BROWNFIELDS REDEVELOPMENT USING SIX PHASE HEATING IN GLACIAL TILL SOILS

Client: Avery Dennison Company

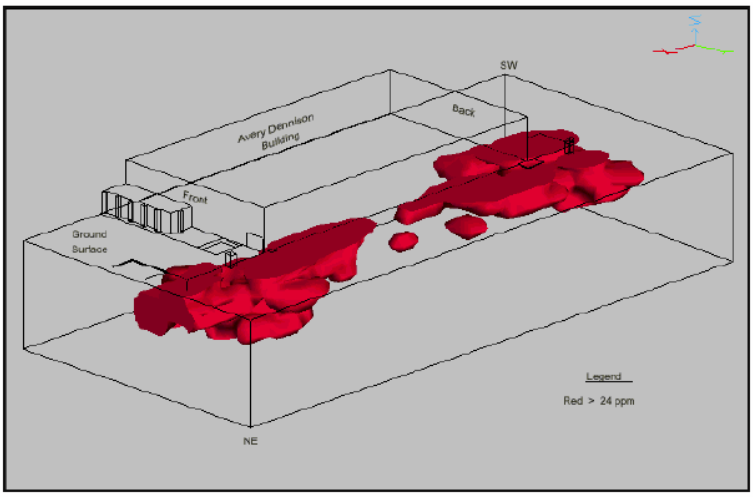
Waukegan, IL

December 1999-November 2000

Current Environmental Solutions (CES) was contracted to provide Six Phase Heating (SPH) services at a former film coating operation in Waukegan, IL. Methylene chloride (MeCl) was used routinely at the facility as a solvent. In 1985, a fitting failed on a storage tank resulting the release of MeCl to surrounding soil. A consultant was hired to provide initial remediation services and to define the extent of contamination

Seven subsurface soil and groundwater investigations were subsequently performed between 1985 and 1997 in order to delineate the subsurface contamination. The investigations had shown that the subsurface consists of silty clay from grade to 22 feet below grade (bg). From 22 ft. bg to approximately 28 ft. bg was a flowing sand unit. Groundwater was typically found at 25 ft. bg. As typically found in glacial till, perched groundwater was detected as high as 6 ft. bg. All told, nearly 16,000 cubic yards of soil were contaminated with 15,000 pounds of MeCl. The highest soil concentration was identified at nearly 50,000 mg/kg.

The investigations also identified three MeCl source areas. The main contamination was identified in the soil surrounding the former tank storage area in the rear of the facility. The second contaminated area was found in the front of the facility in the soil surrounding the original MeCl off loading point. The third spot of soil contamination was found in an alley adjacent to the facility where the MeCl transfer lines were located.



Several remediation techniques have been implemented at the site to remove MeCl from the soil. Initially a grout curtain was installed surrounding the former tank area. A vacuum extraction system was installed and operated for three years in the former tank area. A pump and treat system was also installed and operated for two years. Finally, perched water sparging was performed with limited results.

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Excavation was considered, but not selected due to the risk of harming the structural integrity of the facility and the neighboring plant.

TECHNOLOGY

SPH has emerged as the leading technology to address difficult in-situ soil and groundwater remediation situations, specifically in low permeability stratigraphy. It has proved an efficient, rapid means of remediating soil contaminated by volatile and semi-volatile organic contaminants.

The technology was developed for the US Department of Energy at Pacific Northwest National Laboratories (PNNL) operated by the Battelle Memorial Institute (BMI). CES was the original licensee of this technology, and the original company formed by BMI to commercialize the technology.

SPH uses polyphase electricity to resistively heat the soil and groundwater to the boiling point of water. This increases the volatility of contaminants, which improves the effects of vacuum extraction. The heat also initiates VOC degradation through various pathways. Once steam is generated in situ, it acts as a carrier gas which strips out contaminants from the soil or groundwater. The steam is collected from the subsurface by a soil vapor extraction process, and treated aboveground by conventional means such as activated carbon and catalytic oxidization.

APPLICATION

The SPH system consisted of 95 electrodes, 34 vacuum extraction wells, five horizontal wells and 41 subsurface thermocouples. The site was heated using a 1,250 kW power supply capable of remote operation and monitoring. Remediation occurred both outside and inside the existing facility. Approximately 10 % of the treatment system was installed below grade because the contamination extended below a public access road.

RESULTS

After six months of operations, the site had been heated to an average temperature of 80°C, with central areas at boiling. Because, relatively little contamination had been extracted using vacuum extraction techniques, CES collected and analyze soil samples and vapor samples for sign of VOC degradation. Following an initial sampling in heavily treated areas, it was discovered that the MeCl had degraded to chloride ion. It is suspected that the degradation mechanism was hydrous pyrolysis oxidation (HPO), but this mechanism was never confirmed.

Once the final closure soil sampling was complete, it was determined that MeCl contamination that formerly exceeded 40,000 mg/kg, with an average concentration of 1,389 mg/kg and a 95th percentile of 2,453 mg/kg, had been reduced to below the Illinois EPA-approved soil remediation objective of 24 mg/kg. The average concentration of methylene chloride remaining in the soil after treatment with SPH was 2.51 mg/kg. The 95th percentile for the soil remaining beneath the identified area of soil contamination was 3.46 mg/kg. Having achieved the Illinois EPA's most stringent Tier 1 Soil Remediation Objective for Residential Properties (13 mg/kg), the State of Illinois issued a **"No Further Action"** letter to the owners, and the property was subsequently redeveloped into an office and warehouse park.

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