Community Guide to In Situ Carbon Amendments for Groundwater

What Are In Situ Carbon Amendments?

In situ carbon amendments are materials that are placed underground to remove contamination from groundwater. The amendments are made up of small particles of coal, wood, nutshells or other carbon-rich materials that have been heated to increase the surface area of the particles. Reactive materials such as iron particles or peroxide may be added to help destroy some types of contaminants. Microbes (very small organisms naturally found in the environment) may also be added to promote destruction. (See *Community Guide to Bioremediation*.) The technology is "in situ" because cleanup is conducted in place, without having to pump out groundwater for treatment above ground. In situ carbon amendments most often are used to treat groundwater contaminated with petroleum products and solvents.

How Do They Work?

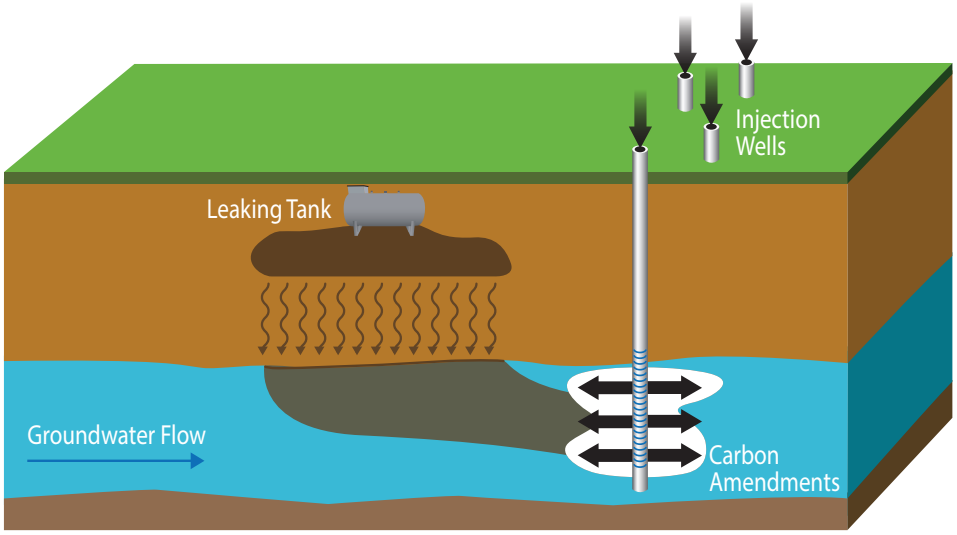
The amendments treat contaminants through two processes: adsorption and degradation. Adsorption takes place when contaminants stick to the carbon particles. (See *Community Guide to Granular Activated Carbon Treatment*.) Degradation occurs when reactive materials or naturally-occurring microbes cause chemical and biological reactions that change the contaminants to less harmful substances. The specific reactive materials selected depend on conditions at the site.

The mixture of amendments is placed underground to directly contact contaminated soil and groundwater. Most often, amendments are injected through vertical pipes or pipes that are angled to reach contamination beneath objects on the ground surface. Trenches also can be dug and filled with the amendments, or earthmoving equipment can mix them into the soil. The amendments usually form a reactive zone across the flow of the contaminated groundwater so that the water flows through it. High-pressure injection, or fracturing, can help place amendments in dense clay or silty soil. (See *Community Guide to Fracturing for Site Cleanup*.)

How Long Will It Take?

It may take several months to a few years to complete a cleanup using in situ carbon amendments. The cleanup time will depend on several factors that vary from site to site. For example, cleanup with in situ carbon amendments will take longer where:

- Concentrations of contaminants are high.
- The contamination source has not been completely removed.



Carbon amendments can be injected underground to treat fuel from leaking tanks.

Injecting amendments at angle underground.

- The contaminated area is large or hard to reach.
- The soil requires fracturing.

Are In Situ Carbon Amendments Safe?

In situ carbon amendments do not pose a threat to site workers or to your community when properly handled. Because contaminated soil and groundwater are cleaned up underground, workers are not exposed to contamination. Treated water is analyzed regularly to ensure that the carbon amendments continue to work properly.

How Might They Affect Me?

You may notice increased truck traffic as the equipment and materials are delivered to the site. You might also hear construction noise as amendments are injected or mixed, or as trenches are dug. Dust from site activities is controlled by spraying water and covering stockpiled soil and materials.

Why Use In Situ Carbon Amendments?

In situ carbon amendments can treat a wide variety of contaminants and usually work very quickly. Injecting amendments can help reach groundwater contamination at facilities where buildings, paving and other structures block large treatment equipment. Once amendments are in place, treatment occurs without disrupting activities on the property, and requires little energy or maintenance. In situ carbon amendments have been selected for use at several Superfund sites and other cleanup sites across the country.

Example

Water supply wells near the East 67th Street Ground Water Plume Superfund site in Texas were contaminated by a release in the 1980s of chemicals, including solvents, from a former chemical facility. New water supply wells were installed in clean areas, and soil vapor extraction and bioremediation were used to treat shallow source area contamination.

In 2017, carbon amendment was injected in the ground beneath the street to treat groundwater and to prevent the further spread of contaminants. The reactive zone formed by the amendment is 300 feet long and extends 85 to 100 feet below the ground surface. Contaminated groundwater is treated as it flows through the zone, which is expected to be effective for about 15 years. After that, additional injections may be needed. Groundwater is sampled before and after flowing through the reactive zone to monitor performance. Within the first three years, data showed that contaminant concentrations met treatment goals.

For More Information

- About this and other technologies in the Community Guide Series, visit: https://clu-in.org/cguides or https://clu-in.org/remediation/
- About use of cleanup technologies at a Superfund site in your community, contact the site's community involvement coordinator or remedial project manager. Select the site name from the list or map at http://www.epa.gov/superfund/sites to view their contact information.

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