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P.O. Box 226 • Seneca, KS 66538 • 785/336-3760
FAX 785/336-2751 • http://www.krwa.net

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Nathanial Dunbar, II
US EPA
Drinking Water Management Branch (DRWM)
901 N. 5th Street
Kansas City, Kansas 66101

Mr. Jim White
Indian Health Service
701 Market Place Dr.
Oklahoma City, Oklahoma 73114
Tulsa, Oklahoma

Dear Nathan and Jim;

Here is information in follow up to the 30-day study made on the Kickapoo Tribal Water Treatment Plant by the Kansas Rural Water Association. Subsequent to that work effort, we have made numerous stops to the Tribal System to check on water quality.

During the 30-day study, we made many logs and spreadsheets to help the operators better determine the quality of water. These also assisted the operators to catch any problems, before those issues disrupt water quality delivered to customers.

On our frequent follow up visits to the plant, it was necessary to clean the analyzers to ensure accurate readings. The chlorine residuals were low on many of our visits. These problems were generally occurring because of pumps loosing prime and having clogged injectors. With proper monitoring and record keeping, these problems should have been addressed prior to low chlorinated water entering the clearwell. This will be a more important issue when the system begins to feed ammonium sulfate.

It is KRWA's opinion that the operators need to improve in their monitoring in the plant and the distribution system. Adequate storage provides the ability to shut the treatment plant down if needed. In any emergency, the system has approximately 72 hours of water available without the plant being in operation.

The operators are doing better at conducting their daily tests. We have viewed the data taken and most of the monitoring is being properly performed. The main problem is the plant runs on auto and comes on during nighttime hours. The plant is operating without operators present to monitor water quality. We highly suggest the plant only be online when operators are present to address any problems that may occur.

Some of the main problems we had during the 30-day study concerns the filters. One of the filters was taking more flow and more of the chlorine residual. Also, a filter valve that had broken on the south filter had to be removed and re-welded. KRWA staff set a laser transit on the filters to adjust the float to obtain a proper distribution of flow through each filter. The chlorine line was also re-tapped to gain more consistent residuals to each filter.

The current pumps that the Tribe is using have frequent problems of losing prime. The pumps and tubing were replaced to alleviate the problem. The chlorine injectors also needed to be cleaned to dose a uniform amount of chlorine.

On many occasions, we adjusted the analyzers to operate correctly. It was necessary to replace the bulb in the filter analyzer. We were not getting very good mixing in the rapid mix so the injectors were lowered approximately two feet to achieve better mixing in the rapid mix. This explains why the chlorine residuals were so erratic. During the time KRWA staff operated the plant, there was a chlorine leak one weekend; a considerable amount of chlorine was lost. It was necessary to wash the plant down to remove the odor of chlorine gas in the plant.

To address the TOC problem we removed sludge from the solids contact basin and increased the polymer dosage. After taking TOC samples it appears that the plant had met the required reduction.

On March 4, the contact basin turned over, causing high turbidity in the solids contact basin. We shut the plant off for several hours and increased the polymer to treat for the high turbidity. After several hours, the turbidity decreased; we then returned the plant online.

One of the biggest factors to improve water quality was to decrease the flow rate through the plant from 200 gallons per minute to 160 gallons per minute. Reducing the flow rate provided additional settling time in the clarifier and also reduced the hydraulic loading on the filters by removing additional turbidity. There was a marked reduction in turbidity at the bottom of the filters. This demonstrates that the longer plant running time greatly improves the water treatment process and may provide reduced TOC's. One of the major goals is to try to have the plant produce a finished water of 1 NTU turbidity coming off the solids contact basin going to the filters. Typically the finished water turbidity was less than .1 NTU.

The distribution system has excess capacity with one large standpipe and one small standpipe and many miles of pipeline. We overflowed each standpipe and took chlorine samples to check the chlorine residuals to determine if the residual was consistent throughout the distribution system. KRWA suggested that operators adjust the level of storage more frequently and that the operators also flush the distribution system lines.

During the 30-day study, KRWA conducted many tests for chlorine residuals. All of the tests indicated adequate residual.

A brief summary for Operation and Maintenance is enclosed.

Please advise if there are any questions or additional follow-up is needed.

Respectfully,

Lonnie Boller
Kansas Rural Water Association

Enclosure
C: Tony Kimmi, KRWA
Elmer Ronnebaum, KRWA

Kickapoo Water Treatment Plant
Operations & Maintenance Guide
April 2010

1. Raw Water Pump Station

Purpose: The raw water intake pump station is located on the Delaware River near the low-water dam. The raw water pumps can pump raw water to either the pre-sedimentation pond or directly to the plant. Each pump has a capacity of 235 gallons per minute (gpm). Each pump is operated on an alternate basis.

Operation:

- The raw water pumps should only be operated when the raw water turbidity in the Delaware River is low. If possible, the pumps should not be operated when the river level is high due to heavy rains or snowmelt. High flow rates in the river will carry high-turbidity runoff. Operating the high service pumps when river flow is normal will result in better quality water with much lower turbidity entering the pre-sedimentation pond.
- Raw water should always be pumped to the sedimentation pond prior to entering the treatment plant. Pumping raw water directly to the plant should on be done on an emergency basis, or should the pre-sedimentation basin need to be out of service for maintenance.

Maintenance:

- Both high service pumps should be checked daily to ensure against clogging.
- Pumps should be oiled and lubricated as recommended by the manufacturer. The oil reservoir should be checked daily and refilled as needed. Failure to maintain adequate level of oil in the reservoir may result in damage to the pumps.

2. Pre-sedimentation Pond

Purpose: The pre-sedimentation pond provides settling of heavier solids prior to raw water entering the treatment plant. This should result in lower-turbidity water entering the plant, thereby making treatment more effective. Treating lower-turbidity water should also result in a cost savings by requiring less chemical addition. The pond also provides excess capacity of raw water so that raw river water does not have to be used during periods of high flow when raw water turbidity could be very high. The pond holds approximately 3.0 million gallons of water.

Operation:

- The pre-sedimentation pond should only be filled when raw water turbidity is low.
- Operating staff should collect grab samples of river water to determine turbidity levels prior to pumping water to the pre-sedimentation pond.
- The pond should be filled to capacity if raw water turbidities are low. Doing so will allow for increased settling prior to treatment.

Maintenance:

- The depth of sediment in the pond should be monitored yearly to determine if it is filling and sediment removal is needed. Also, weed control should be established to prevent the dikes from being overgrown with vegetation.

3. Rapid Mix Basin (flash mix)

Purpose: The rapid mix basin is located after the pre-sedimentation pond and before the slow mix/flocculation basin. The rapid mix provides complete and thorough mixing of chemicals with the raw water. This mixing action helps promote coagulation, which is the clumping together of very fine particles into larger particles. Chemicals called coagulants help neutralize the electrical charges of the fine particles so "clumping" occurs. This allows the fine particles to form larger particles (floc) that settle and filter better later in the treatment process.

Two chemicals are added at the rapid mix: sodium hypochlorite (free chlorine) and a polymer. Sodium hypochlorite is added to begin the disinfection process to control pathogens. The polymer is added to promote coagulation. Mixing is accomplished using a mechanical mixer mounted on brackets situated above the rectangular, concrete rapid mix basin. KRWA staff recently extended the end of all chemical feeder lines closer to the blade of the mechanical mixer in order to achieve better mixing and prevent short-circuiting.

Maintenance:

- Operating staff should refer to the operations and maintenance manual for the mixer for any problems that may occur. The blades (paddles) of the mixer should be checked monthly. The bearings and drive shaft should be cleaned and lubricated in accordance to manufacuturer's specifications.
- The rapid mix should be checked monthly to confirm that chemicals and floc particles are not adhering to the interior walls of the basin. If materials are found on the walls, the walls should be washed down and/or scrapped to remove the collected material.
- The ends of all chemical feed lines should be checked weekly to ensure they are submerged below the water surface and discharge near the blade of the mixer.

5. Slow Mix/Flocculator

Purpose: The purpose of the slow mix is to allow larger particles to combine and form even larger particles that will settle better in the clarifier. Contact between larger particles results from gentle stirring action. Large particles (floc) are best formed when gentle mixing action is used. Dimensions of the slow mix are 10 feet x 12 feet with an average depth of 12 feet.

Needed Improvements:

- The slow mix should be provided with a better mixing system. It is suggested that the mechanical mixer be equipped with larger paddles instead of the existing single blade at the end of the mixer shaft. The mixer should have larger, multiple paddles along the length of the shaft. This will result in better floc formation and better settling in the clarifier.

Maintenance:

- The slow mix pump should be checked periodically to determine if it is operating correctly. Pumps should be oiled and lubed as recommended by the manufacturer. The oil reservoir should be checked daily and refilled as needed. Failure to maintain adequate levels of oil and failure to lubricate can result in damage to the pump.

6. Clarifier

Purpose: The circular clarifier was manufactured by General Filter Company. This basin is designed to remove particles (floc) that are heavier than water and help reduce loading on the rapid sand filters. The velocity of the water is decreased in the clarifier to promote better settling. This allows gravity to remove (settle) floc particles effectively. Also the clarifier should be sludge judged daily to determine the amount of solids in the basin. If the solids are over a foot high, the operator should manually blow off the sludge periodically to keep a lower level. A large buildup of sludge in the basin will reduce the detention time.

7. Rapid Sand Filters

The filters should be operated at the lowest flow rate to achieve the best filtration, acquire more detention time, and decrease the turbidity levels in the finished water. This manner of operation will also increase the possibility of removing more Total Organic Carbon (TOCs). Currently the filters have online analyzers. These should be monitored every two (2) hours, while the plant is in operation. EPA's requirement for turbidity for finished water is .3 NTU or less. The Kickapoo Tribal Water Treatment Plant has the capacity to produce finished water with less than .1 NTU, as shown in the 30-day study conducted by Kansas Rural Water Association in 2010.

Close monitoring head loss gauges and turbidimters will determine the backwash schedules. The flow rate for backwashing should be between 15 to 17 gpm per square foot. The backwash rate is difficult to determine however, because of a leaking backwash valve. It is recommended to not backwash both filters at the same time. This method of operation will provide adequate time for each filter to recover and settle out. This will also help reduce higher turbidity as the filter settles.

Typically, the highest turbidity water going to the clearwell is experienced immediately following backwashing. It is recommended after backwashing to allow that filter rest for a short time to regain compaction. Doing so will allow the filter to produce lower turbidities in a more immediate timeframe. The media should be raked periodically during backwash. This will help reduce the formation of mud balls in the filters.

8. Clearwells

The circular clearwell provides for a long contact time of the free chlorine. This is a likely contributor to the plant being out of compliance with the Disinfection Byproducts Rule.

The below ground clearwell structure should be cleaned and inspected bi-annually. Clearwell levels could be controlled (lowered) to make the plant operator longer during plant cycles.

9. High Surface Pumps

The high surface pumps are currently set up to alternate. The high surface pumps should be maintained on a regular basis. This should include lubrication to ensure proper operations and integrity of the equipment for long service life. Manufacturers' recommendations should be adhered to.

The packing gland should be inspected on a routine basis and tightened if needed. The packing gland should have leakage of approximately one drip per second to allow cooling and lubricating of the packing gland. Operators should avoid over-tightening of packing glands so to not have an adverse impact on pump shafts.

10. Chemical Feed Systems

Currently the plant has two (2) chemical feed systems. One is the sodium hypochlorite feeder and the other feeds polymer. Each unit is set up with dual feed pumps. These pumps should be inspected daily to ensure prime has not been lost and that an accurate feed rate is being accomplished. The injectors should be cleaning on a monthly basis to ensure against buildup or plugging at the end of the injector. Cleaning can be accomplished by using a muriatic acid solution.

11. Distribution System and Storage Facilities

The standpipe should be inspected bi-annually to determine if maintenance is required. The tank should be drained an inspected visually, then washed to remove any sediment. Extra precautions need to be taken when entering the storage tank. To ensure water quality, appropriate disinfection should be accomplished before putting the storage tank back in service.

It is a recommended practice to also periodically overflow the storage tank to remove possible debris from the surface and to also help ensure adequate chlorine residuals.

Distribution pipelines should be flushed and periodically to ensure good water quality and integrity of the pipeline and valving. Flushing of distribution systems is extremely important during hot summer months, as it is more difficult to maintain chlorine residual in warmer water temperatures.

12. Monitoring Equipment

Currently the system has four turbidimeters. These meters should be cleaned on a weekly basis. The bulbs and filter lenses should be cleaned by wiping with a Kim wipe to prevent scratching of the glass.

The chlorine analyzer should be cleaned monthly at the time when reagent bottles are changed. This process could be accomplished by using the cleaning solution provided with the analyzer. Cotton swabs should be used to clean the photocell and analyzer. The analyzer tubing should be replaced quarterly to ensure proper operations.