

Advanced In Situ Remediation Technologies in The Netherlands: An Overview Based on Actual Projects

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In a densely populated, highly industrialized nation such as The Netherlands, pressure on land use is high. Over the past 20 years, a (now fully matured) remediation industry developed. Groundwater Technology has been an active and innovative player in the Dutch soil remediation market over the past 2 decades. A number of advanced in situ remediation solutions were developed to service the market needs.

Human error caused 600 m³ (pure) benzene to spill into a tank bund in just 2 hours. Approximately 50% was recovered immediately, the remainder caused massive soil & groundwater contamination. Corrective action was initiated within 12 hours, the first phase consisted of containing the contaminants while the second phase (actual remediation) was installed. The bulk of the contamination was removed in 12 months through multi-phase (product, water & soil gas) high-vacuum extraction. The remediation was tied into the on site off-gas and waste water treatment systems to maximise product recovery and because it was determined to be the most economical solution. After 12 months of operation, only 500 kg of contaminants remained and the remediation was converted to less intensive, more cost-effective techniques (soil vapour extraction, oxygen infusion and (as pilot) perchlorate injection)

In other cases, heat enhanced remediation was used to speed-up in situ remediation projects. In one case, creosote was remediated from a strongly layered sand, clay and peaty soil. The site was a railroad sleeper conservation yard with a history of more than

100 years of creosote spills. In a pilot project, one month of (traditional) pump & treat removed a few kilograms from one single test well. Steam heating the soil to boiling point increased product recovery to more than 3000 kg (pure liquid creosote) in just 30 days. In four other projects, gasoil type product was removed from free phase product to below detection in both soil and groundwater in less than 2 months

Another case illustrates the advantage of prompt corrective action in case of an inadvertent spill. A corrosion induced leak in the bottom membrane of an aboveground storage tank caused a hazardous (carcinogenic & teratogenic) hydrocarbon product to spill into the tank mound. We contracted to remediate the spill to regulatory closure for a fixed fee. While the tank was lifted to fix the bottom membrane, an in situ remediation system was installed in just 2 days. In situ remediation (multi-phase high vacuum extraction with catox offgas treatment) removed contamination from free phase to non-detectable in 12 months.

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Yvo M.M. Veenis, director of Groundwater Technology BV, has 20 years professional experience in the Dutch soil and groundwater consulting & remediation industry. Mr Veenis worked on projects in Belgium, Germany, United Kingdom, France, Italy, Spain and the USA; Mr Veenis holds an MSc in Hydrogeology from the Free University Amsterdam.