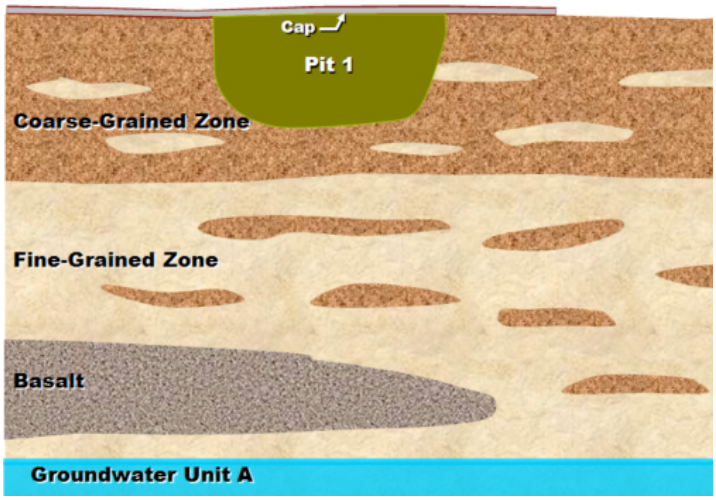
Landfill Remediation with Refrigerants and Chlorinated Solvents

Landfill in Arizona

PROJECT DESCRIPTION

Between 1979 and 1980, industrial and hazardous wastes were disposed of at the Site in a series of unlined pits, each of which was used for a particular type of waste disposal. It is reported based on evaluations of manifests that approximately 3.4 million gallons of hazardous liquid wastes and between 3,700 and 4,100 tons of solid wastes were disposed of in the pits at the Site. Of particular focus is Pit 1 (50 feet long, 50 feet wide and had a depth of approximately 20 ft), which accepted a mixture of organic and oil wastes. The bulk of environmental impacts to soil and groundwater at the Site are related to wastes disposed at Pit 1.

SITE GEOLOGY



The Site's vadose zone consists of an upper coarse-grained zone (CGZ) and a lower fine-grained zone (FGZ). The CGZ generally extends from ground surface to approximately 30 feet below ground surface (ft bgs) and consists predominantly of interbedded silty sand, gravelly sand, and sandy gravel. The FGZ generally extends from depths of approximately 30 to 60 ft bgs and is comprised of silt and clay units with varying amounts of sand and gravel. Beneath the FGZ exists a basaltic lava flow unit that is variable in thickness. Currently, additional FGZ vadose zone is present beneath the basalt unit; this portion of the subsurface was saturated during the initial SVE operation in the 1990s. Two groundwater units, Unit A and Unit B, have been defined at depth beneath the basalt unit.

CONTAMINANTS OF CONCERN

Initial investigations conducted in the 1980s, concluded that Site groundwater and soil were impacted by volatile organic compounds (VOCs), primarily 1,1,1 trichloroethane (TCA), 1,1-dichloroethene (1,1-DCE) and trichlorotrifluoroethane (Freon 113). As a result of these initial investigations, the site was added to the National Priorities List (NPL) in 1987, becoming a federal Superfund site. Numerous investigations of soil, soil vapor, and groundwater have since been conducted.

Concentrations were measured at up to 20,000 mg/kg of total VOCs; individual compounds consisted primarily of 1,1,1 TCA, 1,1-DCE and Freon 113.

VAPOR TREATMENT SYSTEM DESIGN

The following design factors were considered during the selection of the best-available technology for the Site:

- Capable of treatment of elevated VOC vapor concentrations (up to 1,200,000 ug/L);
- Flow rate (estimated required flow rate of 200 scfm at the manifold)
- Vacuum (estimated operating vacuum of 10-14 in Hg)
- Contaminant characteristics (presence of Freon and other compounds that have relatively poor adsorption properties)

SYSTEM PERFORMANCE AND RESULTS

In March 2006, eleven FGZ SVE wells in the vicinity of Pit 1 were piped into the SVE system. Initial mass removal calculations indicated recovered solvent was generated at a rate of 2 gallons per hour. Combined soil vapor flow rates to the C3 technology treatment system are approximately 150 SCFM. After approximately 6 months of operation, rates of solvent recovery dropped to approximately 0.4 gallons per hour. To enhance mass removal efforts, three sub-basalt wells were piped into the SVE system in December 2006 and August 2007. Flow rates from these wells were limited due to the thin vadose zone beneath the basalt and the potential for groundwater mounding, but the product rate increased (a maximum of 0.6 gallons per hour was initially observed). In December 2007, the majority of the system vacuum was focused on select FGZ and sub-basalt wells, which had exhibited the highest VOC concentrations. During December 2007, it is estimated that the daily VOC mass removal rate increased from approximately 0.25 to over 0.4 gallons per hour. From 28 March 2006 through 31 December 2007, a total of approximately 5,200 gallons of solvents, approximately 28.5 tons, have been recovered.

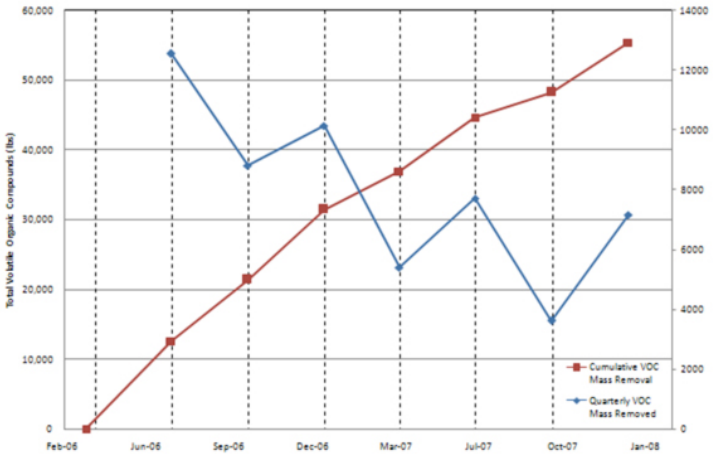


Figure 4: The cumulative and quarterly mass totals removed by the re-started SVE system from March 2006 to December 2007.

Over the 21 months of operation the vadose zone VOC plume has been significantly reduced in size and concentration. Corresponding decreases in Unit A groundwater concentrations and a reduction in influent mass to the GRS have also been observed.

SUMMARY AND CONCLUSIONS

The use of C3 Technology at the Site is a cost-effective, socially-responsible off-gas treatment technology during the “mass-removal” phase of SVE. The remote geography of the site dictated that it was more cost effective to use the recovered solvents in fuel blending processes rather than recycling.