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Zerovalent iron micro and nanoparticles for groundwater remediation: from laboratory to field scale

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Improving colloidal stability of MZVI and NZVI using biopolymers

MZVI (microscale zero valent iron) and NZVI (nanoscale zero valent iron) are not stable when dispersed in water:

- Relevant mass, high density
- Gravitational sedimentation

NZVI 5-100 nm

Particle-particle attraction (magnetic forces)

Aggregation and sedimentation

Green polymers (guar gum and xanthan gum) can improve stability via:

- Kinetic stabilization
- Increased fluid viscosity

MZVI and NZVI injection in porous media

The mobility in porous media of MZVI and NZVI dispersed in guar gum and xanthan gum was tested in column transport tests (1-D) and a finite-differences model was developped for 1D and radial simulation of MZVI/guar gum injection:

- Column tests provide information on:
  - porous medium clogging
  - pressure build up during Injection
  - interactions among iron particles and porous medium

- Transport modelling:
  1D transport tests performed at different flow rates and polymer concentration were fitted using MNMs (www.polito.it/groundwater/software).
  Results were used to develop a radial transport model.

Field applications

Delivery: Direct push systems (high pressure & discharge rates)

Site: Aarschot (Belgium)
Contamination: 1,1-DCA, 1,1,1-TCA, TCE, cis-1,2-DCE
MZVI: H20 (d50=1.2 mm, BASF)
Guar gum: 5 g/l
Slurry: 1.5 m3, iron conc. 66 g/l
Injection design: pressurized well

Injection point: P704
Injection points:
- 10.5 - 8.5 m bgl, 0.5 m spacing
- Injection well P704
- PV (-)


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Results were used to develop a radial transport model.

Integer distribution in the subsurface (left determined from magnetic susceptibility analysis on core samples (center) and map of the test area(right).