

ARSENIC IN DRINKING WATER COMPLIANCE SUCCESS STORIES

Ripon, CA: Pilot Studies Useful for Treatment Evaluations

Case Study Contact Information

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The City of Ripon, CA completed a pilot study to compare three different treatment systems for removing arsenic from their groundwater supply.

Lessons Learned

The City of Ripon, CA piloted three different coagulation/filtration systems using ferric chloride as the coagulant. The pilot study showed that all three systems were capable of reducing arsenic to acceptable levels and demonstrated high water production efficiency in the range of 90 to 99 percent based on backwash volume and the number of events. Using a bidding process, the City awarded a contract to Kinetico, Inc. to install treatment facilities which are expected to be placed into service in December 2006.

During the pilot study evaluations, the City also identified a sulfur-modified iron test media that can remove nitrate from water and also can benefit the arsenic treatment system by providing a source of iron. Iron combines with arsenic and the resulting compound is removed by filtration. The City is continuing to evaluate this media on a pilot-scale because several wells have elevated levels of nitrate in addition to arsenic.

System Description

The City of Ripon, California, located 80 miles east of San Francisco, serves approximately 12,000 residents with an average daily demand of 4.0 MGD. The City has six wells that are used for potable water.

Two of the potable supplies, Wells 9 and 10, were found to contain arsenic at concentrations of 11 to 12 ppb. Both wells also have nitrate levels that exceed the MCL of 10 mg/L. Water quality and operating data for these wells are summarized below.

Well No.	System Type	Date Drilled	Production Rate (gpm)	Max Nitrate Conc. (mg/L)	Max Arsenic Conc. (ppb)
9	Potable	1989	600	41	12
10	Potable	1993	2,000	27	11

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Pilot Study Evaluation

The City completed a pilot study to identify the necessary operating conditions for removing arsenic from Wells 9 and 10 using a coagulation/filtration process with ferric chloride as the coagulant. Arsenic is removed from the water by co-precipitating the arsenic with iron onto the filter media as ferric arsenate. The pilot study set-up is shown in the photo, below. Six objectives were identified for the pilot study:

1. Demonstrate the ability of the arsenic treatment systems to achieve treated arsenic goals under dynamic operational conditions.
2. Validate the optimal coagulant conditions determined at the bench-scale.
3. Comparatively assess the ability of the filtration systems (granular and ceramic media and membrane) to remove arsenic.
4. Establish the water efficiency for each treatment system.
5. Evaluate the coagulation and filtration backwash residuals quantity and quality.
6. Provide an opportunity for City personnel to gain experience in operating the treatment systems.



Pilot study operation at Ripon, CA

Three filtration system vendors participated in the pilot study: Kinetico, Inc.; Layne Christensen; and Pall Corporation. The Kinetico

system used pressure filtration with a ceramic media, Macrolite[®], which is chemically inert and uniform in size. The Layne system featured pressure filtration with LayneOx[™] media, a high rate granular media. The Pall system featured membrane microfiltration using polyvinylidene fluoride (PVDF) hollow fiber membranes with a pore size of about 0.1 microns.

Three pilot study runs were conducted with ferric chloride dosage rates varying from 2 to 10 mg/L. All three treatment technologies were capable of removing arsenic to levels below the MCL, and all three demonstrated high water production efficiency in the range of 90 to 99 percent based on backwash volume and the number of events. Based on pilot study results, the City decided to use a ferric chloride dosage rate of 7 mg/L. The City has contracted with Kinetico Inc. to design and build the treatment facilities which are expected to be put into service by December 2006.

Funding Process

The City received \$450,000 in federal funding to offset treatment costs for Well 9. This funding was provided by a congressional line item appropriation. As part of the funding process, the City completed detailed documentation on arsenic treatment alternatives and other project justification. The remaining treatment expenditures were funded through revenues received from local water customers. No rate increase is anticipated.