Advancements in Field Implementation and Method Development of Single Well Tracer Studies used to Calculate LNAPL Flux Rates in Impacted Aquifers

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Abstract: Many industrial sites, including petroleum refineries, midstream terminals, and fueling stations, have had releases resulting in Light Non-Aqueous Phase Liquids (LNAPL) underlying their site about the water table. The level of remedial effort needed to reduce risk at a site can vary greatly depending on the rate at which an LNAPL plume is migrating. Obtaining an accurate LNAPL flow rate improves site characterization and ultimately, site remediation.

Historically, LNAPL baildown tests and petrophysical techniques have been used to estimate LNAPL flow rate. Colorado State University (CSU) has developed an instrument called the LNAPL flux tool based on single well tracer dilution studies using an *in situ* monitoring well mixing cell and a fluorescent organic tracer. CSU is currently developing a related, but separate technique called Monitored LNAPL Stability (MLS), using fluorescent organic tracer without a mixing cell. The goal of CSU's efforts is to develop a low-cost, commercially viable, accurate, and easily understood method to measure LNAPL flow.

The LNAPL flux tool has been deployed successfully at several active and former petroleum refineries. The flux tool has been used in areas with low flow rates (10^{-6} cm/sec) and also in areas adjacent to LNAPL recovery wells with higher flow rates (10^{-2} cm/sec). Currently, improvements are being made to the tool to simplify its field deployment and long-term reliability.

MLS techniques are currently being developed for use at sites where very low flow is expected or very small thicknesses of LNAPL is present in monitoring wells and adjacent geologic formation. MLS uses a fluorescent organic tracer injected into LNAPL in monitoring wells. The well is then periodically gauged with a down-hole fiber optic cable, similar to collecting fluid levels. A LNAPL flow rate can be calculated from loss of tracer signal over time. The current challenges with MLS are long-term tracer stability, and developing conservative techniques for periodic fluorescence gauging.

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