treatment.

If the hazardous waste is thoroughly treated, it is less likely that the problem will merely be moved from one place to another. We make sure, for instance, that in *solving* a problem with contaminated soils we don't *create* a problem with contaminated water. It may cost more money initially to thoroughly treat a hazardous waste, but in most instances and in the long run, we believe the price of the permanent solution will be justified.

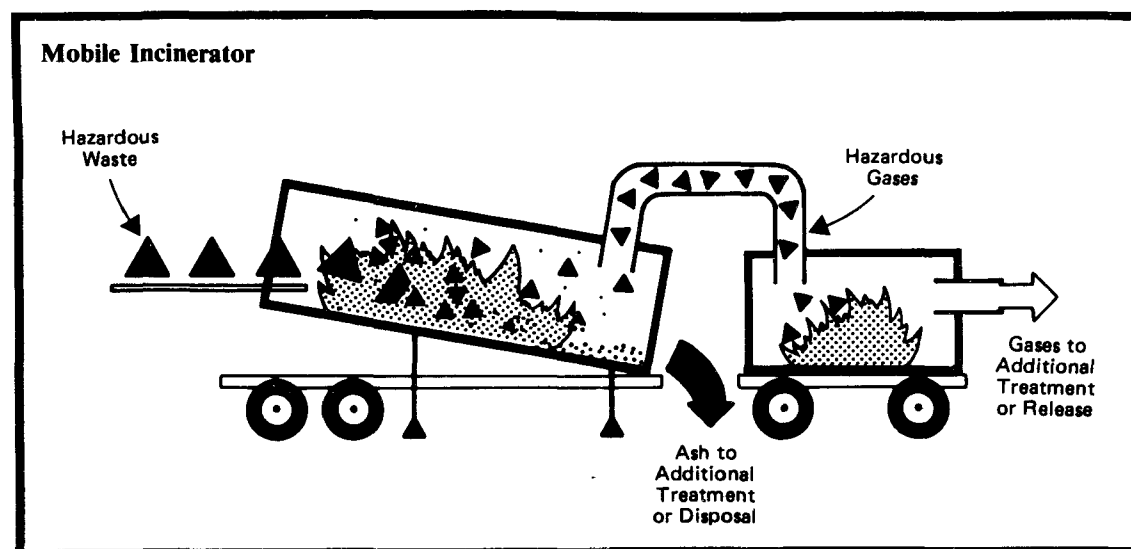


## WAYS TO DESTROY OR CHANGE WASTES

When we **DESTROY** or chemically **CHANGE** hazardous waste, the waste actually turns into some other material that is not harmful—or not *as* harmful—to people or to the environment. Even when we use a technique that destroys, or nearly destroys, the hazardous waste, smaller amounts of residue are usually left which must be disposed of. Two of the most common methods used to **DESTROY** or change hazardous waste are described below.

### • THERMAL TREATMENT

For centuries, people have used heat, usually in the form of fire, to get rid of waste. In the right conditions, and if properly controlled, heat—or **THERMAL TREATMENT**—is still a good technique and can be used on hazardous waste. There are many different kinds of thermal treatment. Some of these use flame to burn the waste, and others heat the waste to extremely high temperatures without a



flame. Types of processes that do not use a flame to heat the waste are called "pyrolysis," "plasma arc," "fluidized bed treatment," and "infrared treatment."

The most common thermal treatment is *incineration*, in which hazardous waste is burned using a flame at high temperatures.

Special incinerators have been designed to burn liquid, solid, and gaseous wastes. When a hazardous waste is incinerated, ash and gas are usually formed. The ash may still be considered hazardous. However, it is usually much easier to handle than the original material that was burned, primarily because the ash takes up less space than the original waste and because it is solid. If the gases created when a waste is burned are still hazardous, they can be captured with air pollution control devices and burned or treated again. This helps prevent hazardous chemicals from being released into the air.

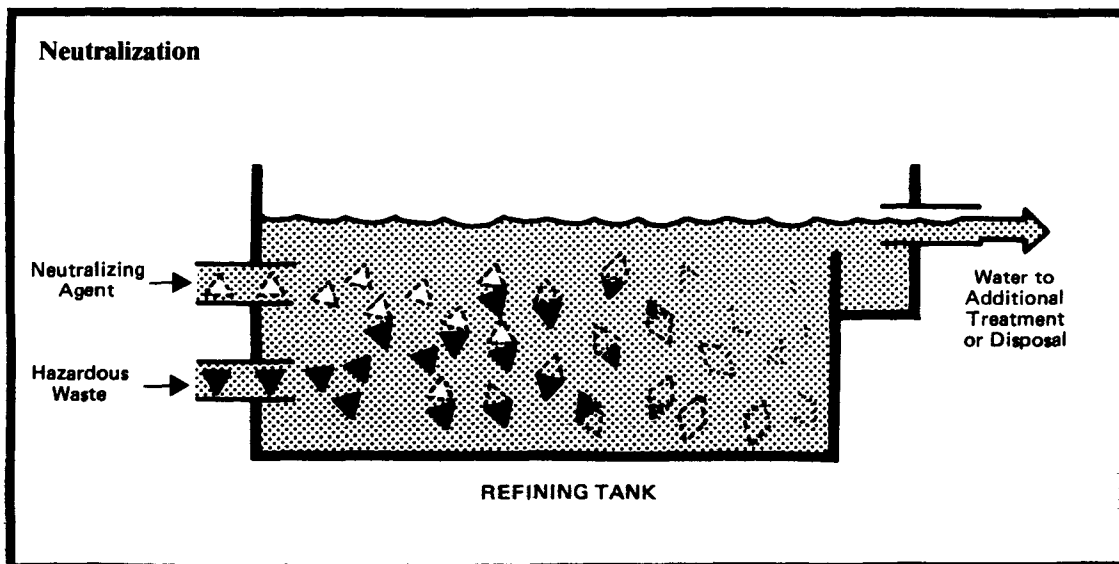
Incineration can be costly because the equipment is expensive and because it requires a lot of energy. Its advantages are that it greatly reduces the volume of the waste and often completely destroys the hazardous chemicals.

Currently, if waste at a SUPERFUND site is to be burned, it is usually removed from the site and taken to the incinerator. In the future, mobile incinerators, which can be moved from one hazardous waste site to another, may be used more often.

#### • NEUTRALIZATION

When we eat too much of certain kinds of foods, we get what the commercials call "acid indigestion." The solution to this problem is to take bicarbonate of soda, which NEUTRALIZES the acid in our stomachs. Certain kinds of hazardous wastes can be treated in the same way. If they are acid wastes, an *alkali* (like bicarbonate of soda) can be mixed with the waste. This causes a chemical change to occur in the waste, making it harmless, or nearly so. If the waste is alkaline (sometimes called "basic"), an acid can be added to achieve the same result.

The diagram below shows how a neutralization process works. Usually, two tanks are used—the first to begin the neutralization process and the second to refine it.



#### WAYS TO IMMOBILIZE WASTE

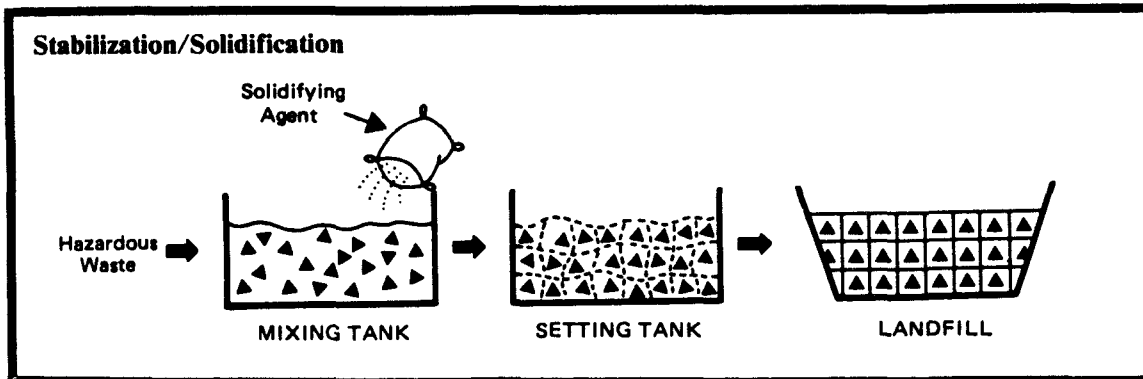
When we IMMOBILIZE hazardous waste, our goal is to put the waste into a solid form so that it is easier to handle and less likely to move into the surrounding environment. Immobilization is useful for wastes that

might seep into underground water or might be carried by rainwater into the environment. It is especially useful on certain metals which cannot be destroyed. Once a waste has been immobilized, the solid waste must be properly disposed.

- **STABILIZATION/SOLIDIFICATION**

The stabilization/solidification process can be compared to the preparation of sweetened gelatin. When gelatin is added to flavored sugar water, the gelatin dissolves. Together the gelatin and the sugar are “fixed” in the water. When the gelatin sets, it “solidifies” the liquid and everything in it. When applying these principles to hazardous waste, engineers and scientists mix solidifying agents such

as fly ash or cement with the hazardous waste, which both “fixes” and “solidifies” the material. This serves three purposes. First, the ash or cement can react chemically to “fix” the hazardous waste. Second, if necessary, the ash or cement is made into a solid block that can be permanently sealed and stored more easily than a liquid can. Third, once the hazardous waste is chemically bound to the ash or cement, it is less likely to be washed into the environment by rainwater.



## WAYS TO SEPARATE WASTE

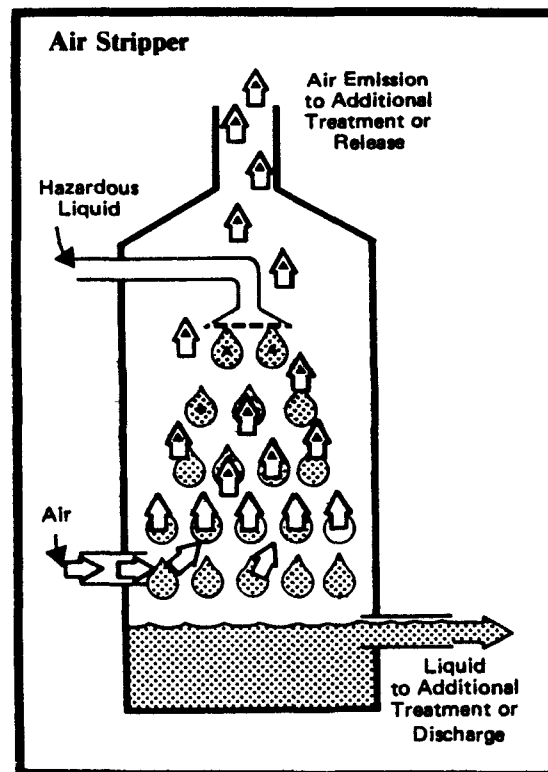
If we can SEPARATE one hazardous waste from another, or if we can take a hazardous waste out of the material it has contaminated, it is easier to destroy, immobilize, or bury the waste. Separation can, in some cases, allow the waste to be recycled for other industrial processes. Often water, soils, or air that were contaminated by hazardous waste can also be reused after being separated from the hazardous chemical. Separating the waste sometimes involves changing the waste from one form (solid, liquid, or gas) to another. Several techniques used to SEPARATE wastes are described below.

- **AIR STRIPPING/STEAM STRIPPING**

Certain kinds of chemicals that tend to evaporate easily are called “volatiles.” They can be removed from water using a technique called AIR STRIPPING. Air stripping literally forces the chemicals out of the water by pushing air through it, causing the chemicals to be mixed with the air. If the mixture of air and chemicals that results is still hazardous, it can be further treated before being released.

Some chemicals that cannot be released by air stripping are released when heat is

applied. This process is called STEAM STRIPPING, and it is similar to air stripping. Steam is pushed into the waste to raise the temperature and help release the chemicals from the water or steam.

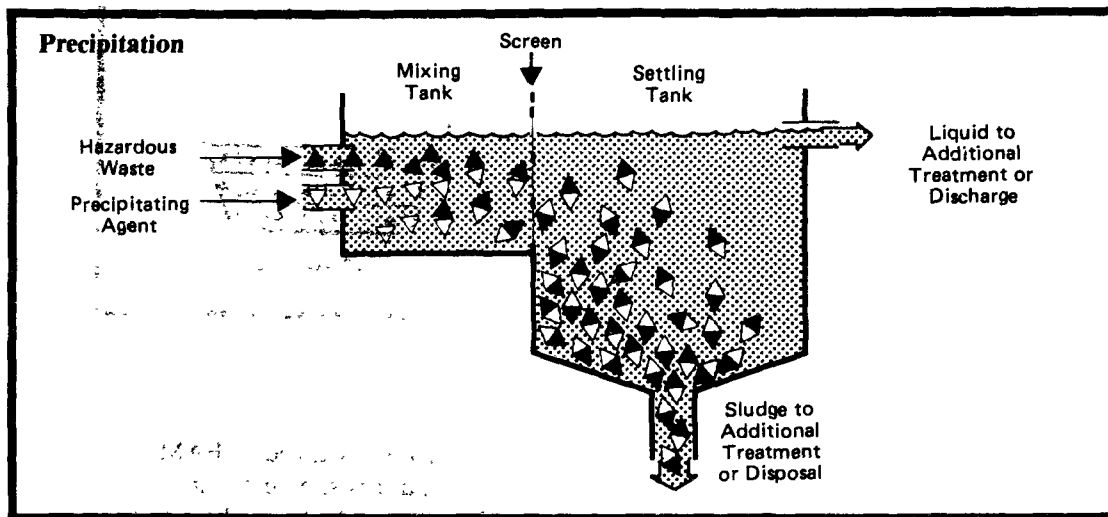


• **PRECIPITATION**

In treating some hazardous waste, a process can be used that mimics the way rain falls from the sky. Rain is created when drops of water form around tiny particles of dust. When enough drops form around the particle of dust, it is too heavy to remain a part of the cloud, and it falls to the ground as rain or "precipitation." When a **PRECIPITATION** method is used to treat hazardous waste, a material that will attract the hazardous chemicals is placed into the

liquid hazardous waste. The hazardous chemicals bind to the material and form large particles called "floc."

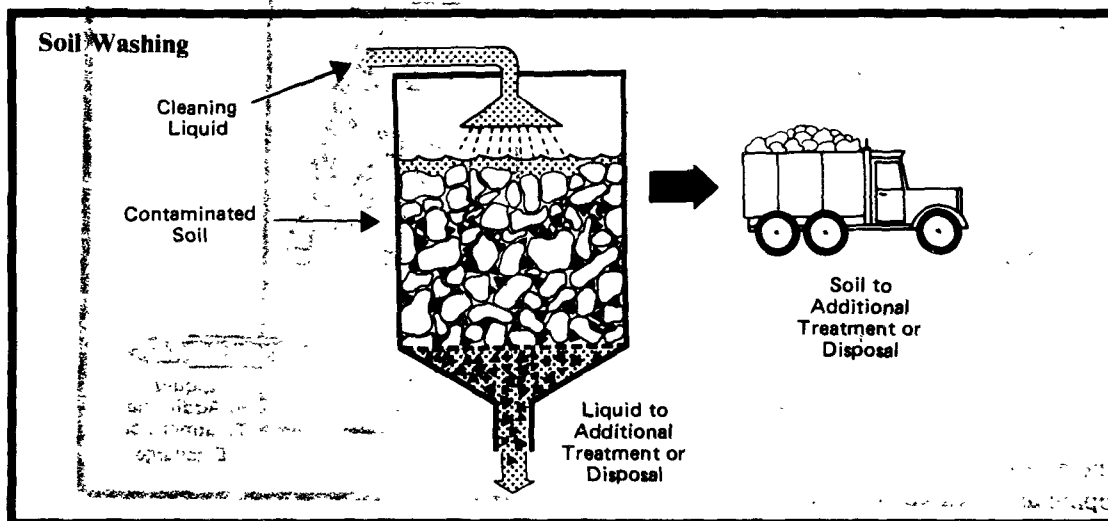
If the floc is distributed throughout the liquid, it can be filtered. If the floc is heavier than the liquid, it will sink to the bottom. The "sludge" that is formed can then be separated from the liquid. This is the process illustrated in the diagram. This separation process reduces the volume of material that must be further treated, destroyed, or immobilized.



• **SOIL WASHING AND FLUSHING**

If soil is contaminated with a chemical that can be easily dissolved, **SOIL WASHING** or **SOIL FLUSHING** can be used as a treatment. The equipment used in **SOIL WASHING** is not much different from a standard household washing machine—only larger. The contaminated soil and a cleaning liquid are mixed in a tank. The hazardous chemicals dissolve in

the cleaning liquid, which removes the chemicals from the soil. The liquid is then collected and treated. **SOIL FLUSHING** is similar to **SOIL WASHING** except that it occurs right in the ground. Liquid is passed through the soil and collected, usually in pipes or wells at the base of the contaminated area. The liquid is sent through the soil again and again until the soil is clean enough to leave in place.

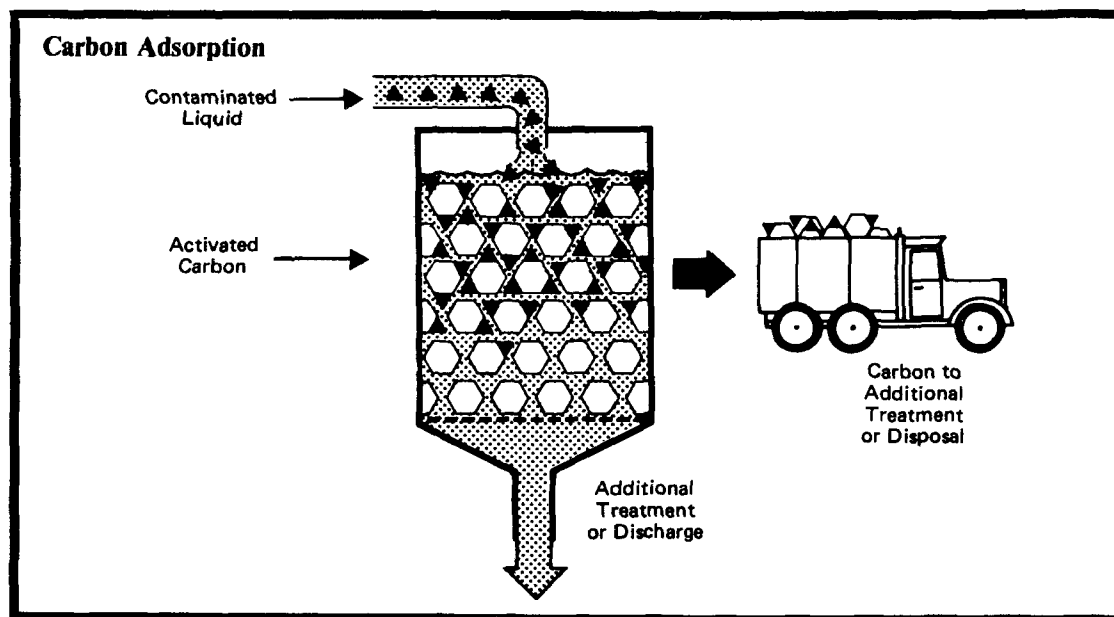


• **CARBON ADSORPTION**

Some people put charcoal filters on their faucets at home to purify their drinking water. These charcoal filters function almost exactly like large CARBON ADSORPTION tanks that treat gaseous and liquid hazardous waste. Air and water that contain hazardous chemicals are allowed to move through tanks containing carbon that has been "activated" to better treat the waste. The carbon filters the waste out of the air or water in two ways. First, the carbon can chemically combine with the waste. Second, it can catch

hazardous particles just as a fine wire mesh catches grains of sand.

After a carbon adsorption process has been used, the carbon will have high amounts of hazardous chemicals in it. It can then be disposed of through some other technique or cleaned and reused. Carbon adsorption is often used as the final process when a number of treatment processes are used. When carbon adsorption is used as the final process, the treated water is safe to drink and the treated air is safe enough to release.



**THE USE OF ALTERNATIVES TO LAND DISPOSAL**

Over time, EPA will use these and other methods more often to manage hazardous wastes at SUPERFUND sites. Variations on these techniques will be tested and brought into use, and new, more efficient, less costly techniques invented. EPA has begun the

Superfund Innovative Technology Evaluation (SITE) Program to help speed these processes. The SITE program will help demonstrate that alternative technologies can work at Superfund sites.

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If you are interested in alternative ways of managing hazardous wastes and would like to learn more about what EPA is doing to promote these, please contact the Superfund Hotline at 1-800-424-9346.

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