GUIDELINES FOR THE PREPARATION OF WHITE PAPER

Name: Andreas D. Jazdanian
Affiliation: Burns & McDonnell Engineering Company Inc.
E-mail: ajazdanian@burnsmcd.com
Webpage:

Geoenvironmental Research Experience (list projects in progress or completed within the past 5 years)**:**

- Conventional Fenton oxidation PAHs, chlorinated VOCs, BTEX
- Modified Fenton oxidation PAHs, PCP, 2,4 D, 2,4,5 T, chlorinated VOCs, BTEX
- Enhanced Anaerobic Bioremediation of PCE
- Enhanced Anaerobic Bioremediation of 1,1,1-TCA
- Nanoscale iron treatment of TCA
- Nanoscale iron treatment of arsenite
- Calcium hydroxide and Fe(II) treatment of As(III) species
- Calcium peroxide and Fe(II) treatment of As(III) species
- Lab scale simulation of soil washing process

Geoenvironmental Teaching Experience (list related courses, including short courses, taught within the past 5 years)**:**

Geoenvironmental Consulting Experience (list major projects only)**:**

- Containment Wall for tarry DNAPL
- Compatibility testing of slurry materials with tarry DNAPL
- Enhanced anaerobic bioremediation of PCE in ground water with Na-lactate
- Electro-resistive soil heating for DNAPL removal
- Surfactant-polymer flooding of aquifer for DNAPL removal
- Geochemical modeling of acid mine drainage (AMD) for treatment design
- Design of AMD treatment in shallow earthen ponds and wetlands
- Geochemical modeling of As(III) oxidation and sorption for in situ aquifer remediation

Appraisal of Geoenvironmental Research, Education and Practice (limit to 1-2 pages)**:**
A systematic research of the distribution of chemicals/amendments in the subsurface for in situ treatment would help the remediation industry to select the site-specific delivery method for chemicals/amendments. The most common technologies that are in use for in situ delivery include:

- Injection with direct push probe,
- Injection with high-pressure lance,
- Hydraulic fracturing with propant followed by injection of solution or slurry,
- Injection wells,
- Combination of injection and extraction wells (push-pull method).

The cost of chemicals is usually less significant than the cost of labor and equipment for in situ application of chemicals. In general, the amounts of chemicals introduced into the subsurface are by orders of magnitude greater than the reagent requirements determined during a lab study. Greater reagent concentrations are applied to reduce number of injection points, volumes injected, and labor hours of an injection campaign. The success of the in situ remediation depends on the distribution of reagents or amendments in the contaminated area. The systematic study would have to encompass the determination of reagent distribution as a function of both:

- Delivery method, and
- Lithology.

The current status of knowledge in the area of reagent distribution in overburden soils is insufficient to predict vertical and horizontal area coverage with any degree of certainty. While the effect of several physico-chemical mechanisms (desorption, dissolution, partitioning, etc.) on the success of an in situ injection campaign will remain unpredictable due to the limitations of site characterization data, the distribution of chemicals could become predictable, since the method of injection is controlled by practitioners of in situ remediation. The following list includes some unanswered questions:

- Can the distribution of injection ports (both vertically and horizontally) improve the efficiency of chemical distribution and overcome migration in preferential pathways?
- How do injection pressure and flow rate affect lateral distribution?
- Are the diffusion, dispersion and dissolution of high concentration solutions or slurries effective in the attainment of area coverage?
- How does the effectiveness of electro-osmotic flow compare to other delivery methods in distributing reagents in medium to high permeability aquifers?
- Etc.?

Perspective on Emerging Geoenvironmental Issues and Technologies (limit to 1-2 pages)**:**
In situ remediation technologies will most likely become more of a focal point. The predominant technologies for source area remediation of soils remain excavation, treatment and/or disposal, or containment, where feasible. In many cases after the remediation of the soils, source area and down-gradient ground water impacts have to be addressed. In order to contain cost of long-term operation and maintenance (O&M) of pump-and-treat systems, efforts will have to be made to reduce or obviate pump-and-treat remediation. Materials that can persist in the subsurface, and either directly or indirectly contribute to degradation or fixation of contaminants will be of interest to the practitioners of in situ remediation. The ease of injection will be a pertinent property of these materials. It should be noted that injection campaigns are much less expensive than the design, construction and O&M of permeable reactive barriers.