# *Harmful Contaminants, Innovative Solution*
## GAC Contactors

CASE STUDY

***Location:*** **Magna, Utah**
***Owner:*** **Magna Water District**
***Engineer:*** **Carollo Engineers**
***Contractor:*** **Alder Construction**

## Perchlorate Contamination

The Magna Water District provides drinking water and wastewater treatment for the City of Magna, Utah. Drinking water was drawn from wells where dissolved solids, minerals and salts, and naturally occuring arsenic were persistent problems.

During routine testing in 1997, trace elements of perchlorate were found in one well at the Barton Wellfield. A plume from the defense industry had contaminated the groundwater with perchlorate. Because of the rapid-moving nature of plumes, the entire Barton Wellfield was shut down for fear of further contamination.

Naturally occurring arsenic levels at the Barton Well Field were between 8 and 18 µg/L. In 2001, the EPA adopted a new arsenic standard of 10µg/L, replacing the old standard of 50 µg/L, and requiring compliance by January, 2006. While the EPA had not made a final regulatory determination by setting a maximum contaminant level (MCL) for perchlorate, the Magna Water District took a proactive approach and began looking for a solution for perchlorate remediation that could also provide arsenic removal (the EPA most recently declared an interim health advisory of 15 µg/L in January, 2009).

A series of studies were conducted over the course of the next several years to evaluate processes for simultaneous arsenic and perchlorate removal. Following the studies, the engineer concluded that electrodialysis reversal (EDR) was the most cost-effective contaminant removal system. Typically, EDR systems are used for desalination and to remove charged particles (lead, copper, chromium, and nitrates). Magna installed the first EDR for arsenic and perchlorate removal.

## Equipment Selection

After the removal of perchlorate and other contaminants from the drinking water, the concentrated waste stream required disposal. If perchlorate is not destroyed, it will continue to pollute the environment and drinking water supplies. Magna, in conjunction with Carollo Engineers, developed a biological process to destroy perchlorate. The concentrated reject stream from the EDR was combined at a 1.5:1 ratio with screened wastewater and allowed to react anaerobically. Vertical pressure filters were the best treatment housing equipment option to provide this anaerobic reaction. In 2007, WesTech was contracted to supply six vertical pressure vessels for digestion (12 ft diameter x 9.5 ft long).

| Vertical Pressure Filters | |
|---|---|
| Quantity | *6* |
| Size | *12 ft diameter* |
| Area per Filter | *113 ft²* |
| Design Flow | *2604 gpm* |
| Filtration Rate | **Nominal:** *3.34 gpm/ft² (377 gpm)* **Maximum:** *4.6 gpm/ft² (520 gpm)* |
| Backwash Flow Rate | *26 gpm* |

WesTech's vertical pressure filters were filled with 54" of Granular Activated Carbon (GAC) media. Because of the media depth, the underdrain design needed to be modified for the system. The unique header and lateral underdrain design developed by WesTech, in collaboration with Carollo, ensured uniform distribution of flow in the vessels. With WesTech's extensive experience in designing and constructing pressure filters, the large-diameter vessels and media depth were customized to match the water quality and remove perchlorate.

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## EDR Contaminant Removal

| Contaminant | MCL | Feed Water | Filtered Water |
|---|---|---|---|
| *Perchlorate (2-Step Process)* | *10 µg/L (treatment goal)* | *10-25 µg/L* | *< 4 µg/L* |
| *Perchlorate (4-Step Process)* | *10 µg/L (treatment goal)* | *50-60 µg/L* | *< 4 µg/L* |
| *Arsenic* | *10 µg/L* | *8-18 µg/L* | **Range:** *Non-Detect-7.3 µg/L* **Avg:** *1.6 µg/L* |
| *TDS* | *2000 mg/L* | *770-1350 mg/L* | **Range:** *10-390 mg/L* **Avg:** *231 mg/L* |
| *Silica* | *Unregulated* | *11.7 mg/L* | *11.5 mg/L* |

Due to its porous nature, GAC was an optimal growth media where the wastewater developed a biofilm around the media. When perchlorate-contaminated water passed over the media, the oxygen starved bacteria consumed the oxygen in the perchlorate, breaking the O-Cl bonds, and destroying the perchlorate.

## Biological Perchlorate Removal

| | *BIOBROx* | *Alternate Biological Processes* |
|---|---|---|
| *Contact Time* | *10 min* | *6-24 hrs* |

The biodestruction of blended residual oxidants (BIOBROx®) process provided sustained perchlorate and arsenic removal below detection with much shorter detention times than traditional methods. In addition, BIOBROx® is lower in cost due to lack of aeration requirement and the fact that it is contained within a smaller footprint than traditional biological processes.

## Customer Satisfaction

As perchlorate is difficult and costly to track, nitrate levels are routinely monitored. In a pilot study completed before plant operation began, when nitrate levels were below 0.05 mg/L, perchlorate levels were non-detectable.

The Magna Water District has received recognition for its forward thinking and role in advancing water treatment technology. By destroying perchlorate, Magna created an environmentally friendly treatment process.

In a letter to the water district, Senator Orrin Hatch said, "It is exciting to know that the project continues to be an efficient and cost-effective solution to the problem."

## GAC Contactors for Arsenic and Perchlorate Removal

*Installation of Vertical Pressure Filters for BIOBROx® Process*

*Magna Water Treatment Plant in Operation*

> *"The simultaneous removal of arsenic, perchlorate, and TDS by EDR, followed by the biodestruction of perchlorate in the concentrate represents a unique approach to a complex water quality problem."*
>
> **AWWA and Cummings, Michelle et. al June 2007**



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