

Case Study: Northern California Wine Country Tackles Arsenic Contaminant in Groundwater

INTRODUCTION

Wine producers in the northern California wine country, including Sonoma, Napa, Lake and Mendocino counties, encounter high levels of arsenic in groundwater extracted for use in wine processing and irrigation. These producers must lower arsenic levels to newer drinking water standards set by the U.S. Environmental Protection Agency (EPA) and California's Department of Health Services. Arsenic removal is also indicated to ensure product safety and to maintain customer confidence in wine products. Graver Technologies LLC, in cooperation with its water treatment partners, has installed more than a dozen state-of-the-art treatment systems that use MetSorb™ HMRG adsorbent media to remove arsenic.

OCCURRENCE

Ongoing water quality compliance testing has confirmed the presence of arsenic in water systems in this region. Arsenic, which has been implicated as a cancer risk, is a metallic contaminant of greatest concern in the western United States. Experts believe that water in some geologic formations acquires arsenic by flowing through bedrock and dissolving iron or manganese oxides under anoxic conditions. The arsenic in this area appears as two species: arsenic V and arsenic III. The water also demonstrates an elevated pH and high concentrations of competing contaminants such as silica.

For many years, federal and California drinking water standards for arsenic were 0.05 mg/l. Following reassessments, the United States Environmental Protection Agency (EPA) established a federal Maximum Contaminant Level (MCL) of 0.01 mg/l that the agency required states to adopt by 2006.

TREATMENT OPTIONS

Graver and its water treatment partners set a goal of meeting these new state and federal standards and further lowering the levels of both arsenic species (As^{+3} and As^{+5}) to the maximum extent feasible. The treatment options for removing arsenic have been identified by the EPA and they include the categories:

1. Adsorption
2. Lime-softening
3. Ion exchange
4. Reverse osmosis
5. Coagulation/filtration

Adsorption technologies have been extensively evaluated and are increasingly recognized as the most feasible treatment processes for small water systems such as those in the four wine-producing counties. These technologies present a series of benefits:

1. Lower capital costs
 - a. Equipment and installation
 - b. Packaged units enable small footprint
2. Reduced operational and maintenance activities
 - a. Less operational oversight
 - b. Less mechanical/electrical sophistication
3. Reduced waste generation
 - a. Minimal backwash
 - b. No waste sludge generation

When evaluating treatment options for arsenic, it is often the case that minimal waste generation and waste handling significantly influence the selection criteria.

METHODS

To define the treatment effectiveness of an adsorbent technology in source water containing arsenic, a number of small water systems in northern California measured arsenic levels prior to on-site treatment and again after installation. The source water quality data is presented in Table 1.

Water Quality Prior to Treatment - Table 1										
	pH	Total Arsenic <i>µg/l</i>	Arsenic ⁺³ <i>µg/l</i>	Silica <i>mg/l</i>	Total Hardness <i>mg/l</i>	Alkalinity <i>mg/l</i>	Iron <i>mg/l</i>	Manganese <i>mg/l</i>	Phosphate <i>mg/l</i>	Vanadium <i>µg/l</i>
Ground Water Quality	8.3	26	18	65	30	125	<0.3	<0.05	0.25	5

A typical treatment design consisted of two 36" X 72" fiberglass reinforced plastic (FRP) vessels plumbed in series charged with 25 cubic feet of adsorbent media. The adsorbent media chosen for the testing program was

the nano-titanium oxide (MetSorb brand from Graver Technologies) based upon results realized in previous full-scale arsenic treatment installations. The treatment system was designed to accommodate 100 % of the 60 gallon per minute (GPM) well pump capacity. A pre-filtration step, using traditional 25-micron bag filters, was installed to keep sand or dirt from the well from accumulating on the adsorbent media. The two FRP vessels containing the MetSorb adsorbent media were plumbed in a Series (Lead/Lag) configuration. This design allows the Lead vessel tank to act as the “worker” tank for arsenic adsorption while the Lag vessel acts as the “guard” column, providing adsorption capacity as the Lead column reaches exhaustion. A flow-meter, flow-totalizer is typically installed after the treatment system to capture the total quantity of water treated. In our specific situation, the Lead adsorption vessel was capable of treating a total of 7,000,000 gallons of groundwater prior to exhaustion.

CONCLUSIONS

These systems have been extremely effective in removing arsenic and co-occurring metallic contaminants of concern such as manganese, silica, vanadium, selenium and uranium. The data concluded that the nano-titanium oxide adsorbent media (MetSorb®) effectively removed arsenic (both arsenic V and arsenic III species) to below the safe drinking water MCL. Further, the adsorbent was very effective despite high pH levels in the water and high concentrations of competing contaminants such as silica. Finally, the adsorbent media did not demonstrate the release of arsenic often associated with traditional iron-based adsorbent media. A graph of the post-treatment data is presented in Table 2.

TABLE 2 – Post MetSorb Treatment

	pH	Total Arsenic µg/l	Arsenic ⁺³ µg/l	Silica mg/l	Total Hardness mg/l	Alkalinity mg/l	Iron mg/l	Manganese mg/l	Phosphate mg/l	Vanadium µg/l
Ground Water Quality Prior to Treatment	8.3	26	18	65	30	125	<0.3	<0.05	0.25	5
Water Quality Post MetSorb™ Treatment	8.3	<0.5	<0.5	<10	30	125	<0.3	<0.05	<0.05	<1.0

The continued application of adsorbent technologies is an efficient and cost-effect treatment solution to remove arsenic from groundwater. It is extremely useful for small water systems where financial and human resources are limited and cost effective, easy-to-operate treatment solutions are needed. It is recommended that a characterization of the saturated media be conducted for proper disposal consideration under the Federal Resource Conservation and Recovery (RCRA) as well as State and local disposal

restrictions.

REFERENCES

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MetSorb™ HMRG adsorbent media is a highly effective granular adsorbent that removes Arsenic III & V, and a wide variety of heavy metals including Lead, Chromium+6, Selenium, Uranium and Vanadium from aqueous sources. For more information on MetSorb® arsenic adsorbent media contact James Knoll at 410 596-9434, or by email at jknoll@gravertech.com.