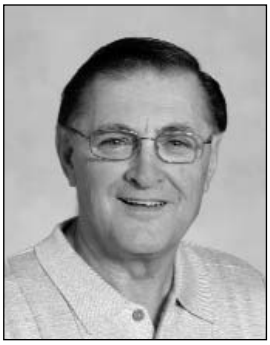
by Bert Zerr

Minneapolis constructs iron and manganese removal plant

Minneapolis, which advertises itself as a progressive and growing community, is located in Ottawa County in north-central Kansas about 20 miles north of the Interstate 70 (I-70) and Interstate 135 (I-135) intersection. As I-135 travels to the north, the highway designation changes to Highway 81 near Minneapolis. Highway 81 is actually a part of the Pan American Highway linking the United States to other countries to the north and south. To encourage travel along this route, a group of interested people formed the Pan American Highway Association, of which Minneapolis is a member. The Association works to promote tourism along Highway 81 from McPherson, Kansas to Watertown, South Dakota. It is the Association's position that Highway 81 is the best route between the two cities and since most miles are freeway highway, it is the quickest route.



Bert Zerr
Consultant

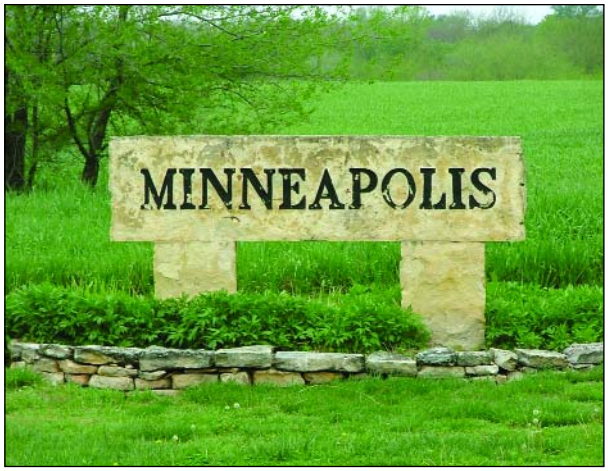
A geological wonder located near Minneapolis is an area known as Rock City. The rocks at Rock City are huge sandstone concretions. In an area about the size of two football fields, 200 rocks, some as large as houses, dot the landscape. There is no other place in the world where there are so many concretions of such giant size. Geologists are in general agreement that these concretions were formed millions of years ago of Dakota Sandstone, which was deposited when an inland sea covered areas in Kansas.

To illustrate the city's progressive approach, a program was established offering a free lot to anyone willing to build a house in Minneapolis. This program along with a school and city property tax rebate program has resulted in the addition of 25 new houses in two new subdivisions.

"There are very few lots remaining in the two original subdivisions and the city is considering opening a third subdivision," City Administrator/ Clerk Barry Hodges explained.

Due in part to the city's progressive nature and, more importantly, because of the many red water complaints the city has received over the years, the city made the decision to construct a treatment plant to remove the minerals (iron and manganese) that were causing the problem. After much discussion at city council meetings during which local residents participated, and after several trips out of town to visit other plants, the city chose Layne-Western for the project. After reviewing the results of a pilot study conducted by Layne-Western, the city decided to proceed with construction of a plant. Wilson and Company Engineers and Architects, Salina, Kansas was retained to design the project. BRB Contractors, Inc., Topeka, Kan., was the general contractor.

Due in part to the city's progressive nature and, more importantly, because of the many red water complaints the city has received over the years, the city made the decision to construct a treatment plant to remove the minerals (iron and manganese) that were causing the problem.



A limestone city marker welcomes visitors to the city of Minneapolis on Highway 81 in north central Kansas.

The levels of iron and manganese from the city's wells average about 1.34 mg/L iron and 0.90 mg/L manganese. However, from February to May 2007, iron levels as high as 2.06 mg/L and manganese levels as high as 2.00 mg/L were detected. These are very high levels and greatly exceed the secondary standards for iron (0.3 mg/L) and manganese (0.05 mg/L). Secondary standards are established only as guidelines to assist public water systems in managing their drinking water for aesthetic considerations such as taste, color, and odor. See sidebar for a list of the 15 contaminants identified by the Environmental Protection Agency as secondary contaminants.

The city has four wells as water sources; however, only three wells are available as of May 2007. One of the wells was taken out of service due to contamination of the groundwater in the area. A remediation project is currently ongoing. The other three wells, each having a pumping capacity of about 600 gpm, pump to a new Layne 1.5 MGD filtration plant to remove iron and manganese. The filtration plant utilizes three *Layne Ox* lined vessels, each containing proprietary media. Chlorine is injected into the line ahead of the vessels to oxidize the iron and manganese, thereby allowing the precipitated minerals to be filtered out. Filtered water flows into a 0.289 MG clearwell. Two high service pumps, each capable of pumping 1,150 gpm, then pump treated water into the distribution system. Pre-chlorination facilities, to oxidize the iron and manganese, and post-chlorination facilities add chlorine as needed.

Left: Plant Superintendent Ron Ketron is at the plant control panel checking the display for active alarms.

Center: The inline turbidity meter is used to monitor the turbidity level in the supernatant being returned to the plant.

Right: Minneapolis chose Layne-Western as the supplier of filter vessels. The unit pictured here has three vessels mounted on a skid.

Extra capacity designed in

Even though current flow rates are in the range of 0.250 to 0.300

MGD during colder months and 0.600 to 0.700 MGD during warmer months, the plant was designed with a maximum flow rate of 1.5 MGD with two filter vessels in use. A third filter vessel was provided for redundancy, allowing the plant to continue uninterrupted when one filter vessel is taken out of service during backwashing or maintenance. The filter backwash pump rate is 1,450 gpm and the backwash cycle currently runs for a period of five minutes every three days for each filter. Backwashing is presently controlled manually by monitoring the pressure differential at the filter. Eventually, the city plans to change to automatic control of the backwash cycle, either by timer or volume (gallons through the filter).

Left: The two nearest pumps are high service pumps delivering water to the distribution system. The third pump is used for backwashing filters. All are equipped with soft start.

Center: The transfer pumps here are used in the backwash recycling and washing process. One is used to transfer supernatant from the backwash holding tank to the filters. The other is used to pump wastewater containing high solids from the bottom of the tank to the city sewer system.

Right: The onsite generator shown here was sized to operate the plant for a 24 hour period without refueling. A second standby generator is located at the city's Well No. 13.

"The city is very satisfied with plant performance thus far," Plant Superintendent Ron Ketron noted.

EPA CHART

Secondary Maximum Contaminant Levels

Contaminant	Secondary MCL	Noticeable Effects above the Secondary MCL
Aluminum	0.05 to 0.2 mg/L*	colored water
Chloride	250 mg/L	salty taste
Color	15 color units	visible tint
Copper	1.0 mg/L	metallic taste; blue-green staining
Corrosivity	Non-corrosive	metallic taste; corroded pipes/ fixtures staining
Fluoride	2.0 mg/L	tooth discoloration
Foaming agents	0.5 mg/L	frothy, cloudy; bitter taste; odor
Iron	0.3 mg/L	rusty color; sediment; metallic taste; reddish or orange staining
Manganese	0.05 mg/L	black to brown color; black staining; bitter metallic taste
Odor	3 TON (threshold odor number)	"rotten-egg", musty or chemical smell
pH	6.5 - 8.5	*low pH:* bitter metallic taste; corrosion *high pH:* slippery feel; soda taste; deposits
Silver	0.1 mg/L	skin discoloration; graying of the white part of the eye
Sulfate	250 mg/L	salty taste
Total Dissolved Solids (TDS)	500 mg/L	hardness; deposits; colored water; staining; salty taste
Zinc	5 mg/L	metallic taste

* *mg/L is milligrams of substance per liter of water*

"Test results since the plant began operation in late February confirm that average iron and manganese concentrations in the treated water were in compliance with secondary standards at 0.053 mg/L and 0.018 mg/L respectively. Maximum concentrations in the treated water during this time period were 0.130 mg/L for iron and 0.050 mg/L for manganese."

This tank is being used as the filter backwash holding tank.

The project, which includes the treatment plant and piping from the wells to the plant, was constructed at a cost of about $2.77 million. A loan of $2.5 million was obtained through the Kansas Public Water Supply Loan Fund, as administered by the Kansas Department of Health and Environment. Minimum residential water rates basically doubled as a result of the project. Monthly minimum rates went from $14.50 to $28.51 for 2,000 gallons. Water usage over 2,000 gallons increased from $2.40 to $3.09 per 1,000 gallons. Both Deputy City Clerk Fran Frain and Barry Hodges noted that there have been a few complaints (about a dozen) because of the rate increase. There have been more positive comments about the improved water quality.

If a system has an iron and manganese problem, the project at Minneapolis is one example of how a water system addressed the concern of discolored and staining water.

KRWA staff members are available to visit with a city council or rural water district board to discuss improvements that may be considered to improve the water quality in a system. Give KRWA a call at 785/336-3760 for answers to water quality questions or e-mail me at bert@krwa.net. I'll be pleased to meet with you or your board/council to help sort out the options that may be available to your system.