Field-Collected Soil Gas Data as an Inexpensive Line of Evidence to Monitor Natural Attenuation

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Background/Objectives. Clients continue to challenge consultants to identify inexpensive alternatives to laboratory analysis that can take several weeks to obtain data and more reliable than standard field geochemistry (pH, DO and ORP), particularly at complex sites with numerous monitoring wells. In response to that challenge real-time data collection using a four-gas monitor (oxygen, carbon dioxide, hydrogen sulfide and methane) was used to monitor soil gas data at two different sites to determine if the collection of these soil gases in the vadose zone can provide useful information to monitor for natural attenuation and/or active in situ bioremediation.

Approach/Activities. Monitored natural attenuation is the final remedy at a coal-fired power plant site in the mid-Atlantic following a multi-phase remediation approach that included trench and multi-phase fuel oil LNAPL extraction and injection of activated sodium persulfate. To determine if sufficient physical removal, oxidation and degradation of LNAPL had been implemented to allow for natural attenuation, soil gases (oxygen, carbon dioxide, hydrogen sulfide and methane) were monitored for several months concurrent with groundwater sampling. Soil gas data were collected using a landfill four-gas monitor connected to a small hand-held vacuum pump at select well locations that were constructed with well screens exposed above the water table to allow for collection of soil gases at the soil/water interface. These data were then compared to laboratory analytical data and field geochemistry data to develop lines of evidence regarding natural attenuation. Soil gas data were also collected at a site where anaerobic reductive dechlorination was being implemented to remediate chlorinated solvents in groundwater beneath a warehouse building in New Jersey. Biostimulation and bioaugmentation were implemented via injections of emulsified soybean oil and a microbial consortium to augment the indigenous microbes to accelerate anaerobic reductive dechlorination of CVOCs (TCE, cis-1, 2-DCE and VC). The soil gas data were compiled with CVOC analytical data, dissolved gas analytical data and field biogeochemistry data to determine if reductive dechlorination is occurring.

Results/Lessons Learned. Challenges encountered during collection of the soil gas data at monitoring wells included excess moisture in the flow and groundwater elevations that blocked well screens in the vadose zone. The collection of soil gas data required sufficient vacuum be applied to the monitoring wells to monitor the soil gases. This required a small hand-held vacuum pump and a small knock-out pot to prevent excess soil moisture and sometimes groundwater from interfering with the collection of the soil gas. The soil gas data collected at shallow wells outside of the treatment zones appeared to be a mix of oxygen and carbon dioxide, with little methane or hydrogen sulfide and indication of aerobic conditions. Wells within the treatment zones showed elevated methane and hydrogen sulfide with low percentages of oxygen and carbon dioxide an indication of predominantly anaerobic environments. The data presented will provide the correlation or lack thereof with the laboratory analytical and field biogeochemical data.