Arsenic Compliance News™

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Pressure Filtration WTP Drops Costly and Troublesome Polymer While Maintaining Arsenic Compliance

Also Cuts $FeCl_3$

After polymer was discontinued, pressure filter runs increased from 4 hours to 8 hours, in spite of compromised media. Filter runs will increase further when existing media is replaced with Tonka IMAR media, specially developed for removal of iron, manganese, arsenic, and/or radium.

Table #1:
Gains After Elimination of Polymer

- $FeCl_3$ dramatically reduced
- Filter runs increased in spite of compromised media
- Polymer-related filter problem-solving time eliminated
- Polymer purchase eliminated
- Polymer injection equipment maintenance eliminated
- Total man hours for filtration process reduced

Each of five pressure filters operates at 2500 gpm, with discharge to a 2 million gallon finished water tank. Currently, iron levels range from non-detectable (<0.01 ppm) to 0.12 mg/L, compared to a goal of no more than 0.3 mg/L. Arsenic concentrations are still consistently below 10 ppb, generally ranging from 3 – 8 ppb.

Corcoran, CA -- Plant and operations management for an 18 MGD, arsenic removal water treatment plant (WTP) here report they have been able to discontinue use of a costly and troublesome polymer addition, as well as substantially cut back ferric chloride ($FeCl_3$) use, while maintaining compliance with their 10 ppb arsenic limit.

The plant's pressure filtration manufacturer did not recommend polymer usage, but the city's facility was built to include it as an option in their treatment regime. Polymer addition, instituted as a safety precaution to prevent breakthrough, began soon after the plant started up in June, 2006. The addition was discontinued late last year.

The USEPA Arsenic Rule, in effect as of January, 2006, requires all potable water systems to provide water with an arsenic concentration of 0.010 mg/L (10ppb) or less.

"The water looks good and tastes good, and the arsenic is reading consistently between 6 and 8 ppb," said Steve Kroeker, public works director and chief water plant operator for the City of Corcoran. "We've been off the polymer for 5 or 6 months now and are doing just fine."

"We could have been spared all that if we had listened to the manufacturer we ended up using. An original pilot test had recommended the need for a polymer in the process, and our design engineer had confirmed the need for the polymer."

The Grade IV Water Treatment Plant is a significant upgrade from the City's previous practice of just adding sodium hypochlorite to a groundwater storage tank, which had resulted in arsenic in finished water in the range of 24-25 ppb, well within the previous arsenic maximum contaminant level (MCL) of 50 ppb.

The new plant was built to meet the new 10 ppb standard. Average flow is 5000 gpm, or 7 MGD. Seasonal variation so far has been from 3 MGD to about 12 MGD, with the gross treatment capacity at 18 MGD. The manufacturer of the arsenic removal system and related equipment is Tonka Equipment Co. of Plymouth, MN. Tonka also conducted a 40-day pilot test, at no cost to the city, using reduced $FeCl_3$ and no polymer addition.

The groundwater source is comprised of nine deep wells, ranging from 300 ft. to 1000 ft. All the wells yield water with arsenic > 10 ppb.

Groundwater is pumped to the 500,000 gallon raw water blend tank. As raw water enters the tank, sodium hypochlorite is applied at 3.85 mg/L, both for disinfection and to oxidize arsenite (As^3) to arsenate (As^5), making it readily precipitable.

Six filter feed pumps draw from the raw water tank to a common manifold containing a static mixer. There, 39% ferric chloride ($FeCl_3$) is added at 3.8 mg/L, as a bonding agent for the arsenic, and thereby creating larger particles for filtration. Each of five pressure filters operates at 2500 gpm, with discharge to a 2 million gallon finished water tank.

"When we started off, the engineers were shooting for arsenic below 3 ppb, so we had $FeCl_3$ at 12.0 mg/L, and polymer at 1.2 mg/L," recalled Joe Faulkner, lead shift operator. "We were getting breakthrough at the end of the filter runs, and the polymer was gumming up the filters. A filter run is supposed to be 8 hours, but it was cut to 4 hours with a head loss of 8 to 12 psi before backwashing."

Mr. Kroeker worked extensively with Mr. Faulkner for many months to solve the problems. They have concluded that eliminating the polymer from the treatment process has been very beneficial in several ways.

The use of the polymer apparently was creating an iron/polymer sludge on top of the media, which the water could not penetrate. With much of the water following the path of least resistance, it would channel along the sides of the filter, rather than through the media as it should.

The plant had used the polymer for about three (3) years, at the rate of six to seven 250-gallon totes per year. Based on Tonka's piloting results, $FeCl_3$ feeds were reduced and polymer addition was eliminated, thereby achieving significantly reduced costs, while still keeping the arsenic levels below the Federal MCL of 10 ppb.

Discontinuing the use of the polymer not only relieved the burden of a substance that was said to be difficult to handle, and its cost, but also resulted in definite savings in the operational costs of the plant.

Not only was there no longer a need to purchase the polymer, but the need for the maintenance of the polymer injection equipment was eliminated, and a reduction of man-hours needed to operate that portion of the plant treatment processes was realized.

In addition, plant management noted additional costs associated with the problems potentially linked to the use of the polymers, such as short filter runs, the time to determine what the problems had been, and now, the cost of replacing the media, which is expected to resolve continuing problems with the filters.

According to the operators, during the backwash cycles, when the water would channel, it would lift the media higher than it was designed for, causing a substantial loss of media. Approximately eight inches of media has been lost from each filter per year, and they are expecting to continue to lose media until the media can be replaced.

"The polymer remaining in the filters has turned into balls, like pieces of gum," Faulkner noted. "We're still losing anthracite because of those mud balls. So we tried going down 4 or 5 in. into the anthracite to remove the mud balls, but we could not remove all of that residual polymer material. When the mud balls go through the air wash, they drop to the gravel, and create a barrier where the water can't flow up. We're still doing all right with this compromised media, but we are looking forward to replacing it, which we believe is the only way to completely solve this problem."

The filter media consists of 18 in. of anthracite, 18 in. of GreensandPlus™, 4 in.of torpedo sand, and 12 in. of gravel. The current plan, as soon as budgets will allow, is to replace the GreensandPlus™ media with an 18" layer of specially graded, commercially-available sand from Tonka called IMAR.

In addition, the supporting gravel layers will also be replaced, per the design specifications. If the media cannot be replaced this year, it will be included in the 2010-11 budget, for replacement next year.

Before eliminating the polymer, the City had completed a 40-day pilot test, under Tonka supervision, in order to determine what could be done to resolve the various problems with the operation of the plant.

The results of those extensive tests showed that the plant could be operated successfully with less $FeCl_3$ and no polymer addition, and still achieve arsenic levels below 10 ppb. Subsequent operations of the plant, at current winter flows, have proven out the conclusions drawn from those tests. Furthermore, significantly longer filter runs were observed during the pilot test with the new media.

Charlie Mahady, a chemical engineer and Tonka's expert on arsenic removal, supervised the 40-day pilot test.

"We were very pleased with the results," he said. "Considering the pilot's success, we are confident that the City will achieve the desired filter performance without the use of a polymer, once the mudballs are removed and existing agglomerated media is replaced. We look forward to helping the City get to that point."

The operators use ongoing monitoring of iron and arsenic in the effluent to determine the effectiveness of the filtration process.

Currently, the iron levels range from non-detectable (<0.01 ppm) to 0.12 mg/L, compared to a goal of no more than 0.3 mg/L of iron in the effluent stream, which is USEPA's secondary maximum contaminant level (SMCL). Arsenic concentrations in the final finished water are still consistently below the Federal MCL of 10 ppb, generally ranging from 3 – 8 ppb.

Each of the five 12' diameter x 40' long Tonka horizontal pressure filters is comprised of two cells sharing a common underdrain. When filter refurbishment is complete, the filter cells will contain 36 in. of Tonka IMAR media, which has been specially developed for removal of iron, manganese, arsenic, and/or radium.

The system is controlled by Tonka's PLC-based automatic control panel, which has been customized to automatically backwash the filters by loss of head, by time, or by operator initiation. It also interfaces with the plant's SCADA system to provide operators with real time system feedback. The duration of the backwash and other functions is locally selectable and adjustable by the operator through a color touch screen interface.

For further information, contact Tonka Equipment Company, 13305 Watertower Circle, P.O. Box 41126, Plymouth, MN 55441, Tel. (763) 559-2837, Fax (763) 559-1979, www.tonkawater.com.

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