Integrated Large-Scale Remediation of Chlorinated Volatile Organic Compounds and Perchlorate in Soil: Bermite Facility, Santa Clarita, California

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The former Bermite facility (the Site) comprises nearly 1,000 acres and historically was used for manufacturing of flares, fireworks, munitions, and rocket motors beginning in 1934 and continuing until operations ceased in 1987. Soil and groundwater at various locations at the Site were impacted by volatile organic compounds (VOCs), perchlorate, and to a far lesser degree, metals. VOC concentrations in soil in 16 areas warrant remedial measures based on exceedances of risk-based threshold concentrations (RBTCs) established for the Site. Many of these areas are also impacted with perchlorate in excess of RBTC and/or soil screening level (SSL). The approved integrated remedial action plan for soil includes a two-step remediation approach: soil vapor extraction (SVE) for removal of VOCs followed by excavation and ex situ biological destruction of perchlorate. Compared to the alternative of large-scale transport and off-site disposal of perchlorate-impacted soils, the on-site treatment and destruction of perchlorate has been highly efficient, with considerably reduced negative impact on the environment and surrounding community. SVE units have been operated in areas of high VOC impact to reduce concentrations appropriate for perchlorate excavations and ex situ bioremediation. SVE is or will be implemented in the remaining lower priority areas after completion of the SVE operations at the higher priority areas. More than 1.7 million cubic yards of soil with perchlorate concentrations exceeding the RBTC and/or SSL were present prior to the start of remediation. The depths of excavations for ex situ perchlorate treatment range from approximately 5 to 45 feet. Perchlorate-impacted soils are excavated and transported to treatment pad areas (TPs) where stockpiled soils are screened and conveyed to one of two pug mills operating in parallel where an amendment solution consisting of water, glycerin (electron donor), and di-ammonium phosphate (DAP) (nutrient) are added and thoroughly mixed with the soil. The pug mills are operated at an average rate of approximately 350 to 400 tons/hour. The amended soils are conveyed from the pug mills into the treatment cells on TPs, covered with tarps, and secured to minimize contact with air. After approximately 20 to 30 days of incubation in a treatment cell, confirmation samples are collected at a depth of approximately 2 feet below the top of the cell and at 10- or 15-ft intervals along the length of the cell. If the concentrations of the samples exceed the RBTC or SSL, the cells are re-sampled again one to two weeks later. Once the perchlorate concentrations at each sampled interval in the treated soil are confirmed to be less than the RBTC or SSL, or the average of all the intervals is less than RBTC, the process is deemed successful and the soil cleared for use as “clean” backfill material. The timing of the initial sampling and frequency of additional samples vary depending on the perchlorate concentrations in the baseline samples, the observed cleanup rate, and time of the year. It has been documented that bioremediation in general proceeds more rapidly during the hotter summer months than during other times of the year. In general, the soil residence time in the treatment cells needed to achieve the cleanup goals is on the order of 20 to 30 days in the summer and 45 to 60 days during winter, depending on the initial perchlorate concentrations in the soil being treated. For water conservation and efficiency, storm water collected at containment structures in the remediation operation areas and catch basins constructed at other areas of the Site is recycled and used in the pug mills. In addition, treated water from groundwater containment operation will be recycled and used in the perchlorate remediation operation.