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Emerging Technology Bulletin

Process for the Treatment of Volatile Organic Carbon and Heavy-Metal-Contaminated Soil

International Technology Corporation

Technological Description: The batch steam distillation and metal extraction treatment process is a two-stage system that treats soils contaminated with organics and inorganics. This system uses conventional, readily available process equipment, and does not produce hazardous combustion products. Hazardous materials are separated from soils as concentrates, which can then be disposed of or recycled. The treated soil can be returned to the site.

During treatment, waste soil is slurried in water and heated to 100 degrees Celsius. This heat vaporizes volatile organic compounds (VOC) and produces an amount of steam equal to 5 to 10 percent of the slurry volume. Resulting vapors are condensed and decanted to separate organic contaminants from the aqueous phase. Condensed water from this step can be recycled through the system after further treatment to remove soluble organics. The soil is then transferred as a slurry to the metals extraction step.

In the metals extraction step, the soil slurry is washed with hydrochloric acid. Subsequent countercurrent batch washing with water removes residual acid from the soil. The solids are then separated from the final wash solution by gravimetric sedimentation. Most heavy metals are converted to chloride salts in this step. The acid extract stream is then routed to a batch distillation system, where excess hydrochloric acid is recovered (see figure below). Bottoms from the still, which contain heavy metals, are precipitated as hydroxide salts and drawn off as a sludge for offsite disposal or recovery.

As a batch process, this treatment technology is targeted at sites with less than 5,000 tons of soil requiring treatment. Processing

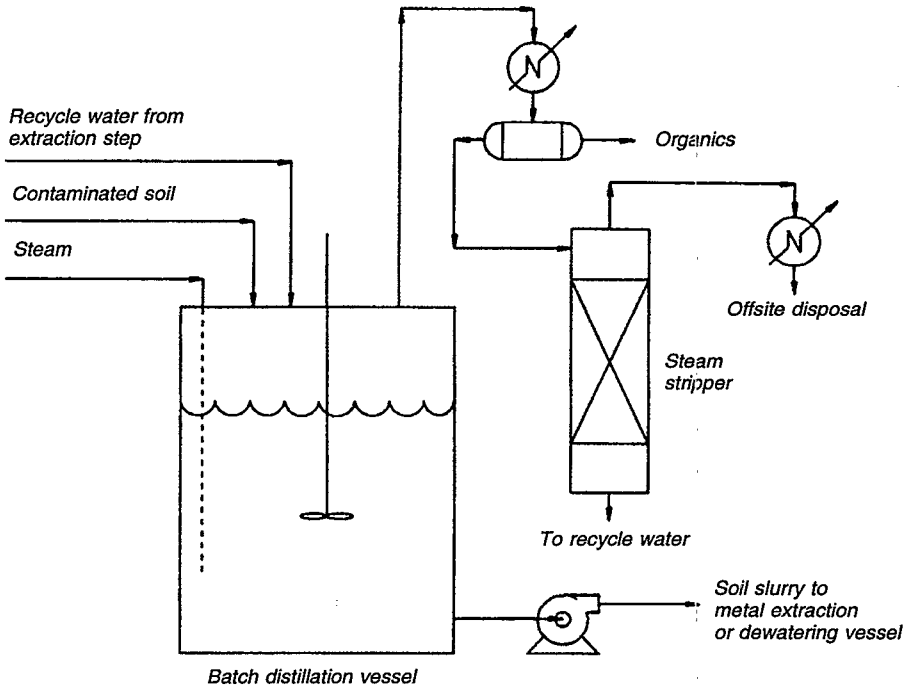

Figure 1. *Batch steam distillation step.*

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time depends on equipment size and batch cycle times; roughly one batch of soil can be treated every four hours. Estimated treatment costs per ton, including capital recovery, for the two treatment steps are as follows:

Batch Steam Distillation

500-ton site	$299-393/ton
2,500-ton site	$266-350/ton

Metals Extraction
(including acid recovery)

500-ton site	$447-619/ton
2,500-ton site	$396-545/ton

Waste Applicability: This process may be applied to soils and sludges contaminated with organics, inorganics, and heavy metals.

Results: The batch steam distillation and metal extraction process was accepted into the SITE Emerging Technology Program in January 1988. Under the program, three pilot-scale tests have been completed on three soils, for a total of nine tests. The removal rates for benzene, toluene, ethylbenzene, and xylene were greater than 99 percent. The removal rates for chlorinated solvents ranged from 97 percent to 99 percent.

One acid extraction and two water washes resulted in a 95 percent removal rate for heavy metals. Toxicity characteristic leaching procedure tests on the treated soils showed that soils from eight of the nine tests met leachate criteria. Data were also collected on the recovery rate for excess acid and the removal rate for precipitation of heavy metals into a concentrate.

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