FIELD DEMONSTRATION OF SUPERSATURATED WATER INJECTION FOR ENHANCED NAPL RECOVERY IN SOURCE ZONES

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Supersaturated Water Injection (SWI) is an effective technology for Nonaqueous Phase Liquid (NAPL) recovery. Carbon dioxide (CO_2) supersaturated water injected into the subsurface results in the nucleation of CO_2 bubbles at and away from the injection point. As the supersaturated liquid flows through the porous medium, gas evolution occurs in situ as the system returns to thermodynamic equilibrium. The nucleating bubbles coalesce, rise and volatilize residual NAPL ganglia. SWI offers the following benefits:

- Light NAPL (LNAPL) and Dense NAPL (DNAPL) recovery enhancement system for trapped and immobile NAPL mass
- Uses CO_2 to strip volatile NAPL component for capture in the unsaturated zone
- Mobilizes liquid NAPL trapped in aquifer matrix for recovery

When rising CO_2 bubbles contact hydrocarbons they cause volatilization. Groundwater and soil vapor (including CO_2 and volatilized hydrocarbons) are removed through recovery wells. SWI technology is focused on the enhancement of NAPL recovery and is operated in conjunction with conventional recovery systems (product pumping, Multi-Phase Extraction, and Soil Vapor Extraction).

SWI uses the gPRO® system by inVentures Technologies to supersaturate water CO_2 for injection below the water table. The CO_2 gas is dissolved at a pressure higher than the prevailing subsurface pressure. Following injection, carbonated water moves out from the injection well and begins to release dissolved gas forming a treatment zone. Discrete volumes of gaseous CO_2 grow and rise due to buoyancy. Because of the oil's intermediate wettability, some of the oil contacted by gas remains associated with it and is mobilized. This NAPL can then be recovered by conventional systems. Volatile NAPLs, such as separate phase hydrocarbon gasoline or chlorinated solvents, are transferred to the gas phase during the SWI process and mobilized up for vapor phase recovery.

SWI is more effective at mobilizing residual NAPL than sparging because gas saturation develops in situ, leading to greater microscopic sweep efficiency. The CO_2 gas phase becomes mobile when the gas saturation reaches approximately 12%, at which point advective gas flow is initiated. Considerable lateral, and therefore uniform, expansion of the gas phase occurs prior to the onset of upward mobilization of growing gas clusters under the action of buoyancy forces. Gas mobilization is accompanied by fragmentation and stranding of the gas clusters, which prevents fingering of the gas phase and stabilizes the displacement.

SWI field data will also be included in presentation, if available.

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