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Air Sparging: Enhancing the volatilization of organic compounds through selection of optimized pulsation frequency

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Air sparging has been successfully applied to remediate groundwater contaminated with volatile organic compounds. As shown in our previous studies (Ben Neriah and Paster, 2016, 2017), temporal changes in the discharge rate result in enhanced mixing and improved remediation efficiency.
In the current work we focused on the approach of pulsed air sparging. We studied how the duration of the pulse affects the remediation efficiency, and how to obtain an optimal choice for this parameter. These important questions have received little attention in the literature.
To study this, we first performed laboratory experiments. A cylindrical tank was packed with fine sand and filled by VOC contaminated water. For a total period of 8.5 hours, pulsed air sparging was applied via an air diffuser, and concentrations of the VOC in air and water were measured. The experiment was repeated over 3 different durations (i.e. 5, 10 and 20 mins).
Next, we used the T2VOC code to setup a numerical simulation model of two-phase flow and transport for this case. The model was calibrated to the experimental results, and then used to simulate a range of pulse durations.
The results of the experimental and numerical studies show that the proper selection of the pulse duration is critical for the remediation efficiency. To illustrate this in our case, the measured contaminant mass removal improved by 12% when the pulse duration was shortened from 10 to 5 minutes. A commonly used method for determining the pulse duration is based on measurements of groundwater pressure response (GPR) to the initiation of air injection. We tested this method using the model, and showed that determining the optimal pulse duration based on GPR measurements may result in a substantial error. The location of the measurement point was shown to have an affect on the GPR. Additionally, GPR changes substantially between the first and subsequent injection cycles. As a result, optimal pulse duration deduced from single cycle GPR measurement may considerably differ from the optimal.
Although these results are unique for the conditions explored, they may provide valuable insights on the process of choosing the optimal pulse duration and its significant effect upon the remediation efficiency.

References:
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