ION EXCHANGE TECHNOLOGY FOR PERCHLORATE REMOVAL AND RECOVERY

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Ion exchange is one of the most promising treatment technologies for removing low levels of ClO$_4^-$ at a relatively high flow rate. Currently, the most commonly used ion-exchange techniques include (i) selective but non-regenerable throwaway resins for single use, (ii) nonselective or low-selective resins with sodium chloride brine or acid regeneration, and (iii) selective and regenerable strong-base anion exchange resins with ferric chloride and acid regeneration. Each of these treatment options has its own advantages and disadvantages, and selection of these options depends upon, among other factors, the site-specific groundwater chemistry, the perchlorate contaminant concentration, secondary waste generation, and cost effectiveness. This presentation will discuss the fundamental mechanisms and selectivity issues related to ion exchange so as to better understand the pros and cons of various treatment options and the conditions under which the best treatment option is utilized. The presence of competing ions such as sulfate and nitrate will greatly diminish the treatment efficiency of non-selective or moderately selective anion-exchange resins, particularly for treatment of perchlorate contaminated water at low concentration levels. On the other hand, resins with high-selectivities show merits under these circumstances. Regeneration of highly-selective ion-exchange resins gives additional benefits, in which not only sorbed perchlorate can be quantitatively destroyed or recovered by eluting with as little as one bed volume of the regenerant solution but also the production of secondary wastes is minimized during treatment. The perchlorate recovery technology turns an environmental remediation liability into the reutilization of a valuable material and additionally allows for recovering trace quantities of perchlorate in water or sediments for isotopic forensics studies.