

ACTIFLO® Clarifiers to Treat Sanitary Sewer Overflow in Lawrence, KS WWTP



Overview of ACTIFLO® Process Basins



One train of ACTIFLO® Process Hydrocyclones

CHALLENGE

The ACTIFLO Process was evaluated as an alternative for sanitary sewer overflow (SSO) treatment at the City of Lawrence, Kansas's wastewater treatment plant (WWTP). Prior to implementation of the ACTIFLO Process and expansion of the existing biological treatment trains, the facility struggled with handling wet weather events that exceeded the 9 MGD (average) or 18 mgd (peak) flow capacity.

I. Kruger, Inc. in cooperation with Black & Veatch Engineers, developed a 2 x 20 MGD ACTIFLO design for CSO treatment for the Lawrence project. The ACTIFLO Process was designed to supplement the biological process and was completed as new construction at the existing plant site.

PROCESS DESIGN SUMMARY

The biological plant was expanded to treat 12.5 MGD; 25 MGD at peak capacity. During a storm event the first 25 MGD to the WWTP will pass through the main plant's biological treatment system, which includes aerated grit removal. Since this first flush is processed through the biological treatment plant and receives grit removal, no additional permanent grit removal equipment was added. Peak wet weather flow can reach 65 MGD, thus the ACTIFLO Process was designed to treat 40 MGD in a 2x20 MGD arrangement.

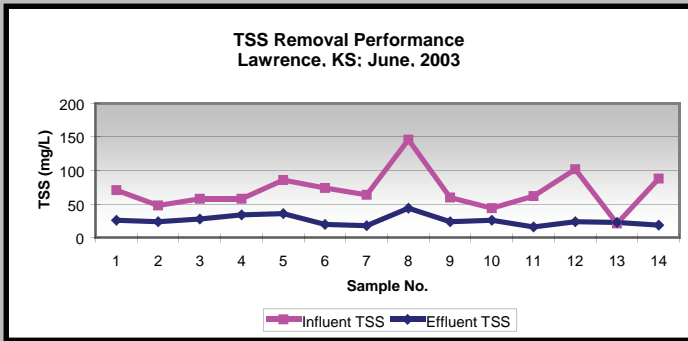
To meet the project strategy, the ACTIFLO Process was chosen to handle the SSO flow during rain events. The design implemented at the Lawrence, KS WWTP is summarized in Table 1.

PROCESS SOLUTION

The ACTIFLO Process is designed to treat 40 MGD in a 2x20 MGD arrangement. The clarifier design rise rate is 60 gpm/sq. ft. Chemicals used include chlorine, ferric chloride, and Ciba 110 liquid polymer. In the upstream piping of the ACTIFLO Process, screened influent is injected with ferric chloride prior to entering the ACTIFLO tanks. Coagulated wastewater flows into the coagulation tank where rapid mixing is imparted. Then wastewater flows into the injection basin where microsand and ½ the polymer are dosed together. Treatment continues in the maturation tank where the remainder of the polymer is added and the ballasted flocs form and mature.

Hydroxide flocs generally have a specific gravity of 1.05-1.2, while microsand has a specific gravity of 2.65, thus providing accelerated settling in the settling tank. Microsand Ballasted floc enters the clarifier where it settles readily while clear water flows up through lamella tubes, thus polishing the effluent. Clarified water is collected in stainless steel launders, disinfected with chlorine prior to being blended with 25 mgd from the main liquid treatment train. Final effluent is dechlorinated and then discharged to an outfall. Permit compliance is based on the combined final effluent quality. The average effluent turbidity out of the ACTIFLO Process in the past year was 3-4.5 NTU.

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Graph 1

Table 1: Process Design Summary Lawrence, KS 2 x 20 MGD	
Coagulation Tank Number of Tanks per Train HRT, minutes Length x Width x Depth, ft Mixer Horsepower, HP	1 0.80 10'-10" x 8'-8" x 16'-0" 5.0
Injection Tank Number of Tanks per Train HRT, minutes Length x Width x Depth, ft Mixer Horsepower, HP	1 1.0 10'-10" x 10'-10" x 16'-0" 7.5
Maturation Tank Number of Tanks per Train HRT, minutes Length x Width x Depth, ft VFD Mixer Horsepower, HP	1 3.0 17'-3" x 20'-6" x 16'-0" 10.0
Settler Design Number of Settlers per Train Length x Width x Depth, ft Diameter of Scraper, ft Rise Rate, gpm/ft ² Scraper Horsepower, HP	1 20'-6" x 20'-6" x 16'-0" 20'-6" 60 3.0
Sand Recirculation Circuit Number of Pumps per Train Capacity per pump Pump Horsepower Number of Hydrocyclones per Train Capacity per Hydrocyclone	3 (2 +1 standby) 400 gpm 20 HP 3 400 gpm

Table 1

Slurry pumps withdraw the sand/floc mixture from the bottom of the settling basin and send it to hydrocyclones that separate the floc from the microsand. The microsand is recycled back into the ACTIFLO system, where it is re-injected along with polymer in the injection tank. The hydrocyclone overflow solids are sent to the sludge handling system for further treatment and disposal.

The detention time through the ACTIFLO Process at full capacity is less than 10 minutes for a corresponding design treatment rate of 60 gpm/ft². Each ACTIFLO system was installed with a coagulation tank with a design HRT of 0.8 minutes, an injection basin with a design HRT of 1 minute, and a maturation tank with an HRT of 3 minutes. As well, each ACTIFLO train is equipped with 3 hydrocyclones to process sand/waste sludge (see photograph).

The performance requirements for the CSO treatment system are to reduce inlet Total Suspended Solids (TSS) to less than 45 mg/L as a weekly average. The following graph illustrates effluent TSS results at the plant during rain events in June, 2003.

Clarifier performance has been very reliable with ferric chloride dosages averaging 74 mg/L and polymer dosages averaging 2.4 mg/L. Results from rain events during 2004 are shown in Table 2.

CONCLUSION

Data collected during storm events in both 2003 and 2004 illustrate that the ACTIFLO Process consistently produces effluent that meets the performance requirements of TSS less than 45 mg/L.

STORM DURATION	3 HOURS	6 HOURS	21 HOURS	16 HOURS
Average Flow (MGD)	11	9	10	9.5
Average TSS (mg/L)				
Influent	162	89	122	71
Effluent	20	14.5	12	13

Table 2



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