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Dynamics And Remediation Of Fine Textured Soils And Ground Water Contaminated With Salts And Chlorinated Organic Compounds

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Soil and ground water are frequently contaminated by industrial activities, posing a potential risk to human and environmental health and limiting land use. Proper site management and remediation treatments can return contaminated areas to safe and useful states. Most remediation research focuses on single contaminants in coarse and medium textured soils. Contaminant mixtures are common and make remediation efforts complex due to differing chemical properties. Remediation in fine textured soils is difficult since their low hydraulic conductivities hinder addition of amendments into and removal of contaminated media out of the impacted zone.

The objective of this research is to assess contaminant dynamics and potential remediation techniques for fine textured soil and ground water impacted by multiple contaminants in Edmonton, Alberta, Canada. The University of Alberta's Ellerslie Waste Management Facility was used to process liquid laboratory waste from 1972 to 2007. A waste water pond leak prior to 1984 resulted in salt and chlorinated organic compound contamination.

An extensive annual ground water monitoring data set for the site is available since 1988. Analytical parameters include pH, electrical conductivity, major ions, volatile organic compounds, and metals. Data have been compared to Alberta Tier 1 Soil and Groundwater Remediation Guidelines to identify exceedances. The parameters of greatest concern, based on magnitude and frequency of detection, are electrical conductivity, sodium, chloride, chloroform, and dichloromethane. Spatial analyses of the data show that the contamination is focused in and down gradient of the former waste water pond. Temporal analyses show different trends depending on monitoring well location.

Laboratory column experiments were used to assess leaching as a potential treatment for salt contamination in fine textured soils. Saturated hydraulic conductivity was measured for seven soils from two depth intervals with or without calcium nitrate amendment. Results show all factors and interactions were significant. Leachate electrical conductivity was measured for five soils from two depth intervals with or without calcium nitrate amendment for eight sequential pore volumes. Results show highest electrical conductivity for the initial pore volume and decreasing electrical conductivities for subsequent pore volumes.

Laboratory microcosm experiments are being used to assess anaerobic biodegradation as a potential treatment for chloroform contamination in fine textured soils and ground water. The first experiment investigates the bioremediation potential for indigenous microorganisms using acetate, lactate, canola oil, nitrate, and sulfate as carbon source or terminal electron acceptor amendments. The second experiment investigates the bioremediation potential for microorganisms from a secondary contaminated site which could be used as a microbial inoculation source. The same amendments except lactate were used. Headspace chloroform analysis results do not indicate the occurrence of biodegradation in any treatment meaning that bioremediation may not be a viable option.

Results from this research will be used to conduct a risk assessment for the site incorporating site and contaminant characteristics. A management and remediation plan will be developed so the land can be safely used and the university's lease can be terminated. The research will contribute to our knowledge on remediation with contaminant mixtures and fine textured soils.