Lessons Learned from an In Situ Thermal Desorption Pilot in Shanghai China

Sailor Zhang (sailor.zhang@greenment.net), Hui Tu, Chen Wang and Lie Ma (Shanghai Greenment Environmental Technology Co., Ltd., Shanghai, China)

Background/Objectives. Contamination of aniline and chlorobenzenes in soil and groundwater were identified in a demobilized dyestuff chemical plant in Shanghai, China (the Site). Pilot tests were conducted to screen suitable technologies for the full-scale remediation of the Site. A plot with significant concentration of aniline, chlorobenzene, 1,2-dichlorobenzene and 1,4-dichlorobenzene in soil and groundwater was selected for one of the pilot tests. The contamination extended from ground surface to 14 m below ground surface (bgs). The subsurface soil profile consisted primarily of a backfill layer underlain by a silty clay layer and a muddy silty clay layer over a clay layer. Site hydrogeology conditions revealed that the shallow groundwater belonged to Quaternary pore-phreatic and the bottom of the phreatic aquifer was located approximately 14 m bgs, which was above a continuous and stable confining bed consisting of clay layer with thickness more than 10 m. The stable groundwater table was 1.0 m to 1.5 m bgs and hydraulic gradient was approximately 0.001.

Approach/Activities. Thermal conductive heating (TCH) using gas fired heater was selected for this in situ thermal desorption (ISTD) pilot testing. The treatment zone was selected in the source zone area of the plot with an area of 21.7 m^2 (3.5 m by 6.2 m) and depth of 14.2 m. A waterproof curtain using a cement mixing pile with a depth of 16 m was installed isolating the treatment zone from the surrounding groundwater and the concrete pavement was covered on the treatment zone for heat isolation and rainwater and vapor control. A total of 11 gas fired heaters and 15 vapor extraction wells including 11 collocated extraction wells and four independent extraction wells with a depth of 14.2 m were installed in the treatment zone. Before heating started, groundwater in the treatment zone was removed by pumping through the extraction wells as much as possible. Extracted soil vapor by vacuum pump was treated by condensation, gas/liquid separation and activated carbon adsorption. The extracted groundwater and condensates from vapor treatment were discharged to the municipal sewer system after treatment. The ISTD system operated for 60 days and the soil temperature reached 200 degrees centigrade in the central treatment zone. A total of 39,200 m^3 of natural gas was consumed and approximately 180 m^3 condensate was collected during the ISTD operation.

Results/Lessons Learned. Concentrations of aniline and chlorobenzenes in soil of the treatment zone were all below 3 mg/kg, far below the remediation targets, which demonstrated that ISTD was one of the feasible remediation technologies for the Site with lots of challenges such as deep contamination depth, adverse geology conditions and high pollutant concentration. Lessons learned from the pilot included: possible waterproof curtain break during heating and resulting poor groundwater control; significant concrete pavement cracks on the ground surface and poor vapor control; severe extraction pipeline and vacuum pump corrosion for higher temperature and chloridion; inaccessible of hot soil sampling during operation due to poor equipment layout.