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Demonstration Bulletin

Unterdruck-Verdampfer-Brunnen Technology (UVB) Vacuum Vaporizing Well

Roy F. Weston, Inc. / IEG Technologies Corporation

Technology Description: The Weston/IEG UVB technology is an in situ groundwater remediation technology that combines air-lift pumping and air stripping to clean aquifers contaminated with volatile organic compounds. A UVB system consists of a single well with two hydraulically separated screened intervals installed within a single permeable zone. The air-lift pumping occurs in response to negative pressure introduced at the wellhead by a blower. This blower creates a vacuum that draws water into the well through the lower screened portion of the well. Simultaneously, air stripping occurs as ambient air (also flowing in response to the vacuum) is introduced through a diffuser plate located within the upper screened section of the well, causing air bubbles to form in the water pulled into the well. The rising air bubbles provide the air-lift pump effect that moves water towards the top of the well and draws water into the lower screened section of the well. This pumping effect is supplemented by a submersible pump that ensures that water flows from bottom to top in the well at a rate of approximately 20 gal/min. As the air bubbles rise through the water column, volatile compounds are transferred from the aqueous to the gas phase. The rising air transports volatile compounds to the top of the well casing where they are removed by the vacuum blower. The blower effluent is treated before discharge using granular activated carbon.

The transfer of volatile compounds is further enhanced by a stripping reactor located immediately above the air diffuser. The stripping reactor consists of a fluted and channelized column that facilitates the transfer of volatile compounds to the gas phase by increasing the contact time between the two phases and by minimizing the coalescence of air bubbles.

Once the upward stream of water leaves the stripping reactor, the water falls back through the well casing and returns to the aquifer through the upper well screen. This return flow to the aquifer, coupled with inflow at the well bottom, circulates groundwater around the UVB well. The extent of the circulation pattern

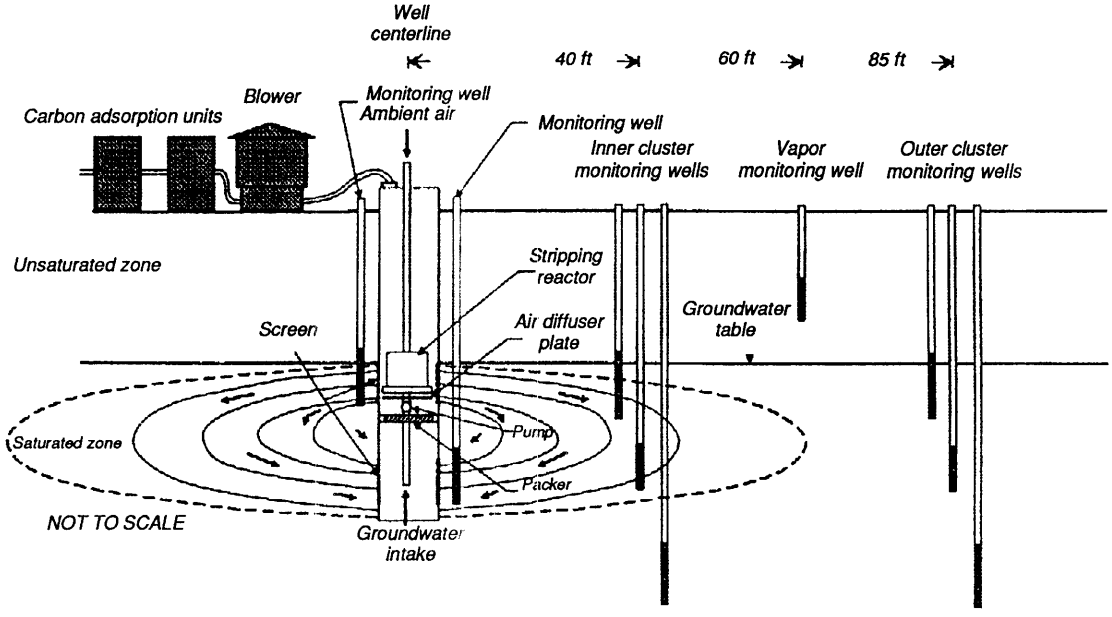

Figure 1. *The Unterdruck-Verdampfer-Brunnen Technology as demonstrated.*

is known as the radius of influence, which determines the volume of water affected by the UVB system.

Waste Applicability: The UVB technology, demonstrated from April 1993 to May 1994 at Site 31, March Air Force Base, CA, has removed trichloroethene (TCE) and 1,1-dichloroethene (DCE) from groundwater. The developer claims that the technology can also clean up aquifers contaminated with other organic compounds, including volatile and semivolatile hydrocarbons. Additionally, the developer claims that in some cases the UVB technology is capable of simultaneous recovery of soil gas from the vadose zone.

Demonstration Approach: The UVB technology demonstration evaluated the reduction of TCE and DCE concentrations in the groundwater discharged from the treatment system, the radius of influence of the system, and the reduction (both vertically and horizontally) of TCE and DCE concentrations in the groundwater within the radius of influence over the course of the pilot study.

The demonstration program objectives were achieved through collection of groundwater and soil gas samples, as well as UVB system process air stream samples over a 12 month period. To meet the objectives, data were collected in three phases: baseline sampling, long term sampling, and dye tracer sampling. Baseline and long term sampling included the collection of groundwater samples from eight monitoring wells, a soil gas sample from the soil vapor monitoring well, and air samples from the three UVB process air streams both before UVB system startup and monthly thereafter. In addition, dye tracer study was implemented to evaluate the system's radius of influence. This study included the introduction of fluorescent dye into the groundwater and the subsequent monitoring of 13 groundwater wells for the presence of dye 3 times a week over a 4 month period.

Preliminary Results: Demonstration results indicate that TCE concentrations were reduced by greater than 94 percent in groundwater discharged from the system. TCE concentrations were reduced from a mean of approximately 53 micrograms per liter (µg/L) in the system's influent to approximately 3 µg/L in the system's effluent. A meaningful estimate of the system's ability to remove DCE could not be made due to the low (less than 4 µg/L) influent concentration of DCE.

Based on the results of the dye tracer study, the radius of influence was estimated to be at least 40 ft. Modeling of the radius of influence by the developer suggests that it may extend to approximately 83 ft; however, preliminary interpretation of site-specific data obtained from the demonstration and aquifer testing suggests that the radius of influence may be less than 60 ft.

In general, TCE and DCE in the shallow and intermediate screened monitoring wells showed a reduction in concentration over the duration of the pilot study. Concentrations of target compounds in these zones appeared to homogenize as indicated by the convergence and stabilization of TCE and DCE levels.

Key findings from the demonstration, including complete analytical results and an economic analysis, will be published in a Capsule Report and an Innovative Technology Evaluation Report. These reports may be used to evaluate the UVB technology as an alternative method for cleaning up similar groundwater contamination across the country. The results will also be presented in a videotape.

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