Project Abstract: Rocky Mountain Regional HSRC Proposal – Project 11 (Carlson and Pruden)

1. **Title:** Assessment of Electrokinetic Injection of Amendments for Remediation of Acid Mine Drainage
2. **Investigators:** Dr. Kenneth Carlson; Dr. Amy Pruden
3. **Institution**: Colorado State University, Fort Collins, CO 80523
4. **Project Period:** 11/1/03 – 10/31/05 (2 years)
5. **Project Cost:** $179,575 ($136,724 Rocky Mountain Regional HSRC; $42,851 Cost Share)

6. **Project Summary:** Electrokinetic injection for uniform delivery of amendments to the subsurface is a technology that is generating a significant amount of interest for remediation of groundwater contaminants such as chlorinated solvents and other contaminants. Delivery of remediation amendments to contaminated groundwater has been limited by the heterogeneous nature of the subsurface. Electrokinetic injection has the potential to *uniformly* deliver electron donors across the contamination zone to stimulate the development of a sulfate reducing microbial community facilitating the precipitation of metal sulfides. The proposed research will assess the benefits of electrokinetic injection of acetate and citrate amendments for acid mine drainage treatment applications of relevance to the Rocky Mountain region. An electrokinetic injection system could be an alternative or a supplement to permeable reactive barriers (PRBs). Since an EI system may be easier to install and provide less of an impact on the environment, it may be appropriate for sites where PRB technology is not feasible. In addition, an EI system could supplement a PRB by operating in an unamended mode (resulting in precipitation of metal hydroxides and oxides) when microbial activity is limited due to influences such as temperature or unknown toxicity events.

a. Objectives: The research proposed here will test the hypothesis that EI delivery techniques can be used as a technically feasible and cost effective approach for remediating acid mine drainage contamination. The proposed 2-year research program can be divided into the following specific objectives.

- *Determine the efficacy of unamended electrokinetic injection for removal of metal contaminants as oxides and hydroxides.*
- *Determine the efficacy of electrokinetic injection for delivery of organic electron donors for stabilizing metals in AMD contamination.*
- *Characterize the microbial community that is stimulated during various electrokinetic injection process configurations and determine the metal removal efficiency of an EI system.*
- *Compare order-of-magnitude costs and operational issues of electrokinetic injection of electron donors and permeable reactive barriers for AMD remediation.*

b. Approach: The proposed research has four tasks that coincide with each of the four objectives. Tasks 1 and 2 will include the fabrication of three electrolytic soil cell systems to study several unamended and electron donor amended configurations. Task 1 will determine the fate of dissolved metals in an unamended electrolytic system using bith simple and advanced metal precipitate analyses. Task 2 will characterize the uniformity of the amendment delivery in an abiotic electrolytic system and Task 3 will investigate the microbial community response to the various process configurations studied. Microbial communities will be characterized by denaturing gradient gel electrophoresis (DGGE) of polymerase chain reaction (PCR) amplified fragments of the community 16S ribosomal DNA. These experiments will be conducted in a manner similar to that described in Task 2 except that the soil environment will be allowed to develop biological activity. Three soil systems will be studied (sand-homogeneous, clay-homogeneous, sand-clay-heterogeneous) with two electron donor amendments (acetate and citrate).

c. Expected Results: This study will provide an assessment of the efficacy of using electrokinetic injection as an alternative or supplement to PRBs for remediating AMD contaminated sites.