Meeting Potable Water Needs

The town of Buckeye, Ariz., has five wells—four of which have arsenic levels exceeding the maximum contaminant level (MCL) of 10 ppb. A pilot study was commissioned to examine the treatability of the raw water and to determine whether it could be used to meet the town's rapidly expanding need for potable water. After reviewing treatment options for Buckeye, RBF Consulting Engineers determined that coagulation filtration would be the best method of treatment for the arsenic problem.

By Chuck Reading & Archie MacDonald

An Arizona town addresses arsenic problems with coagulation filtration

Summary of Operational Improvements

Filter run time: 28 hours vs. 8 hours

Ferric sulfate feed rate: 0.50 gph/1,000 gpm vs. 1 gph/1,000 gpm

Reclaim: 28 reclaims per tank vs. 15 reclaims per tank (each reclaim event is six backwashes)

Sludge transfer interval: four times per year vs. every three and a half weeks

Finished water arsenic levels: ranging from 3.9 to 5.9 ppb

Pumps: Backwash water reclaim and backwash water supply pumps run 72% less often with extended filter run times.

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The coagulation filtration process uses sodium hypochlorite to oxidize Arsenite+3 to Arsenate+5 and ferric sulfate to ferric hydroxide. The combination of ferric hydroxide and Arsenate+5 provides for efficient co-precipitation onto an active permanent filter media.

Pureflow Filtration Division was chosen to supply the arsenic removal system for the Sundance Water Treatment Plant (WTP). Designed to treat 4,000 gal per minute (gpm) per 5.7 million gal per day (mgd) of raw water, with provisions for expansion to 6,000 gpm, the Sundance WTP was commissioned in May 2007 and has been operating successfully since then.

Maximum Arsenic Removal

Initially, the operational parameters for the Sundance WTP were set to achieve maximum arsenic removal. Filters were set to run for eight hours before backwashing, based on a specific ferric sulfate dosage rate necessary for optimal arsenic removal. These operational parameters produced excellent water quality, reducing the arsenic levels on a regular basis to nearly nondetectable.

In April 2008, Rick Harrell, utility maintenance worker for the Buckeye Water Resources Department, was asked to assume operational responsibilities for the Sundance WTP. At this time, the Sundance WTP was discharging sludge to the local sewage treatment plant. Processing procedures at the sewage treatment plant released the arsenic from the sludge, creating unacceptable secondary irrigation water. The sewage treatment plant rejected the sludge from Sundance, forcing it to process the sludge internally. A plate-and-frame filter press was temporarily installed to dewater the sludge, producing filter cakes that could be disposed of in a local landfill.

Harrell's initial challenge was to examine options for reducing the amount of sludge produced by the system and subsequently discharged into the sewer without compromising the plant's treatment goals for arsenic. With support and encouragement from Arnold Coronado, water production supervisor for Buckeye, and representatives from Pureflow, Harrell embarked on a series of operational adjustments that would ultimately lead him to use the Pureflow Filtration water treatment system to its optimal capabilities.

Optimization Plan

In September 2008, Harrell presented his plan for optimization to Coronado and Damon Dequenne, Buckeye's director of water resources. The plan included adjustments to the ferric sulfate dosage rate, filter run times and reclaim set points and performing all necessary testing to ensure that the production of sludge could be safely reduced and arsenic treatment goals maintained.

Harrell asked Pureflow representatives whether the set points were specific for the operation and if the set points could be adjusted to reduce the amount of sludge that was produced by the system. A methodical series of adjustments at the Sundance WTP was initiated. Incremental adjustments to the ferric sulfate dosage and filter run times were carefully planned and executed. The effect of these adjustments on the systems' ability to remove arsenic was recorded and analyzed. Care was taken to ensure that the data was accurate; multiple samples of treated water were taken at each specific set of operational parameters for periods that ranged from one to four weeks.

Relying on customer support and input from Pureflow, the initial adjustment was to extend the filter run times from eight hours to nine and a half hours. These adjustments to the operational parameters of the treatment system initially produced water with an arsenic content of nondetectable to 3.2 ppb. The next set of adjustments included incremental reductions of the ferric sulfate dosage. Systematic adjustments were continued until the combination of ferric sulfate dosage, filter run times and reclaim set points produced maximum arsenic removal with minimal sludge production.

Optimization occurred once the Sundance WTP reached an acceptable balance between sludge production and arsenic removal. At this point, the plant was able to begin discharging the sludge back into the sewer system at a volume acceptable to the sewage treatment plant.

"We continued to move forward with additional changes to filtering times, backwash times, reclaims per tank and ferric sulfate feed rates. The changes to the system have been nothing short of fantastic," Harrell said. "Try something, do not be afraid to challenge the system and do so with the technical input from your equipment manufacturer." WWD

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