

Removing Perchlorate

{with Resin}

Perchlorate (ClO_4^-) is an anion that has been introduced to the environment as a contaminant in both ground and surface water from various chemical and industrial processes. Perchlorate is persistent and long lasting, and once it is introduced into the environment, it migrates freely with water flow and does not easily reduce to a less oxidative state.

By Daryl Gisch & Alan Greenberg

Perchlorate may trigger ill effects to human health even at parts-per-billion (ppb) concentrations, has contaminated large sections of the U.S. and has had a negative effect on the drinking water supplies in some regions of the country. The level at which health issues are triggered and to what level ClO_4^- should be treated is still a matter of much debate and discussion.

Some areas of California and elsewhere are looking at action levels for water remediation treatment when the water source contains more than 4 ppb ClO_4^- .

Resin Solution

Anion exchange resins offer a workable solution for the binding and removal of ClO_4^-

types will retain and bind ClO_4^- , both the functional group and the matrix type effect resin performance with respect to ClO_4^- binding, selectivity and potential leakage. The DOWEX PSR-2 resin is a gel-type anion resin based upon a tri-n-butyl amine functional group.

This resin type has a good selectivity for ClO_4^- over other anions, binding in such a way that removal is nearly impossible. This makes the PSR-2 resin almost ideal for concentrating low levels of ClO_4^- from large volumes of water onto a much

even at very low concentrations and in the presence of other anionic species. Although a range of anion resin

Table 1. Properties of PSR-2 Resin

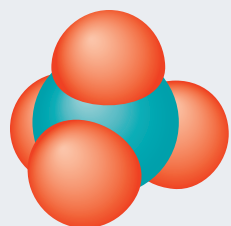
Total exchange capacity, eq/L, min.	0.6
Water content, %	36-46
Bead size distribution	
Size	16-50 mesh
Particle size: on 16 mesh	3% max
Particle size: thru 50 mesh	3% max
Whole uncracked beads, %, min.	90

The data above represent typical physical properties and should not be construed as product specifications.

Table 2. Recommended Operating Conditions for PSR-2 Resin

Maximum operating temperature	60°C (140°F)
pH range (optimum)	0-14
Bed depth, min.	800 mm (2.6 ft)
Flow rates	
Service flow rate	0.5-24 gpm/ft ²
Service linear velocity	10-32 gpm/ft ²
Non-regenerated resin	The PSR-2 is not intended to be regenerated when applied to perchlorate applications
Normal Temperature Range	Ambient or up to 50°C (122°F)

Perchlorate is one chlorine atom (green) and four atoms of oxygen (red).



Anion exchange resins offer a solution for binding and removing ClO_4^-

smaller volume of resin, making the removal from the site and the environment easier.

The resin is based on a gellular strong base anion resin supplied in the Cl^- form. It is designed to offer the highest selectivity for trace contaminants, having an enhanced selectivity for ClO_4^- over other anions such as NO_3^- or SO_4^{2-} as compared to other strong base anion resin types.

The resin meets ANSI Standard 61 as tested by the Water Quality Association. Table 1 lists the properties of the resin and Table 2 lists recommended operating conditions.

Experimental Design

The column design used for the removal of trace contaminants from potable water at three different sites in southern California was as follows: column height, 40 in.; bed depth, 29 in.; column diameter, 2.5 in.; volume of resin in the column, 2.32 L (0.61 gal). The feedwater flow rate was 0.41 gpm (approximately 590 gpd or 2,242 liters per day).

Three different well sites located in La Puente, San Gabriel and Valley County, Calif., were evaluated using the PSR-2 resin.

Each site monitored the concentration of the perchlorate both before being treated by the resin on the influent side and after being treated on the effluent side. The goal of this study was to evaluate how much clean water could be produced before the resin showed perchlorate breaking through to the effluent side at each site.

The three sites each ran for about 260 days of operation, with

each column seeing approximately 154,000 gal of feedwater during the course of the study.

The PSR-2 was shown to successfully bind and hold ClO_4^- at low ppb levels from varied feedwater streams when applied in a continuous column operation:

- Feedwaters holding ClO_4^- ranging in the 12 to 40 ppb level could easily reduce the ClO_4^- to less than 2 ppb.
- One liter of PSR-2 resin was able to remediate approximately 250,000 L (~65,700 gal) of water depending on the water quality.

The PSR-2 resin offers value for producing water that is free of ClO_4^- while concentrating and binding this trace contaminant in the resin so the ClO_4^- can be removed from the site and disposed of in a safe manner. *wqp*

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SEPTEMBER 2008 | 17