Rural Water Training & Tech Assistance Program

Small Wastewater System Case Study

★ City of Alma

Surface of the plant's final clarifier. Excessive scum and floating solids have accumulated due to too many solids in mixed liquor of aeration basin.

City of Alma

Wastewater System Operations
Maintenance and Treatment

Background

On October 19, 2016, Kansas Rural Water Association (KRWA) Consultant Jeff Lamfers traveled to the city of Alma to provide technical assistance concerning several problems with the operation of the city's wastewater treatment plant (WWTP). The city of Alma is located in Wabaunsee County, which is in northeastern Kansas. Alma's wastewater treatment facility consists of an activated sludge removal plant followed by a four-cell lagoon which discharges into Mill Creek. According to the 2010 Census, Alma had a population of 832 people, 342 households, and 212 families residing in the city.

Technical Assistance

On the day of the on-site visit, Lamfers met with Alma WWTP operators Jeff Clark and Trent Viergever. Lamfers observed several problems with the plant's operation. First, the aeration basin was covered with a significant amount of heavy, dark foam. Mixed liquor in the aeration basin was nearly black in color and appeared to be extremely thick. There were excess solids on the surface of the clarifier. Clark mentioned the clarifier had a sludge blanket depth of 1.0 to 1.5 feet. Fortunately, the plant discharges to a four-cell lagoon and permit limits only apply to the lagoon effluent. Regardless, there were several changes that could be made to improve operation of the activated sludge plant so the lagoon is not adversely affected.

This example of technical assistance was provided by the Kansas Rural Water Association under a contract administered by the National Rural Water Association; funding was provided by the U. S. Environmental Protection Agency.

First, Lamfers suggested that Clark and Viergever increase the sludge wasting rate. They ran a 30-minute settleability test and found way too much, dark brown (almost black) sludge. Fortunately the supernatant was very clear. They also observed some scum and solids on the surface, possibly due to grease. They increased the sludge wasting rate from 1,350 gallons/day (225 gallons every four (4) hours) to 1,600 gallons/day (200 gallons every three (3) hours). This represents an 18 percent increase.

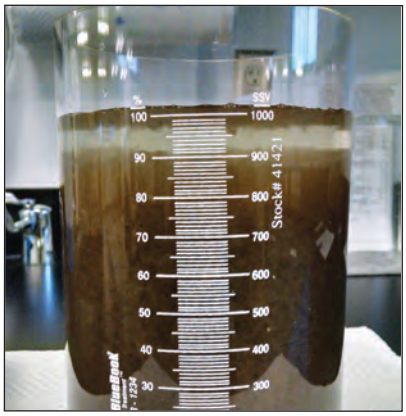
Next, Lamfers instructed Clark and Viergever to monitor the sludge level closely by running settleability tests at least two or three times per week to determine if the sludge level was lowering in the aeration basin. Lamfers was particularly interested in how quickly the sludge would settle in the first ten minutes. Lamfers also recommend that Clark and Viergever run diluted sludge samples to confirm if there was too much old sludge. Lamfers instructed them to set up three beakers: one with 100 percent mixed liquor; one with 50 percent mixed liquor and 50 percent effluent; and, another with 25 percent mixed liquor and 75 percent effluent. Lamfers stated that if the two diluted samples settle much faster than the 100 percent mixed liquor sample (especially the first ten minutes), then there is too much old sludge. The sludge was likely of high quality, just too much of it and too old a sludge age. So that would confirm an increase in wasting would be warranted. If all three samples would settle at about the same rate, then this would indicate that the sludge that was too young. Lamfers requested that Clark and Viergever follow up with test results in a few weeks.

Example of well-settling sludge with proper sludge age while running 30-minute settleability test. Note color and consistency of solids and clear supernatant. Such test results should ensure a high-quality plant effluent.

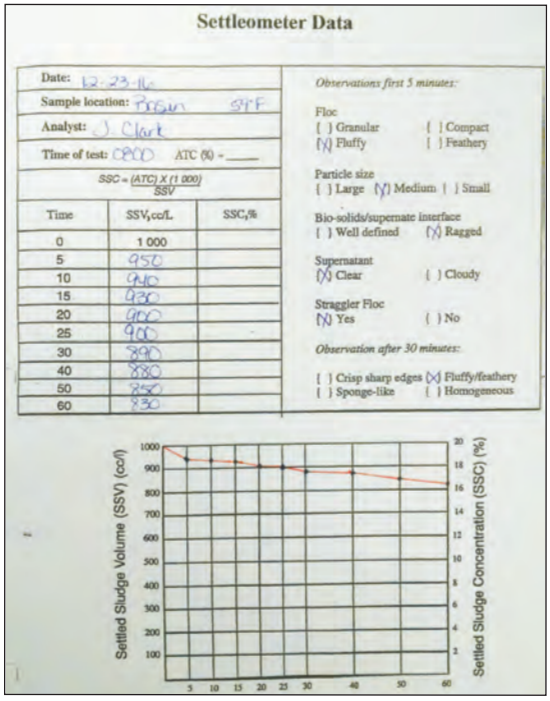
Finally, Lamfers contacted the engineering firm that designed the Alma WWTP, Evans-Bierly-Hutchison and Associates (EBH), about helping with lowering DO levels in the aeration basin. When DO levels exceed 6.0 ppm, the operation is wasting energy (and money) and likely adversely affecting denitrification (nutrient removal). The effects on nutrient removal may be minor since the plant has a separate anoxic basin prior to the aeration basin. But regardless, it is a waste of energy and money. Lamfers requested that EBH contact Clark about the high DO levels and how to control them.

Follow-up and Anticipated Results

On December 23, 2016, Clark contacted Lamfers with test results and photographs that indicated that plant performance had improved. The foam was looking much better on the basin, the liquor was much lighter than the black color that it was previously, and the scum/foam on the clarifier was almost gone. Settling was still slow (see photo) at around 900 at the 30-minute mark, and appeared light and fluffy (see photo). The sludge level was well defined in the clarifier (16 inches) and the bug counts and activity were increased. Clark had not made any significant changes in the plant settings since he last spoke with Lamfers. Lamfers had previously recommended that Clark collect effluent samples from the activated sludge plant to see how their treatment process was working. Clark provided the analytical results to Lamfers and Lamfers stated that based on the results, the activated sludge plant is doing a very good job of removing nutrients (nitrogen and phosphorus) and would easily meet the state required permit limits and should help prevent algal blooms in the lagoon.



Example of young sludge that settles poorly. It is typically lighter in color and fluffy. Sludge age can be increased by gradually lowering rate of sludge wasting.



Settleometer Data

Date: 12-23-16
Sample location: Trtmt Eff
Analyst: J. Clark
Time of test: 0900 ATC (6) = ____

SSC = (ATC) X (1 000) / SSV

Time	SSV_t cc/L	SSC_t%
0	1 000	
5	950	
10	940	
15	930	
20	900	
25	900	
30	890	
40	880	
50	850	
60	830	

Observations first 5 minutes:
Floc: [ ] Granular [ ] Compact [X] Fluffy [ ] Feathery
Particle size: [ ] Large [X] Medium [ ] Small
Bio-solids/supernate interface: [ ] Well defined [X] Ragged
Supernatant: [X] Clear [ ] Cloudy
Straggler Floc: [X] Yes [ ] No
Observation after 30 minutes:
[ ] Crisp sharp edges [X] Fluffy/feathery
[ ] Sponge-like [ ] Homogeneous

Settled Sludge Volume (SSV) (cc/l)
Settled Sludge Concentration (SSC) (%)