FACT FLASH

8: Common Cleanup Methods

Hazardous wastes are often treated to reduce their volume or toxicity and to protect human health and the environment. Other cleanup methods focus on safe management. This Fact Flash presents five common ways of treating hazardous waste: air stripping, capping, precipitation, excavation, and incineration.

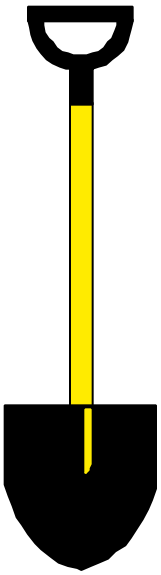
AIR STRIPPING

What is it?

Air stripping removes volatile organic compounds from contaminated groundwater or surface water. Volatile organic compounds, or VOCs, are chemicals that quickly vaporize when heated or disturbed. For example, the gasoline fumes you smell at the gas station are VOCs volatilized in the air. In air stripping, these vapors are transferred from the water in which they were dissolved into a passing air stream. This air stream can be further processed to collect and reuse or destroy the VOCs.

How does it work?

The process starts when contaminated surface water or groundwater is pumped from large storage tanks into the top of a "packed tower" attached to an air blower. This packed tower is simply a large metal cylinder packed with material. While the stream of contaminated water is released into the tower, an air stream is pumped up from the bottom. The material in the tower forces the water stream to trickle down through various channels and air spaces. As the air stream flows upward, the contact of the two streams, called the "counter-current" flow, vaporizes the VOCs out of the water stream and collects them in the air stream, which exits the top of the tower.



How does the tower's packing material work? Inside the packed tower, the water stream forms a thin film on the material, which allows much more of the air stream to come into contact with the water stream. Using smaller packing material increases the surface area available for air stripping and improves the transfer process.

Why is it used?

Air stripping is useful for removing VOCs like trichloroethylene (TCE), dichloroethylene, chlorobenzene, and vinyl chloride. These are all hazardous substances. Equipment used in air stripping is relatively simple, allowing for quick start-up and shutdown and easy maintenance. This makes air stripping well-suited for hazardous waste site operations.

An important factor to consider in using air stripping is its impact on air pollution. Moving VOCs from water to air can mean just transferring pollution. Gases generated during air stripping may need to be collected and treated before they can be released into the air to avoid damaging the atmosphere.

How well does it work?

Air stripping can remove up to 98 percent of VOCs and up to 80 percent of certain semivolatile compounds. It does not work well for removing metals or inorganic contaminants.

CAPPING

What is it?

Capping, often used in combination with other cleanup methods, covers buried wastes to prevent contaminants from spreading. Spreading, or migration, can be caused by rainwater or surface water moving through the site or by wind blowing dust off a site. Caps are usually made of a combination of materials like synthetic fibers, heavy clays, and sometimes concrete. Caps should minimize water movement through the wastes using efficient drainage; resist damage caused by settling; prevent standing water by funneling away as much water as the underlying filter or soils can handle; and allow easy maintenance.

How does it work?

The primary purpose of a cap is to minimize contact between rain or surface water and the buried waste. Two types of caps, multilayered and single-layer, serve this purpose.

- *Multilayered caps* have three layers: vegetation, drainage, and water-resistant. The vegetation layer prevents erosion of the cap's soils; the drainage layer channels rainwater away from the cap and keeps water from collecting on the water-resistant layer, which covers the waste.

- *Single-layer caps* are made of any material that resists water penetration. The most effective single-layer caps are made of concrete or asphalt, but single-layer caps are usually not acceptable unless there are valid reasons for not using a multilayer cap.

Why is it used?

Capping is required when contaminated materials are left in place at a site. It is used when the underground contamination is so extensive that excavating and removing it isn't practical, or when removing wastes would be more dangerous to human health and the environment than leaving them in place. Wells are often used to monitor groundwater where a cap has been installed to detect any movement of the wastes.

How well does it work?

Capping works well for sealing off contamination from the above-ground environment and reducing underground waste migration. Caps can be put over virtually any site, and can be completed relatively quickly. Capping materials and equipment are readily available. A multilayered cap will usually last for at least 20 years. Proper maintenance will make it last even longer.

PRECIPITATION

What is it?

Precipitation separates heavy metals from the water they contaminate.

How does it work?

Precipitation changes dissolved heavy metal contaminants into a solid form that can be separated from the water. Water contaminated with heavy metals is treated with chemicals, which cause the metal molecules to stick together and separate from the water. The solids are removed from the water. The clean water is then pumped back into the ground and the collected metals are properly disposed of (Diagram 1).

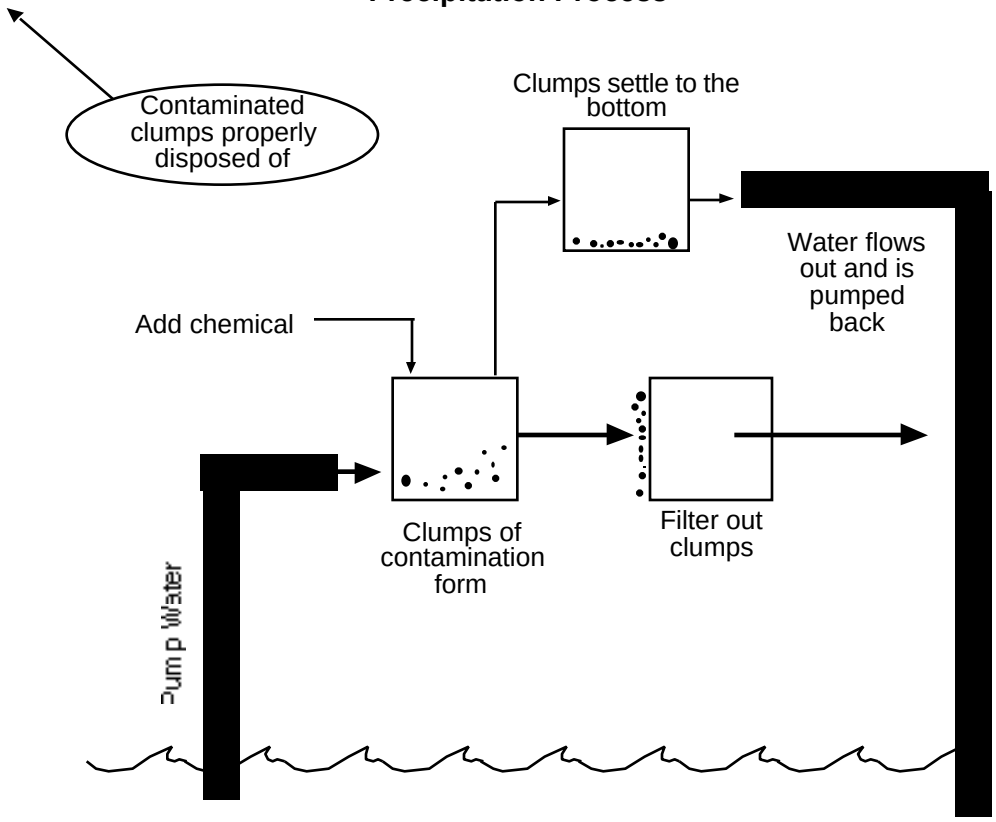
Why is it used?

Precipitation is easy to perform and can be used in many areas. It efficiently treats contaminated groundwater for reuse, and is one of the main methods of treating industrial wastewaters.

How well does it work?

Precipitation can be costly and is difficult to use if the water is contaminated with many types of metals, since different metals may interfere with one another and the cleanup process. Precipitation is very successful in treating wastewaters and is becoming the most widely selected cleanup method for removing heavy metals from groundwater.

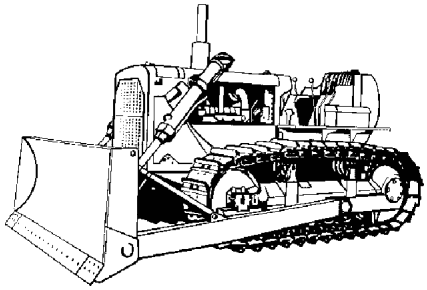
Diagram 1
Precipitation Process



EXCAVATION

What is it?

Excavation removes contaminated material from a hazardous waste site using heavy construction equipment, such as backhoes, bulldozers, and front loaders. At certain sites, specially designed equipment may be used to prevent the spread of contaminants.



How does it work?

The first step in excavation involves sampling and mapping the contaminated area to identify the contaminated area to be excavated. Samples are taken at several different depths in the same location so that a vertical, as well as horizontal, map of the contamination may be developed. Historical records, such as photographs or eye-witness accounts from past employees, and the contamination's effects on vegetation can also be used to pinpoint the area to be excavated.

Once the contamination is fully mapped, it can be removed. When hazardous waste has been buried in the ground a layer of soil may need to be removed before the waste is excavated. This layer, called overburden, is set aside and is later replaced in its original location. Contaminated materials are then dug up and loaded onto trucks for hauling. After it is cleaned up, excavated soil may be returned to its original location for use as backfill. Soil in the walls and bottom of the excavated area is tested to ensure that all contamination has been removed. Excavation proceeds until cleanup goals are met.

Excavation of hazardous waste or contaminated materials must be carefully planned to make sure contamination doesn't spread to clean areas of the site. For example, once excavation equipment is in a contaminated area, it must stay there until the work is completed, then thoroughly cleaned and decontaminated prior to leaving the site. In the event that contaminants have seeped into the groundwater, additional treatment may be necessary.

Why is it used?

Hazardous wastes can generally be excavated without exposing people near the site to contamination. Wastes can be removed for further treatment or disposal at an approved landfill. Excavation uses common construction equipment and is a widely used and accepted method of dealing with hazardous waste. Excavation is also relatively inexpensive compared to other, more complicated treatment technologies.

How well does it work?

Excavation is very effective in removing contamination and is commonly used at remediation sites. There are no strict limits on the types of wastes that can be excavated and removed. Concern for worker health and safety, however, may prevent excavation of explosive, reactive, or highly toxic waste material.

INCINERATION

What is it?

Incineration involves burning hazardous wastes to destroy such organic compounds as dioxins and PCBs. Incinerators can handle many forms of waste, including contaminated soils, sludges, solids, and liquids. Incineration is not effective in treating inorganic substances such as hydrochloric acid, salts, and metals.

EPA establishes and specifies the conditions under which each incinerator can operate by issuing permits. A permit defines how the incinerator must operate, such as:

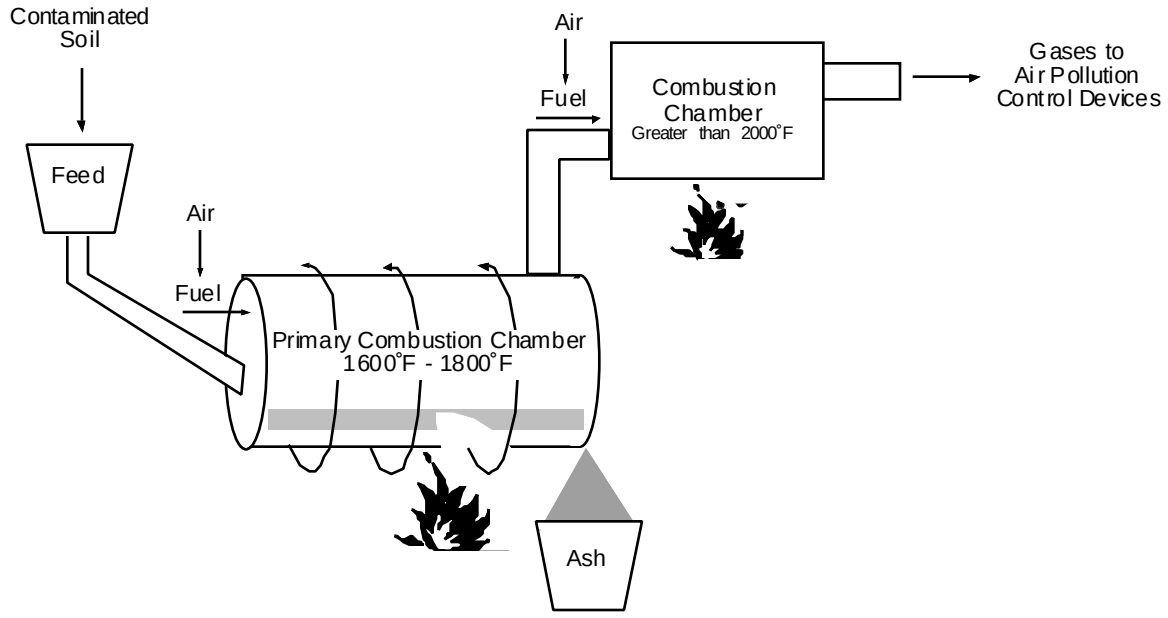
- Maximum carbon monoxide level in stack gases (gases from the combustion process which exit the stack after treatment by air pollution control devices)
- Maximum feed rates (how fast hazardous wastes are fed into the incinerator)
- Minimum burning temperature.

The permit conditions are designed to deliver a "complete burn" of the hazardous waste. For example, a permit requires the waste feed to be cut off if burning conditions are not optimal.

How does it work?

Incineration uses high temperatures (between 1600°F and 2500°F) to degrade contaminants into nontoxic substances, such as water, carbon dioxide, and nitrogen oxides (nitrogen and oxygen). Properly done, high-temperature incineration can be an effective, odorless, and smokeless process. The process is illustrated in Diagram 2.

Diagram 2
Incineration Process



EPA incinerator regulations assume that all leftover ash and material removed from the incinerator are hazardous. Accordingly, they must be disposed of at a facility that has a permit to handle hazardous waste. In addition, water used in the incineration process must meet strict standards before it can be discharged to surface waters.

Why is it used?

Incineration can be a permanent waste disposal solution because it destroys wastes that would otherwise take up space in a landfill. Incineration effectively destroy over 99 percent of all organic compounds.

A common misconception is that the more toxic the chemical, the more difficult it is to burn. EPA's research shows that how toxic a chemical is does not relate to how easily it breaks down under heat during incineration.

How well does it work?

No incinerator can destroy 100 percent of the hazardous waste fed into it. Small amounts are released into the atmosphere through the incinerator stack or are mixed with the ash. EPA requires that each incinerator destroy and remove 99.99 percent of all hazardous waste it processes. For PCBs and dioxin wastes, the standard is 99.999 percent. When operated properly, incinerators can meet or exceed these standards. Operating at this level of efficiency, however, is a complex, highly technical task.