Case Study - Arsenic Treatment Technologies Southern California Water Company's Hollydale System in Paramount, CA

Background: Water Quality Characteristics

The Southern California Water Company (SCWC) serves water to the city of Paramount, California. SCWC's Hollydale System has more than 1,650 service connections, and uses two groundwater wells as the system's sources of supply.

SCWC is conducting arsenic removal pilot tests at their Hollydale System's Century well. The Century well, located in a residential area, has a pumping capacity of 500-600 gallons per minute (GPM). It has raw water arsenic concentrations between 0.015 mg/L and 0.020 mg/L, manganese concentrations between of 0.144 mg/L and 0.180 mg/L, and a pH range of 7.6 to 8.0.

Typical Raw Water Quality - Century Well[1]

pH	7.6-8.0
Arsenic (As(V))	0.015 - 0.020 mg/L
Chloride	31 mg/L
Fluoride	0.27 mg/L
Iron	0.108 mg/L
Manganese	0.144 - 0.180 mg/L
Silica (as SiO_2)	20.5 mg/L
Sulfate	60 mg/L
Total Dissolved Solids	368 mg/L

[1]Galeziewski, T; Castillo, M; Kwan, P; Chowdhury, Z. "Evaluation of Iron and Alumina Based Sorbents for Arsenic Removal Based on Pilot and Full Scale Testing

Pilot Testing

SCWC's Century well site began full-scale pilot testing of adsorption media for the removal of arsenic in October, 2001. SCWC tested four different proprietary adsorption media:

- Granular ferric hydroxide (GFH);
- Iron coated activated alumina;
- Modified activated alumina; and,
- Activated alumina.[1]

All of the raw water from the Century well is pre-chlorinated and treated to remove manganese. During the pilot testing, half the water flowed directly from the manganese treatment system into the distribution system and the other half was treated by one of the four arsenic removal test media. The physical plant used for the full-scale testing of 50% of the flow at the SCWC Century well site

[1]Memo written by Kevin Keenan of the Cadmus Group, Inc. based on a site visit to arsenic removal full scale plant Century well site, SCWC. January 23, 2002.

was designed to convert to 100% operation. SCWC designed the site so that the Company could install an additional four filter vessels once the arsenic removal media was chosen.

The four arsenic treatment vessels are four feet in diameter, six feet high, and were operated in parallel so the influent and effluent of each could be tested separately. Each vessel contained a pea gravel filter bed and about 32 - 36 inches of media. Each was designed to operate at a flow rate of 50 to 70 gpm resulting in five minutes of empty bed contact time (EBCT), though this varied slightly from vessel to vessel.

While traditional pressure filter vessels are filled approximately 2/3 with media to allow for its expansion during a backwash cycle, SCWC discovered that backwashing did not appear to be necessary, nor advantageous with these test media. It appeared from these tests that the vessels can operate while filled to near capacity with media, which would increase operating flow rates and extend filter operation time between loading and disposal of media. During pilot testing, all of the media were assumed to be single-use and disposable, with no on-site regeneration required.

SCWC planned the pilot testing in two phases. In the first phase, the raw water pH was not adjusted and each media was used to exhaustion. In the second phase of testing, SCWC will adjust the pH of the raw water and the most promising media, the GFH, will again be used to exhaustion.

Figure 2: Loading Arsenic Treatment Media

Figure 3: Arsenic Treatment Media

Conclusions

In the first phase of the pilot tests, SCWC found the GFH media was the most successful at removing arsenic and meeting other performance criteria important to the system. Each of the AA vessels experienced arsenic breakthrough in the effluent well before the GFH vessel. This may be partially attributable to the influent pH of 7.4 to 7.9 (AA and GFH tend to be more effective at a lower pH of around 5.5 to 6.0).

The second phase of testing will be conducted on a smaller quantity of the exhausted GFH media removed from the full scale reaction vessel. SCWC will lower the influent pH to 7.0 for a small-scale pilot reaction vessel. The pH of a small flow of water that has been pre-chlorinated and treated for manganese removal will be adjusted by the carefully controlled addition of sulfuric acid. It is

expected that the performance of the GFH media will be re-established at the lower pH, allowing the removal of additional arsenic onto the previously exhausted media.

Figure 4: Century Well Pilot Test Vessels

One concern associated with use of the GFH media is that the spent or exhausted media may need to be treated as hazardous waste, especially in California.[2] If this is the case, the GFH media can be monitored during use and replaced before it reaches exhaustion. While close management of the GFH media may increase overall costs, the system would not need to pay for hazardous waste disposal.

The cost of the site improvement package was approximately $500,000. This included the manganese treatment system, well pump, office and storage building, and landscaping, as well as the arsenic pilot testing equipment. It is estimated that each arsenic reaction vessel cost between $10,000-$20,000[3].

[2]California requires the use of the Waste Extraction Test (WET) test to determine if a waste is hazardous. Some contaminants (including arsenic) are apparently removed more readily by the WET test than by the Toxic Characteristic Leaching Procedure (TCLP) test used by other States. The spent media containing high levels of arsenic may be more likely to be considered hazardous in California.

[3]Dr. Jason Wen, SCWC. "Memo by Kevin Keenan: Site Visit to Arsenic Removal Full Scale Plant Century Well Site Southern California Water Company (SCWC)." January 23, 2002.