Direct Sonic Injection for Enhanced Remediation

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Background/Objectives. Direct-push injection (DPI) has been widely implemented to facilitate in situ remediation since the mid-1990s. It has mostly been reliant on advancing the injection tooling using a drill rig's static weight via percussion provided by a hammer head. As the capabilities of the commercially available direct-push rigs improved, the application of in situ remediation by injection became applicable to a wider range of lithologies and into greater depths. Hydraulic and pneumatic fracturing as well as jetting techniques are now widely practiced and have improved delivery of reagents to the subsurface.

Direct injection into wells still remains popular for soluble products. However, wells only target a specific interval and don't allow for incorporating information obtained during an injection program, without installing new wells.

Approach/Activities. Although rotosonic drilling is widely utilized for soil sampling and well installation, rotosonic drilling has not been adopted for direct injection of remediation amendments. The limited use stems from the lack of specialized injection tooling, as well as reluctance of drilling contractors to risk damage to expensive equipment and drilling rods. Nonetheless, direct sonic injection (DSI) offers many advantages. Rotosonic drilling and injection can be used at greater depths and can drill through many geologic media where direct push would fail. Direct push has limited depth ranges and cannot overcome coarse sediments, cobbles, shale, weathered or competent rock. With specialized injection tooling, direct sonic injection has been completed in coarse sediments with cobbles as well as weathered and competent bedrock.

Use of sonic drilling to deploy injection tooling as part of more aggressive processes such as hydraulic or pneumatic fracturing has been established by a few specialized in situ remediation contractors. These typically involved using separate injection and drilling tooling necessitating more complex field procedures. The drill rig is essentially a means to install an injection assembly and thereby de-coupling the drilling and injection components.

This presentation will review several ways of streamlining the drilling and injection processes using a sonic drill rig as an alternative to the conventional direct-push injection approach. DSI approaches have one common element which is the use of the drill casing or barrels as the conduit for the injection similar to conventional DPI with the added capability of sonic drilling to target more difficult or deeper formations.

In addition to being able to address more challenging formations, DSI may also integrate the injection and drilling components by taking advantage of built-in hardware found in most rotosonic drill rigs. It also allows for a wide range of injection nozzle designs according to lithological and injectate characteristics to improve distribution.

Results/Lessons Learned. DSI has proven to be an effective delivery approach in geologic settings were DPI would fail. Lessons learned and results from DSI in weathered bedrock, low permeability formations with cobbles, and competent bedrock will be presented.