By Jon Steele, KRWA Tech Assistant

Buhler's New Plant Addresses Arsenic Removal, Iron and Manganese Too

Two high service pumps output production from Buhler's new treatment plant.

The city of Buhler recently completed improvements to its water system to meet new arsenic standards and improve water quality for customers. A new $1.9 million treatment facility removes the arsenic and more troublesome manganese that has caused discolored water for users in Buhler for decades. Buhler is located just northeast of Hutchinson in Reno County in central Kansas; the city has approximately 1,400 residents.

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Concerning the water source in Buhler, no one was likely to ever notice the small amount of arsenic in the water other than being reminded of the level in the public notices that the city was required to send to customers. I don't believe anyone in Buhler is going to comment "WOW, this water sure tastes better now that we lowered our arsenic level from 30 ppb to less than 10!" Buhler's improved water quality will be notably improved because of the reduced manganese levels. The current drinking water standard or Maximum Contaminant Level (MCL) set by the U.S. Environmental Protection Agency (EPA) for arsenic is 0.010 mg/L or parts per million (ppm). This is equivalent to 10 ug/L (micrograms per liter) or 10 ppb. In 2001, the U.S. Environmental Protection Agency (EPA) reduced the regulatory MCL from 50 ppb to 10 ppb on the basis of bladder and lung cancer risks. The MCL is based on the average individual consuming two liters of water a day for a lifetime. Long-term exposure to drinking water containing arsenic at levels higher than 10 ppb increases the chances of getting cancer.

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In the case of Buhler's source water, the iron wasn't so bad, but the manganese was. Iron content in the city's water averaged .05 -.08 mg/l and the manganese averaged .2 to .3 mg/l. The suggested limit is .3 mg/l for iron and .05 mg/l for manganese. These minerals, if not managed properly, can cause public relation problems for a water system. Some of the more common complaints are taste and odor, stained fixtures and discolored laundry. Other problems can be biofilm buildup in the distribution system, plugged meters, and loss of well yield due to

This plaque gives appropriate credit to community leaders and others for their work on behalf of water system improvements.

plugged well formations, pump intakes and screens. Iron and manganese are naturally occurring minerals especially in the Equus beds, which is the aquifer that supplies the source water for Buhler. Arsenic is also a natural occurring mineral although not as common in Kansas; arsenic is believed to be carcinogenic.

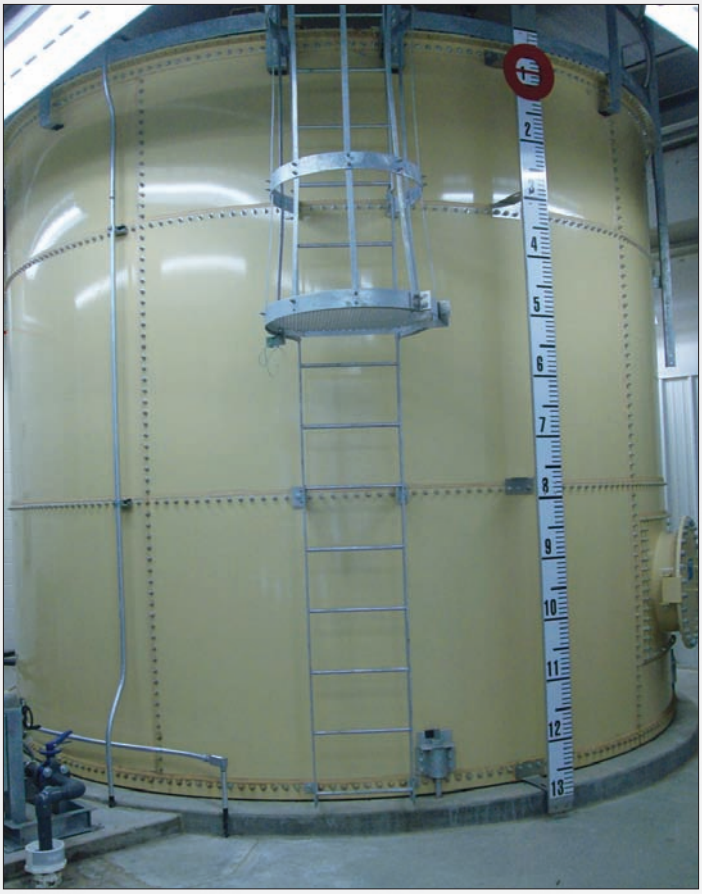
In 2007 the Buhler city council took action and formed a special committee, charged with researching the water quality problems and making recommendations on the aspects of the project including searching for new water sources, interviewing potential vendors, and project budget reviews. Members were Mayor Daniel Friesen, Council Member Phil Neufeldt, community member and former council member Bill Ebeling, former mayor Marlo Oltman, and David Zook, city superintendent.

The local area was examined for developing a new source. Irrigation wells were sampled and a number of test wells were drilled. These all turned out to be unacceptable due to water quality issues. The city instead opted to keep the existing wells and to construct a treatment system.

This photo shows the filter system by LayneOx; it removes iron and manganese and arsenic.

City makes decision on technology

The city eventually decided on the LayneOx treatment system. This system is a fairly new design by the Layne Christensen Company. Some of the older systems used manganese greensand and potassium permanganate and chlorine as an oxidant. Chlorine is the only oxidant used in the LayneOx system. The LayneOx system takes advantage of the fact that iron and manganese are oxidized in the presence of already oxidized manganese in the filter media in the form of manganese dioxide. The system works through oxidation and adsorption and uses a prepared and conditioned natural occurring mined manganese dioxide media.



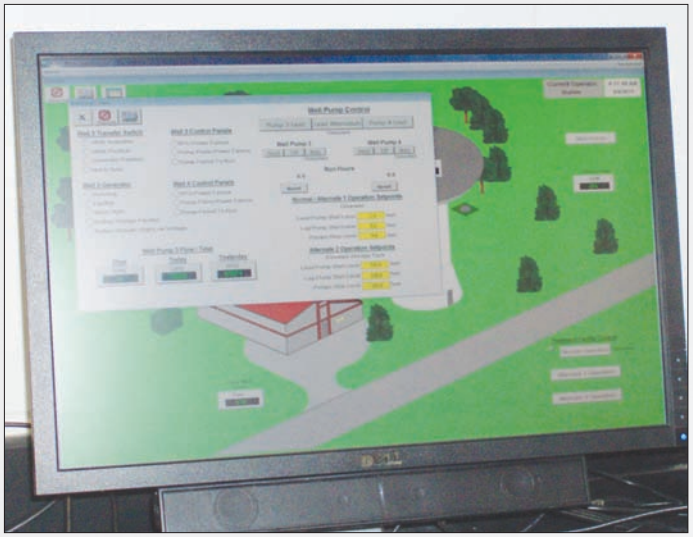
This photo shows the backwash tank in the Buhler water treatment plant.

The arsenic removal is accomplished through a slightly different process than the iron and manganese. Arsenic does not form a large particle that can be easily filtered like oxidized iron and manganese. However it has an attraction to the oxidized iron and to a lesser degree oxidized manganese. Through a process called adsorption, the arsenic particle attaches to the iron oxide particles. Since the iron oxide particles coagulate and become larger, the arsenic is removed along with the iron in the fine filter. Chlorine and ferric chloride are added just prior to the water entering the filters to assist in the oxidation and adsorption process.

The city's two wells were renovated by sonar jet cleaning, installation of new pumps and new electrical controls that included a back up generator, all as part of the improvement project. The heart of the system consists of three treatment vessels containing the filter/oxidant media rated at 300 gpm each, and a backwash system with a containment vessel that recycles more than ninety percent of the backwash water. The water is chlorinated; ferric chloride is then added at 3 mg/l to 4 mg/l and then forced through the filter/oxidant media inside the treatment vessel. After treatment the water is stored in a 200,000-gallon storage system. There are two 50-HP high service pumps rated at 750 gpm each that pump the finished water from the clearwell into the distribution system. Post chlorination is also integrated into the process but as of September 15, 2011, that has not been needed; the operator noted that the chlorine residuals are now much easier to maintain. This can be attributed to the manganese removal as it has the tendency to zap the chlorine residuals in a water distribution system.

The system has its share of what people would refer to as whistles and bells. It includes a high-tech SCADA system, alarms, online turbidity monitoring, online chlorine monitoring, online pH monitoring, filter sensors, automated valves and lots of wiring and plumbing to connect everything. It is easy to see all the advantages of having this treatment system versus an untreated source given the high iron and manganese and other water quality issues of Buhler's groundwater supply.

The building is top-quality, constructed of stone, block and pre-stressed concrete. The structure is very strong and should easily withstand a Kansas tornado. Natural light comes through glass blocks on the east wall. There is a large garage door on the northeast corner of the building; it is designed with a removable metal wall if needed for future equipment replacement should that be necessary. A fully automated backup



The SCADA system provides various alarms and online monitoring for turbidity, chlorine and pH.

generator system was installed at the wells and the treatment plant. The facility is of excellent design with a lot of attention to detail; the contractors all did a great job of constructing the plant and building. Only the finest components were used throughout the whole facility right down to the stainless steel and galvanized bolts and mounting brackets. The city superintendent did note one minor issue since the plant went into service and that was the clearwell vent. It was vented into the building and he did not want to take any chances with chlorine gas vapors from the stored water causing corrosion inside the plant.

The city made a modification themselves by drilling a hole through the wall for the 8-inch vent pipe and vented it to the outside. It turned out great and looks as though it was built that way from the beginning.

Bids were opened in November 2009 and the plant went online in June 2011. The total cost of the project was $1.9 million and was financed with a grant through EPA in the amount of $582,000 and a loan though the Kansas Public Water Supply Loan Fund administered by the Kansas Department of Health and Environment in the amount of $1,318,000. As might be expected, the water rates had to be increased to service the new debt. The old rates were $13.00 minimum with 3,000 gallons of water included and $1.10 per 1,000 gallons up to 25,000 gallons; then $1.25 per 1000, for the next 25,000 to 100,000 gallons and $1.40 per 1,000 for use in excess of 100,000 gallons. The new rates are $25 with 3,000 gallons included and $1.35 per thousand to 25,000 gallons; $1.50 from 25,000 to 100,000 and $1.65 for use in excess of 100,000 gallons monthly.

Design consultants for the project were Miller and Associates Consulting Engineers, PC, McCook, NE; the general contractor was Utility Contractors Inc. of Wichita, KS.

Jon Steele has been employed by KRWA as a Circuit Rider since 1995. Jon is certified as a water and wastewater operator. He has more than twenty-five years experience in public works, construction and industrial arts.