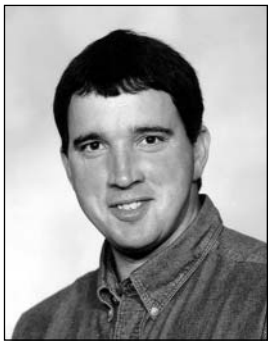
by Lonnie Boller

Turbidity removal and compliance: a challenge for plants in Kansas

Turbidity removal is presenting a greater challenge in water treatment plant operations since the Long Term Enhanced Surface Water Treatment Rule, LT1, went into effect in January 2004. This Rule requires that the combined filter effluent (CFE) turbidity be below 0.3 nephelometric turbidity units (NTU) in at least 95 percent of the measurements taken each month and that the maximum CFE cannot exceed 1.0 NTU.

Turbidity monitoring requirements

The combined filter effluent has to be measured at least every four hours to ensure compliance with CFE turbidity requirements. Since the CFE may meet regulatory requirements even though one filter is producing high turbidity water, the individual filter effluent (IFE) is also required to be monitored and assists treatment plant operators in individual filter performance. Systems with two or fewer filters may conduct continuous turbidity monitoring of combined filter effluent water only and are not required to monitor IFE turbidity.



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For example, if a plant has three filters and two of the filters have turbidity of 0.05 NTU and the third filter has 0.40 NTU, then the combined filter effluent turbidity would be approximately 0.17. Thus, the high turbidity from the third filter that was producing high turbidity water would not be known if it were not for individual filter monitoring. This is the reason that EPA requires individual filter monitoring.

Monitoring and optimizing treatment plant processes prior to filtration takes on greater importance when trying to meet these low turbidity requirements. These processes include coagulation, flocculation, and sedimentation.

Setting dosage rate is critical

Jar testing is an excellent guide on what level of chemical dosages should be set at the plant. Coagulants may be delivered either in dry form or as liquid; and may be in dry bulk, bags, "totes" or drums. Dry chemicals require fairly elaborate dissolving and feeding equipment. Liquid feed systems are somewhat simpler but the chemicals are often more costly.

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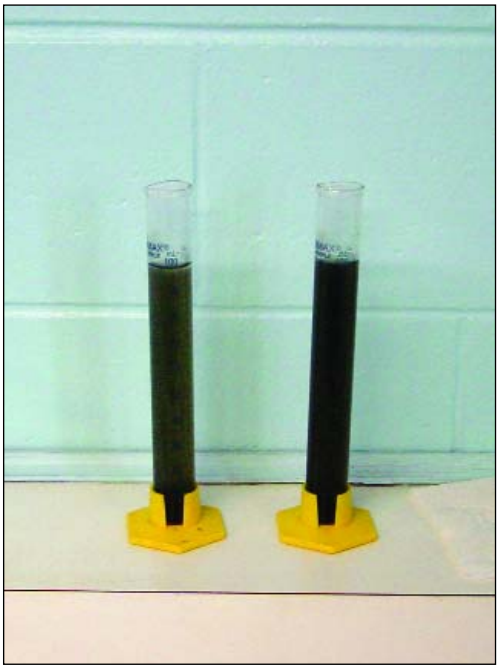
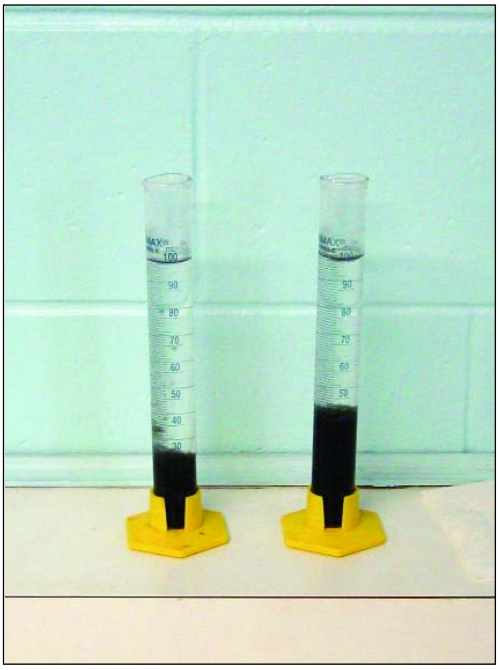
It is very important that the rapid mix be functioning properly. Typically, water mixes 30 seconds to a minute in a rapid mix. This is enough time to give the coagulant a thorough mix with the water. Coagulant effectiveness is dependent on the complex interaction of water characteristics which include pH and turbidity. A chemical salesman will usually assist in jar testing to determine what coagulant dosage will give the best turbidity removal. Solids that are coagulated are still too finely divided for effective removal. The flocculation and sedimentation processes result in the formation and removal of large settleable and filterable solids known as "floc" by creating a suitable environment for agglomeration of the small solids into larger floc particles. The floc particles that are not removed by sedimentation are removed by filtration.

Upflow solids contact basins combine the mixing, coagulation, flocculation and settling functions into one compact basin. By flowing the coagulated/flocculated water through the settled solids layer, enhanced solids removal is obtained in smaller basins. The process works by matching the settling velocity of the floc to the upward velocity of the water, causing the formation of sludge "blanket" which enhances solids capture. As might be expected, operation of solids contact clarifiers requires good operator control of flow and coagulation.

Some operators perform settleability tests for five minutes and/or 30 minutes on the concentrated solids in the mixer/reaction cone of the solids contact basin with a 100-ml





These are pictures of graduated 100ml cylinders that the Sabetha city plant operator uses to do settleability samples from the center cone of the solids contact basins. The photo at left was taken immediately after the samples had been drawn. The operator lets the samples settle for 30 minutes and then determines the solids level for each basin. The photo on the right shows solids levels of 25% and 40%.

graduated cylinder to monitor, control, and optimize the process of floc removal. For example, the city of Sabetha conducts such a daily test on each of the two solids contact basins to optimize turbidity removal.

An operator should have good documentation and process controls. It is important to take and record turbidity readings throughout the process instead of waiting to figure out the water will not meet the requirements at the filter effluent. Most filters in Kansas will sufficiently remove filter influent turbidities at 10 NTU's and lower to meet the effluent turbidity requirements. It is important for water treatment plant operators to optimize the coagulation, flocculation, and sedimentation processes in order to obtain low, filter influent turbidities.

More than likely, the lower the water turbidity of the filters influent, the lower the finish water turbidity will be. Normally the highest filter effluent turbidity water is after the backwashing procedure. It is important that the backwash rate is sufficient to clean the filter bed. In most plants in Kansas the backwash rate would be 15 to 20 gpm per square foot. Directly after backwashing and before putting the filter into service, the operator should either run the filter to waste for 20 to 30 minutes or until the turbidity drops below 0.3 NTU. Some plants do not have the filter-to-waste option. Those plants should let the filter "ripen" which means let the filter set for a period of time with water on top of it before putting the filter back into operation. This "ripening" process

may take hours depending on each individual filter.

KRWA receives many phone calls to assist water systems with filter turbidity problems. We often find that the chemical dosages are set either too high or too low. That's why it is important to calibrate the pumps and feeders, which may become worn over time and pump less or may lose prime. Some larger plants in Kansas have installed online turbidity meters on the effluent of the clarifiers prior to the water entering the filters as a guide to determine coagulant dosage.

Several years ago the city of Valley Falls requested help from KRWA because the city was having problems with turbidity. When I arrived, a chemical salesman was already onsite. We changed the chemical dosage. We also took many turbidity tests to determine that the analyzing equipment was working properly, and to determine the turbidity at various stages of the treatment process. At the time, the turbidity going onto the filter was 1.2 NTU. The filters should have been able to produce good finished water. Next we had to determine if the filters were working properly so we conducted a filter profile. We found several places where the underdrain support caps had been blown out causing the unusual spikes in water turbidity. The following week the city installed a new filter underdrain and new filter media along with a surface wash system. With these changes, the problem of high turbidity was corrected.

Kansas Rural Water Association was pleased to provide assistance to Valley Falls. We are pleased to assist operators with water treatment or other operational issues. Call us at 785/336-3760.

Consider attending the KRWA March conference. Several sessions I would like to draw attention to are included in the sidebar on this page. I hope to see you there.

Watch for water quality sessions at the upcoming KRWA Annual Conference, March 28 - 30

As you can see from the conference program printed in this issue, the KRWA conference has a variety of sessions; with breakouts in any time frame that fit most everyone's schedule. Plus, the EXPO hall is filled to capacity with agency booths and vendors who provide a multitude of products and services.

Tuesday, March 28

- *Water Distribution Workshop includes topic on distribution system pipeline materials, correct application and installation of master meters, storage tanks and rechlorination to maintain chlorine residuals.*

Wednesday: March 29

- *Long Range Planning for a Water Utility*
- *Contracts: Assurance in Water Tank Inspection and Maintenance*
- *KDHE Drinking Water Program Update*
- *Chlorine, it's a Gas! But Let's Practice Safety First*
- *Stage 2 Rule Requirements: Compliance Schedule*
- *Groundwater Protection Using Groundwater Guardian*

Thursday, March 30

- *Controlling and Reducing Disinfection Byproducts in Water*
- *Well Maintenance that Delivers Extra years of Service*
- *Certified Water Operator Forum*