Description of the master's thesis

Zero valent iron (ZVI) colloids have received much attention as a tool for remediation of many groundwater contaminants including chlorinated hydrocarbons. In the past, permeable reactive barriers (PRBs) containing ZVI have been used for plume treatment. However, because PRBs only target the plume rather than completely remediating the contamination, recent research has focused on the direct injection of nano-scale ZVI (nZVI) into the source zone of contaminations. Although the technology is promising, it is still uncertain whether sufficient spreading of nZVI can be achieved at the required radius through injection.

Significant research has been performed to characterize nano- and micro-scale ZVI transport in porous media both by experimental and numerical means, however very little research has been invested into the behavior of ZVI colloids in a radial system. The transport of nZVI colloids in porous media has been experimentally investigated in the Research Facility for Subsurface Remediation at the University of Stuttgart using two different approaches: one characterizing transport in one dimension using columns filled with fully saturated sand and another using a near field scale 60° wedge radial injection experiment. The purpose of these 2D experiments was to prove that 2 meters of ZVI transport could be achieved. Though successful and effective, these experiments are time consuming and impractical for screening tests.

During this Master’s Thesis, two methods were developed to approximate ZVI distribution around an injection well using column experiments. The first was achieved by discretizing the radial system into segments and applying the appropriate boundary conditions in order to approximate the ZVI distribution in columns representing the discretized sections. The second method transfers fitting parameters from a 1D numerical model of column experiments to a 3D radial model which simulates the transport around an injection well.