Soil, Sediment, Bedrock and Sludge

Solidification/Stabilization

Introduction:

Contaminants are encapsulated within a stabilised mass (solidification), or chemical reactions are stimulated between the stabilising agent and contaminants to lower their mobility (stabilisation).

Description:

Solidification/stabilisation (S/S) decreases the mobility of hazardous substances and contaminants via physical and chemical means. Different other remedial technologies, S/S aims to immobilise contaminants within their impacted medium (e.g. soil, sand, and/or building materials) as an alternative to removing them through chemical or physical processes. Leachability testing is normally undertaken to measure the immobilisation of contaminants. S/S techniques can be employed alone or in combination with other treatment methods to yield a product or material appropriate for land disposal or that can be put to valuable use.

In Situ Vitrification (ISV):

In situ vitrification (ISV) uses an electric current to melt earthen materials at tremendously high temperatures (1,500 to 2,000 °C or 2,900 to 3,650 °F) and in so doing so immobilise most inorganics and eliminate organic pollutants by pyrolysis. Inorganic pollutants are integrated within the vitrified glass and crystalline mass. Water vapour and organic pyrolysis combustion products are captured in a hood, which pulls the contaminants into an off-gas treatment system that removes particulates and pollutants from the gas. The vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock. The process destroys and/or removes organic materials. Radionuclides and heavy metals are retained inside the molten soil.

Applicability:

The main contaminant group for *in situ* S/S is usually inorganics (including radionuclides). ISV process can remove organics and immobilise most inorganics in contaminated soils, sludge, or other earthen materials. The process has been tested on a range of VOCs and SVOCs, dioxins and PCBs, and on most priority metals and radionuclides.

Limitations:

- Depth of contaminants may limit some types of application processes.
- Future usage of the site may "weather" the materials and affect ability to maintain immobilization of contaminants.
- Some processes result in a significant increase in volume (up to double the original volume).
- Certain wastes are incompatible with variations of this process. Treatability studies are generally required.
- Reagent delivery and effective mixing are more difficult than for ex situ applications.
- Like all in situ treatments, confirmatory sampling can be more difficult than for ex situ treatments.
- The solidified material may hinder future site use.
- Processing of contamination below the water table may require dewatering.

Data Needs:

Data needs include particle size, moisture content, metal concentrations, sulphate content, organic content, density, permeability, unconfined compressive strength, leachability, pH, and microstructure analysis. For ISV, a minimum alkali content in soil of 1.4 wt% is essential to form glass.

Performance Data:

There have been little, if any, commercial applications of ISV. The process has been used for test and demonstration purposes, with more than 170 tests at various scales being undertaken on a range of soils and sludge.

Cost:

For ISV, standard costs for treatability tests are £ 15 k in addition to analytical fees. Equipment mobilisation and demobilisation costs are from £ 100 k. Vitrification operation cost varies with electricity costs, quantity of water, and depth of process. One recent study on the west coast of the USA estimated vitrification costs at £ 250- £325 per tonne of soil treated.