Enhanced LNAPL Natural Source Zone Depletion by Solar-Powered Bioventing at the Former Guadalupe Oil Field

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Background/Objectives. The former Guadalupe Oil Field was an early (2002 data collection) demonstration of NSZD by aerobic biodegradation of hydrocarbons, including methane, in the deep vadose zone. Recent CO_2 efflux measurements and subsurface temperature profiling have confirmed that this NSZD continues today at similar rates to those measured previously. These same data collection methods are now being used to assess whether delivery of additional air via solar-powered bioventing provides a meaningful increase to the NSZD rate.

Approach/Activities. The tested biovent system is powered by seven 400-Watt photovoltaic solar panels that operate a 600-Watt blower during daylight hours. The blower injects air to a 4-inch diameter well screened across and approximately 8 ft above the water table. A packer is installed to the top 2 ft of the well screen to target air injection to the LNAPL smear zone immediately above the water table. Instrumentation is arranged radially from the injection well to a lateral distance of 125 ft. This includes CO_2 efflux measurements (5 rays at 25 ft spacing), subsurface temperature monitoring pipes (1 ray at 25 ft spacing), and nested vapor wells (1 ray at 50 ft spacing). Background and smear zone untreated comparison data are also collected by these three methods.

Results/Lessons Learned. The solar panels have operated the blower at 31 cfm for an average of approximately 10 hours a day. Oxygen distribution has increased substantially, including elevated concentrations approximately 75 ft from the injection well. CO_2 effluxes have also increased in the test area and the calculated NSZD rate is now approximately two times higher than that measured in the smear zone untreated comparison area. Subsurface temperature profiling corroborates an approximate doubling of the NSZD rate. Together, these data support an interpretation of oxygen-limited hydrocarbon biodegradation under natural conditions that can be enhanced by renewably powered bioventing. From the success of this pilot testing, expansion of a bioventing system across larger areas of the site is currently undergoing a sustainability analysis.