ITRC TECHNOLOGY/METHODOLOGY STATUS REPORT

POST-IMPLEMENTATION

Remediation Technologies for Perchlorate Contamination in Water and Soil

Perchlorate Team

March 2010

Team Leader: Lee Lippincott

TECHNOLOGY STATUS

Status of the Technology

The Perchlorate Team focused on three primary areas during its existence as a group. The first area of focus was risk assessment. Currently, the most stringent regulatory level for perchlorate is in Massachusetts. As the human health review continues to evolve in many states, the critical factors in the determination of a regulatory level from human health–based criteria are relative source contribution, consideration of developmental effects, and determinations of sensitive subpopulations, not incidence of cancer. The U.S. Environmental Protection Agency may be evaluating the risk again in the future.

The second focus area was the determination of sources of perchlorate. The Perchlorate Team was fortunate to have a member who was an expert in this area. An advanced chloride and oxygen isotope method coupled with pattern recognition has been used to determine unique sources of perchlorate from nature in arid regions and production sources throughout of the United States. Perchlorate has also been identified in imported nitrate fertilizers that have been widely used in agriculture throughout the nation. In a 2009 *Environmental Science and Technology* journal article examining polar ice cores dated between 1996 and the present, perchlorate concentrations varied between 1 and 18 ng per liter. The concentrations of perchlorate showed seasonality and were correlated with the total ozone levels from the area. A significant correlation was observed between chloride and perchlorate only for data sets corresponding to peak perchlorate concentrations. Data available suggests that perchlorate from the Arctic snow was formed in the atmosphere following two different mechanisms. Stratospheric chlorine radicals reacted with ozone year-round, producing concentrations of perchlorate correlated with the total ozone level. The second pathway was specific to the summer months, when the amounts of perchlorate were correlated with the chloride concentrations, suggesting a possible tropospheric formation. Research in this area is still continuing.

The third focus area was perchlorate treatment technologies. The past two years of implementation have yielded an explosive development of perchlorate-specific ion exchange (IX) technologies, as well as a variety of different remedial solutions using perchlorate-reducing bacteria both in situ and above ground for treating water and soil matrices. The single complicating factor in treatment is the heterogeneity of the matrix

being remediated. Challenges include co-contamination with other combustion by-products of concern, sources from flares and other ordinance applications, and groundwater contaminated with other co-contaminants such as chlorinated hydrocarbons.

The XAD™ resin and granular activated carbon (GAC) technologies have wide acceptance, and the stakeholders that we have observed have demonstrated a willingness to use this technology. The technology is proven, but research is still occurring to improve perchlorate removal efficiency and capacity.

Evolution of the Technology

IX is the most frequently used method for removing perchlorate from drinking water, and the technology is constantly improving. In IX, water is passed over a resin, and innocuous ions present on the resin are exchanged for the undesirable target ions (e.g., perchlorate ions) that are present in the water. The nonregenerable resin, which is selective for the perchlorate anion (that is, it minimally adsorbs competing anions that may be in solution) must be disposed of when the bed reaches its full sorption capacity. The other type of IX resins that we have seen deployed is nonselective resin that can be regenerated. However, the perchlorate sorption capacity of this resin is extremely limited since the resin will also absorb competing anions, such as sulfate and nitrate, which may be present in the water. Frequent regeneration of this resin is required, resulting in the production of high quantities of perchlorate-containing brine that must be either treated or disposed. In addition, tailored GAC sorption technology is improving as well. This technology continues to be developed because of its utility with co-contaminants other than perchlorate.

ITRC GUIDANCE STATUS

Condition of the Guidance

The current guidance document that the team produced—*Remediation Technologies for Perchlorate Contamination in Water and Soil* (PERC-2, March 2008)—reflects the current status of the technology. All statements in the guidance document are still true. The team believes that the wealth of contact and technical information provided on the team Web page and document resource CD helps users with recent case studies and gives them the contact and technology-related information they need to appropriately apply perchlorate remediation technologies.

Recommendation

As team leader, with the consensus of the past membership of the Perchlorate Team, it is my opinion that the guidance is still accurate and therefore no action is recommended. Perchlorate Internet-based training sessions have been scheduled for 2010, which is past the two-year implementation period for the Perchlorate project.