

GTR™ Ex-situ Thermal Treatment of Contaminated Soil with Chlorinated Products

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Background. Ex-situ Gas Thermal Remediation process (GTR™-ESTD) is an innovative technology developed by TPS TECH, which utilizes high temperature gases to heat soil by conduction and recover the contaminants via vapor treatment system. GTR™-ESTD was applied recently on site in the south of France, where since 1946 the site has been contaminated with dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD) and dichlorodiphenylchloroethane (DDE). The volume of impacted soil is estimated at 14,231m³, 20-40% of which is found in the groundwater area at 1-2m deep. The higher concentration of total DDT, DDE and DDD detected in the soil is 5,800 mg/kg. The aim of the treatment is to reach less than 50 mg/kg. A lab test was conducted followed by a pilot test. The GTR™-ESTD pilot test was carried out with 63 tons of contaminated soil. After 30 days of treatment, successful results were obtained. The full treatment works are expected to take place in 2016.

Approach. GTR™ technology is based on a simultaneous application of heat by conduction and vacuum in the soil. Stainless steel pipes were installed in the soil to circulate hot air. The pipes are equipped with gas burners, and close to them perforated tubes were used to recover the contaminant vapor. Depending on the type and concentration of the contaminant, it will be directed to the burner and destroyed in the flame or recovered with a separate SVE system with a cooling unit followed by GAC filter.

The lab test was performed with a few kg of contaminated soil taken from the site to study the effect of temperature and time on the behavior of contaminants in the soil, and to determine the optimal conditions for thermal desorption treatment. After mixing the soil, 21(x250g) samples were prepared, then heated in an electric oven at different temperatures (from 150 to 250°C) and for different periods (from 1 to 7 days).

Following excavation, in-pile GTR™-ESTD pilot test was carried out using 63 tons of contaminated soil (6mx6mx2.7m). The maximum initial concentration of DDT/DDD/DDE was 5,800 mg/kg-DM. Five horizontal heating pipes (3x5m and 2x3.5m length) and eleven SVE wells were used. The distance between heating pipes was 1.5m. Three burners, supplied with propane, were used to heat the pipes for 30 days. Vapor from heated soil was recovered with a separate SVE system equipped with a cooling unit followed by GAC filter.

Results. The results of the lab test confirm the effect of temperature and time on the reduction of contaminants in the soil; beginning with 950mg/kg-DM of DDT, DDE and DDD in samples, the reduction was greater than 99.9% and reached 99.99% (wt.) after 72h at 250°C.

For ESTD pilot test, all the soil (except a thin layer at the bottom of pile) exceeded 250°C for more than three days. Ten samples of soil were taken and analyzed after treatment. Except for three samples taken at the bottom of pile in the coldest zone (reduction of contaminants between 70 and 82% wt.), the other samples give a reduction between 99.4 and 99.9999% wt. for the total of DDT, DDE and DDD. From an energy consumption perspective, the pilot test required 24kg of propane per ton of treated soil. A significant amount of liquid products was recovered at the end of the pilot test.

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Background. In-Situ Gas Thermal Remediation process (GTR™-ISTD) is an innovative technology developed by TPS TECH, which utilizes high temperature gases to heat soil by conduction and recover the contaminants via vapor treatment system (SVE unit). GTR™-ISTD was applied recently on site in France, where the site is polluted with trinitrochlorobenzene (TNCB) and dinitrotoluenes (DNT). The volume of impacted soil at 5m deep is estimated at 12,500m³. The groundwater level is located between 6 and 8m depth. The higher concentration of TNCB is 169,000 mg/kg and DNT 20,000 mg/kg. A lab test was conducted by a pilot test. GTR™-ISTD pilot test was carried out in an area of 5m x 5m and at 5m depth, located in the zone with the highest concentration of pollutants. The aim of project is to reduce by more than 90% (wt.) the amount of TNCB and DNT present in soil. A reduction higher than 99.999% was obtained after 25 days of treatment. The full treatment works are expected to take place in 2016.

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The lab test was performed with a few kg of contaminated soil taken from the site to study the effect of temperature and time on the behavior of contaminants in the soil, and to determine the optimal conditions for thermal desorption treatment. After mixing the soil, 21(x250g) samples were prepared, then heated in an electric oven at different temperatures (from 150 to 250°C) and for different periods (from 1 to 7 days).

Results. The results of the lab test show a reduction greater than 99.99% (wt.) for the samples heated at 250°C during 72 hours.

The GTR™-ISTD pilot test conducted in hot spot zone sites demonstrated clearly the ability of the process to treat nitro-chlorobenzenes and dinitrotoluenes present in soil. The average soil temperature exceeded 250°C after 30 heating days.

Starting with 169,000 mg/kg of TNCB and 20,000 mg/kg of DNT, the average residual concentrations obtained is 11 mg/kg for total TNCB and DNT, representing a greater than 99.99% (wt.) of reduction. At the end of the test, a significant amount of liquid products was recovered using the SVE unit.