



A Citizen's Guide to In Situ Thermal Treatment Methods

The Citizen's Guide Series

EPA uses many methods to clean up pollution at Superfund and other sites. Some, like in situ thermal treatment methods, are considered new or *innovative*. Such methods can be quicker and cheaper than more common methods. If you live, work, or go to school near a Superfund site, you may want to learn more about cleanup methods. Perhaps they are being used or are proposed for use at your site. How do they work? Are they safe? This Citizen's Guide is one in a series to help answer your questions.

What are in situ thermal treatment methods?

In situ thermal treatment methods, in general, are ways to move or *mobilize* harmful chemicals through soil and groundwater by heating them. The heated chemicals move through the soil and groundwater toward underground wells where they are collected and piped to the ground surface. There the chemicals can be treated above ground by one of the many cleanup methods available.

How do they work?

All thermal methods work by heating polluted soil and groundwater. The heat helps push chemicals through the soil toward collection wells. The heat also can destroy or evaporate certain types of chemicals. When they evaporate, the chemicals change into gases, which move more easily through the soil. Collection wells capture the harmful chemicals and gases and pipe them to the ground surface for cleanup. Thermal methods can be particularly useful for chemicals called *non-aqueous phase liquids* or *NAPLs*, which do not dissolve or move easily in groundwater. As a result, they can be a source of groundwater pollution for a long time without proper treatment. In situ thermal methods include:

Steam injection: Forces or *injects* steam underground through wells drilled in the polluted area. The steam heats the area and mobilizes, evaporates, and destroys the harmful chemicals.

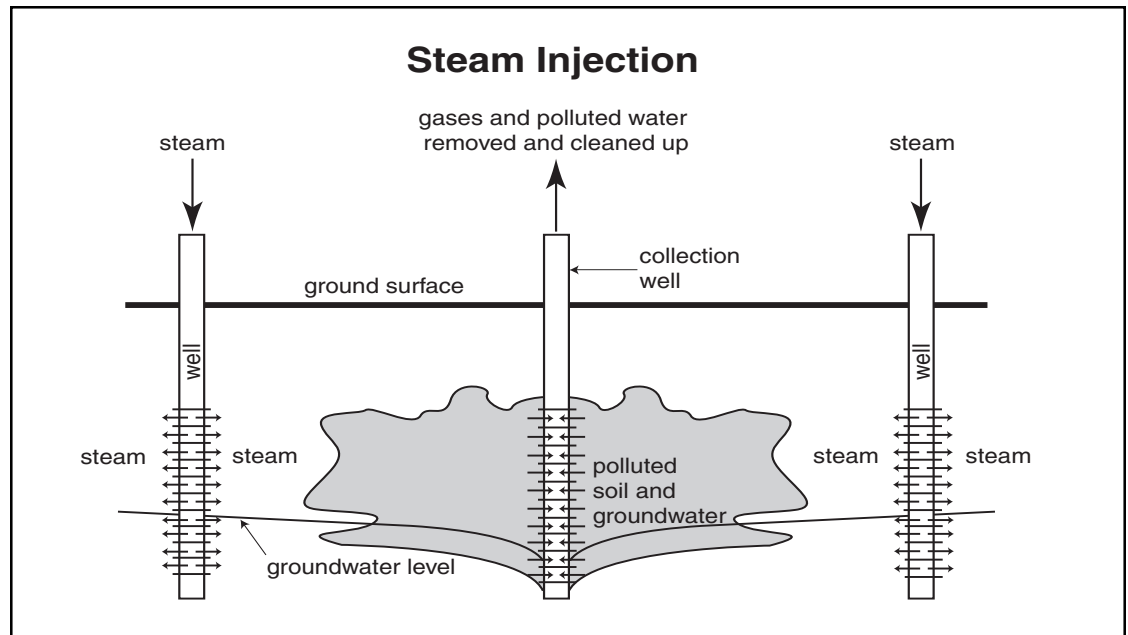
Hot air injection: Similar to steam injection except hot air is injected through the wells instead of steam. The hot air heats the soil causing the harmful chemicals to evaporate.

Hot water injection: Also similar to steam injection except that hot water is injected through the wells instead of steam. The hot water mobilizes chemicals like NAPLs.

Electrical resistance heating: Delivers an electric current underground through wells made of steel. The heat from the current converts groundwater and the water in the soil to steam, which evaporates the harmful chemicals.

Radio frequency heating: Typically involves placing an antenna that emits *radio waves* in a well. The radio waves heat the soil causing the harmful chemicals to evaporate.

Thermal conduction: Supplies heat to the soil through steel wells or with a blanket that covers the ground surface. As the polluted area heats up, the harmful chemicals are destroyed or evaporated. The blanket is used where the polluted soil is shallow. Steel wells are used when the polluted soil is deep.



Are in situ thermal treatment methods safe?

In situ thermal treatment methods are safe when properly operated. When there is a chance that gases may pollute the air, a cover is placed over the ground to prevent their escape. And EPA tests the air to make sure that the dust and gases are being captured. Scientists are also studying whether heat can kill microbes or help microbes *bioremediate* chemicals. (See *A Citizen's Guide to Bioremediation* [EPA 542-F-01-001].)

How long will it take ?

Cleaning soil and groundwater with thermal methods may take only a few months or several years. The time it takes depends on three major factors that vary from site to site:

- type and amounts of chemicals present
- size and depth of the polluted area
- type of soil and conditions present



For more information

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Further information also
can be obtained at
www.cluin.org or
www.epa.gov/superfund/sites.

Why use in situ thermal treatment methods?

Thermal methods speed the cleanup of many types of chemicals in the ground. Faster cleanups can mean lower cleanup costs. Depending on the number of wells needed, thermal methods can be expensive. However, they are some of the few methods that can help clean up NAPL in place. This avoids the expense of digging up the soil for disposal or cleanup. Thermal methods can work in some soils (such as clays) where other cleanup methods do not perform well. They also offer a way of reaching pollution deep in the ground where it would be difficult or costly to dig. Thermal methods are being used at several dozen sites across the country, including a few Superfund sites.

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