By Delbert Zerr, KRWA Consultant

Clay Center Public Utilities Commission Makes Major Improvements to Water Supply System

Clay Center Public Utilities Commission has a new water treatment plant, located in the building shown above. Note the three horizontal tanks on the side of the building. These are the greensand filter tanks. Walters-Morgan, Inc., Manhattan, KS, was the primary contractor on the project.

Clay Center, with a population of about 4,600 people, is located near the center of Clay County, in the north central part of the state at the junction of U.S. Highway 24 and K-15. Clay County lies on the edge of the Junction City-Manhattan-Fort Riley corridor, which is currently one of the fastest-growing regions in the state. As a result of its location, Clay Center has strong ties with Fort Riley, the 4th Brigade, 1st Infantry Division.

Clay Center city government is rather unique in Kansas in that water and electricity are provided to customers by the Public Utilities Commission (PUC) while wastewater service and street maintenance are the responsibility of the city council. The PUC is governed by a three-member board of commissioners whose members are approved by the city council. PUC commissioners serve three-year terms. Clay Center's PUC is one of the oldest municipally-owned utility systems in the country; it paved the way for other municipalities to own and operate utilities. Only three other Kansas cities operate municipal utilities governed by a public utilities commission. They are Kansas City, McPherson, and Gardner.

Clay Center's water supply, which began serving water to customers in 1890, currently derives its source from wells in the Republican River valley. This source has always been very adequate, especially in terms of quantity. With the exception of high hardness and manganese levels, the water quality was satisfactory for many years. In recent times however, one of the city wells was taken out of service due to Volatile Organic Chemical (VOC) contamination, and the water in another well has increased in nitrate concentration. The nitrate issue, along with the requirements of the Ground Water Rule (GWR), caused the city to take a look at their long-term water supply needs. With chlorine being injected at the wells located at various points around town and the first customers being located immediately adjacent to the wells, the PUC was faced with making changes to comply with the GWR. After much thought and discussion, the commission decided to pipe the well water to a common point to comply with the GWR requirements. Further discussion then questioned if the utility was going through the trouble and cost of piping all water to a common point, why not construct a water treatment plant that would allow for compliance with current and future federal and state mandates?

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Determining type of treatment

While considering various treatment technologies and basically deciding on reverse osmosis (RO), the PUC decided to conduct a pilot study at a cost of $200,000. As a result of this study, the PUC learned that in addition to one well having high nitrate, water from two other wells contained excessive uranium. During the pilot study, five different membranes were tested with final results identifying one membrane that doubled production. Also, during the pilot study of the several descaling

Workers install a seal in the piping for one of the two aeration towers in August 2010.

agents tested, one allowed for less product usage (about one-half the amount) at about one-half the cost of the others.

The first part of this project consisted of piping the well water to a common point. A site located on the west side of town was selected as the treatment site. Nowak Construction, Goddard, Kansas, was awarded the contract to install about 14,000 feet of 8-, 12-, and 16-inch pipeline to bring water from the wells to the plant site. The PUC's wells pump water to the new water treatment plant that utilizes RO as the primary treatment process. The PUC has five producing wells, however, only three are being used at the present time because of pump rate variations. Untreated water from the wells enters three greensand filters as the first treatment process.

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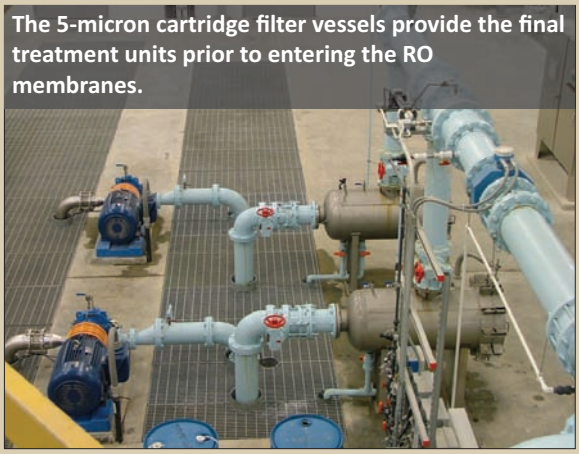
These are horizontal units that were installed to remove chemically oxidized manganese. Sodium permanganate is used to oxidize the manganese as well as to regenerate the greensand. A

An "end view" of the three-greensand filters, the first treatment unit. Most of the tank extends outside the plant building.

This photo shows the 0.500 MG wire-wound pre-stressed concrete storage tank that stores finished water. Water from this tank is pumped to the distribution system as needed. Natgun Corporation with corporate offices in Wakefield, MA, provided this tank.

The 5-micron cartridge filter vessels provide the final treatment units prior to entering the RO membranes.



Costs Impact Rates

The plant was designed to produce 3.0 million gallons per day (MGD). As of September 1, 2010, however, the plant is producing about 1.0 MGD. Provisions were made to allow for expansion, as there is space for an additional two RO skids and one additional greensand filter.

The cost of the entire project was approximately $10 million. The PUC utilized funds from the Kansas Public Water Supply Revolving Loan Fund which is administered by KDHE. This project caused the PUC to increase the water rates to customers.

New rates are as follows: Residential: $30 minimum per month for the first 100 cubic feet (748 gallons) and $1.33 for each additional 100 cubic feet.

Business and Institutional: $35 minimum per month for the first 100 cubic feet and $1.58 for each additional 100 cubic feet.

The monthly charge to residential customers prior to the project was $8 minimum for the first 100 cubic feet and $1.00 per each additional 100 cubic feet.

The new rates obviously represent a significant increase in rates; however, Dean Michaud, Plant Superintendent, states that he has received many positive comments from customers especially since many homeowners are saving money by abandoning their home softeners.

Dean Michaud, Water Plant Superintendent, reviews the screen on the SCADA display near the RO membranes.

continuous regeneration (CR) process is used at these filters. The next treatment unit consists of two five-micron cartridge filters that provide further protection of the RO membranes from large particulates that might get through the greensand filters. To further protect the RO membranes, sodium bisulfate is added to neutralize any permanganate remaining in the water.

Prefiltered water then flows to two RO skids, each skid containing eighteen, twenty-foot long vessels. Each vessel contains six membranes, forty inches in length. The membranes represent the main treatment process at this plant and are for the purpose of not only maintaining Clay Center water in compliance with nitrate and uranium limits but also to soften the water because the well water is high in total hardness. Two booster pumps are used to increase pressure to force water through the membranes. These pumps are designed to supply 144 psi. Currently only about 112 psi is needed to accomplish the job.

The plant layout can be visualized from the mezzanine area. The two tanks in the foreground are used in the clean-in-place process for cleaning the membranes. Also shown are the membranes on the left, and greensand filters in the background.

This photo shows the crane mounted on rails. The steel crane can be moved and positioned as needed to allow for removal of heavy equipment for maintenance.

The three pumps on the left are the transfer pumps moving water from the blend tank to the concrete storage tank. The five pumps on the right deliver water to the distribution system.

Bill Callaway, Superintendent, Clay Center Public Utilities, stands in front of a section of membrane filters in the new PUC plant.

After flowing through an aeration tower to raise the pH, the water flows into a 57,000-gallon clearwell/blend tank. Here, the treated water and some raw well water are blended before being pumped to the 0.500 million-gallon, wire-wound pre-stressed concrete storage tank. The pH leaving the RO skids is about 5.0. The aeration tower along with chemical treatment using caustic soda increases the pH in the finished water to 7.8. At the current time, about thirteen to sixteen percent of the raw water is bypassing the membranes and blending with RO treated water in the blend tank. Three pumps are utilized to transfer finished water to the concrete storage tank and five high service pumps deliver water to the distribution system as needed. Concentrated plant wastewater is pumped to the Republican River in compliance with a Kansas Department of Health and Environment (KDHE) discharge permit.

As membrane technology improves and as more systems look at membrane treatment systems as an answer to their water quality issues, it is important that systems make good choices. Bill Callaway, Superintendent of Utilities, advises not to make such choices based on computer modeling but to instead, conduct a pilot study. Bill encourages that systems should travel around to look at other systems using RO treatment. Systems should investigate other systems to take advantage of their good points and avoid their mistakes. Also, he stated that public water systems should hire an engineering firm that can show extensive experience in RO treatment.

Bert Zerr is currently a consultant with KRWA. He has been with KRWA for the last four years. Bert was a District Engineer with the KDHE in the Salina District Office for thirty-two years.