Ex Situ Treatment of Perchlorate, Metals, VOCs, and Pesticides in Groundwater

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Overview. A groundwater extraction and treatment (GWET) system is used in conjunction with a subsurface barrier wall to control migration of groundwater impacted with perchlorate, chlorate, VOCs, metals, chloride, and DDT. Contaminants are removed by the GWET System treatment train by using a combination of multiple treatment processes, including a chemical precipitation system, a fluidized bed reactor (bioreactor) for degradation of perchlorate, a deep bed filtration system, and granular activated carbon (GAC) polishing. Activities and lessons learned during startup and optimization of the full scale unit process are presented, including inoculation, initializing, and long term operations.

Background/Objectives. The site was mainly a former chlor-alkali manufacturing facility, but for a limited time manufactured DDT. The GWET system is used to control migration of groundwater impacted with perchlorate, chlorate, VOCs, metals, chloride, and DDT. Groundwater is extracted from the well field, treated, and discharged to the adjacent river. Groundwater perchlorate concentrations have been observed up to 119 mg/L which need to be treated in order to achieve the discharge permit perchlorate effluent limit of 0.015 mg/L. Solids generated from the treatment processes are thickened and dewatered prior to off-site disposal.

Approach/Activities. The bioreactor utilizes a bacterial environment to degrade perchlorate. The bioreactor required initial inoculation with bacteria and followed a recirculation start up procedure to build the bacterial population. Nutrient dosing rates and target operating conditions were developed based on measured treatment efficiency during start up and initial forward flow. Periodic re-seeding with bacteria has been conducted to maintain a viable and diverse bacterial population. Next Generation DNA sequencing (NGS) analysis is in process to identify specific bacteria. The upstream chemical precipitation system is used to minimize dissolved metals and solids entering the bioreactor. A continuous deep bed sand filter system is used to remove biosolids exiting the bioreactor. The performance of the sand filter is affected by the operating conditions of the bioreactor and management of solids reject handling.

Results/Lessons Learned. Sustained operation of the bioreactor is dependent on stable operating conditions, developed through close management of biological growth and solids removal. The relationship between nutrient dosing rates, ORP conditions, and coagulant dosing rates and the resulting performance of the bioreactor and solids management system are presented. DDT, which has very low water solubility, moves through the bioreactor primarily as material sorbed to solid particles. The bacteria population in the bioreactor must be maintained at a level sufficient for perchlorate decay, but also well controlled for solids management. The bioreactor was designed to target perchlorate and chlorate, not DDT and daughter products DDE and DDD (DDx collectively). However, some DDx degradation is expected. DDx are ultimately and finally removed via the GAC polishing step. Though some DDx removal is occurring via the bioreactor and various solids removal steps, it has not been necessary to quantify DDx removal at these steps upstream of GAC polishing. Turbidity monitoring and interpretation of relationships with key effluent parameters were used to develop adaptive management strategies and are used for day to day operational decision making.