Fond du Lac WTRRF Recieves 2020 Wisconsin Operation Award

By Cody Schoepke

The Fond du Lac Regional Wastewater Treatment and Resource Recovery Facility is located at the base of Wisconsin's largest inland lake, Lake Winnebago. Wastewater flows in from the City of Fond du Lac as well as 18 other towns and villages surrounding it, Serving approximately 60,000 residents, average daily flows are just shy of 8 MGD but can include significant contributions of I/I during heavy rain events, increasing the flow to 60 MGD. Typical influent concentrations in mg/l are 275, 250, 6 and 22 for BOD, TSS, TP, and NH3 respectively. The plant is a one shift operation consisting of 21 employees: seven operators in an on-call rotation, five maintenance staff (including an electrician), three lab techs, one industrial pretreatment sampling technician, and five admin.

The nearly 200 miles of sanitary sewer within the city is maintained with assistance from other divisions. The televising crew performs the mainline and lateral investigation to prioritize repairs and replacements. Fond du Lac WTRRF utilizes two sewer vacs to keep up on scheduled maintenance of the system. Staff is involved in clearwater home inspections to investigate the various issues that could be occurring within the foundation. The City has invested money in collection system improvements for many years, but has taken a more aggressive approach within the last two years. The new approach considers how to address the large volume of I/I coming from the private side the City has needed to bypass out in the collection system. The treatment plant has had to blend partially treated with fully treated water. With lower effluent limits focusing on mass, the goal is that with the change in mindset of addressing I/I over time, it will minimize or eliminate those situations and aid us in meeting those limits.

The Industrial Pretreatment Program consists of 10 significant industrial users with three of those being monitored 24/7. Industries range from dairy and cardboard/packaging plants to metal coating and manufacturing. The pretreatment program is a critical facet to the overall operation. It has been integral in addressing mercury and phosphorus and will likely be in addressing PFAS as well. Industrial loading to the treatment plant can exceed 50% at times and having that much industry in town can wreak havoc on the secondary treatment system in a short amount of time. Communication with the industries is one of the most important parts of the program.

The treatment facility begins with six submersible influent pumps ranging in capacities of 7 to 13 MGD. The wastewater is pumped to the second story of the influent building where it is gravity fed the rest of the way. Preliminary treatment consists of perforated plate fine screens and grit removal with a vortex-type grit washing system. Two co-thickening primaries are utilized for primary clarification.

As part of a large plant upgrade in 2008, the secondary treatment facility was constructed as a conventional activated sludge system, supporting nitrification, and denitrification. The setup included an anoxic zone followed by an aerobic zone. With a 1 mg/l limit the facility was setup with chemical phosphorus removal. Both ammonia and phosphorus limits were easily met with that design. Since that time Fond du Lac WTRRF has received a new phosphorus limit of 0.19mg/l or 17.366lb as a six-month average. Over the course of the last six years the staff has moved towards biological phosphorus removal as part of our compliance plan. The challenge has been consistency. It is very difficult to perform bio-p at a consistent rate when dealing with a secondary treatment system that wasn't designed with it in mind, with fluctuating influent loads to the facility because of local industry, a heavily loaded sidestream from dewatering, and excessive I/I from the collection system. Several modifications have been made to the aeration basins to promote bio-p activity. Those include: removing a portion

of the diffuser system in the first pass and relocating the mechanical mixers to extend the anoxic zone, adjusting mixer times to create a fermentation scenario to increase the quantity of vfa available, and increasing the baffle wall height to prevent oxygen from flowing back into the newly created anaerobic zone. With this baffle wall addition at normal liquid level height the flow now cascades into the aerobic zone. The design of the baffle wall included four openings at the bottom. It was found that flow was actually pushing through those openings and aiding in that back mixing. As a result, the maintenance staff made gates for all the openings so they'd be blocked off. Lastly, an additional carbon source has been added to our RAS to provide supplemental COD for times when influent loading is decreased.

The ammonia-based aeration control system installed in 2019 has been an integral part in our bio-p success as well. Not only are we controlling air based on ammonia, the control package and diffuser grid layout simultaneous nitrification-denitrification (SND) takes place as the mixed liquor flows through the basin eliminating the need for the separate denitrification zone. Because of this, the staff was able to remove the nitrate recycle pumps that typically pumped aerated mixed liquor back into the anoxic zone and actually blocked off those holes in the wall creating a truly anaerobic zone. As the SND took place, we are able to simultaneously remove ammonia-nitrogen and phosphorus when in the past, with the original design, it was near impossible to both nitrify and remove phosphorus biologically. With staff implemented modifications and the control system, it is able to perform bio-p approximately 80% of the time. Using future control strategies, our goal is to increase that consistency even further.

The last portion of secondary treatment consists of four final clarifiers using the "organ pipe" RAS removal system and is pumped to the head of the aeration basins. Wasting is accomplished by pumping to the primary clarifiers and to digestion.

Fond du Lac WTRRF uses ultraviolet light for its seasonal disinfection requirement before treated effluent is discharged to the lake.

Fond du Lac WTRRF is a high strength waste receiving facility that has approximately 30,000 gallons/day hauled in. That high strength consists of dairy and food wastes from local industry.

The primary/WAS sludge from the clarifiers is pumped to the first of four anaerobic digesters, which then overflows to the second and joins the high strength waste addition. The digesters function in series, therefore the sludge from the second digester is pumped to the third which overflows into the fourth. Most of the digestion takes place in the primary digesters. The typical VSR is in the 60% to 70% range. Approximately 200,000 cubic feet of biogas is produced each day. There is 40,000 cubic feet of storage in the floating covers of the third and fourth digesters.

The biogas produced flows through a biological H2S system, a siloxane removal system, and several moisture traps before being utilized as a fuel source. The most important use is fuel for the 450 kW CAT CHP unit. With this unit running at near full capacity around the clock we are able to produce approximately 45% of the power needed to operate the treatment facility. The waste heat is tied into the hot water loop for process and building heat. The second use is for boiler fuel, which is critical to maintaining process temperatures in the digesters and in heated effluent water for the deammonification system. The remaining gas that can't be used or stored is flared.

The remaining sludge in the digester is pumped to the centrifuges for dewatering. Utilizing a dry polymer a typical end product of 25% Class B cake solid is achieved. Annual production is approximately 10,000 wet tons with 70% of those going to land. The facility does not have any storage and therefore must landfill the remaining material. Further solids handling operations are being evaluated for future implementation.

The typical sidestream ammonia load to the mainstream was approximately 40%, even though it was only 2% of the flow. Knowing the importance of the high strength waste receiving facility to local industry and the community, the possibility of needing to construct a fourth aeration basin at nearly double the cost of a sidestream treatment system, and moving forward with bio-p for addressing our phosphorus issues, the decision was made to implement side stream treatment. Deammonification is the process that utilizes Anammox bacteria to perform high

rate nitrification-denitrification in a small footprint. Three systems were evaluated and the AnammoPAQ system was selected. The Fond du Lac WTRRF was the first Paques System in the US and first deammonification system in Wisconsin.

The centrate flows from the centrifuges to the centrate eq tanks and from there it is pumped up to the tilted plate settler (TPS) where solids are settled out. Solids are one of the inhibitory items for the bacteria therefore it was recommended to install a TPS ahead of the reactor because of the lower capture rate of the centrifuges. The settled solids are pumped back to the digester. The TPS overflows into the reactor with almost no TSS at all. Heated dilution water is added to maintain temperature and ensure any floc material that has developed in the reactor is able to be flushed out. A very low quantity of micronutrients and anti-foam are added continuously. Inside the reactor resides the internal settler, which is where the treated effluent flows out. The lamella plates in this settler help keep the Anammox granules where they belong – in the reactor. Fond du Lac WTRRF started this system up in January 2019, one of the coldest winters on record after several delays in equipment and seed arrival. Amazingly, within three weeks they saw 85% removal of ammonia at near full load to the reactor. Even today they consistently achieve greater than 85% removal on full load.

My predecessors, Jeremy Cramer and Autumn Fisher, put in the work to change the mindset that we are no longer only treating wastewater. I learned so much from them in the short amount of time we were together. I wouldn't be where I am today without their influence, decisions, and knowledge.

I couldn't be more proud when looking at everything the staff has accomplished as part of the daunting task of being a resource recovery facility. From the think on the fly fabricators of our maintenance division, who are always looking to tackle issues in-house, to the operators, who always seem to find a way to get things done our plant exemplifies creativity and efficiency. When a piece of equipment arrives or a new process is started, that's never good enough. Keeping that mindset pushes our facility to new levels.

The lab technicians who work in our onsite state certified lab, are the glue that ties everyone's work together. They are constantly receiving process samples, running profiles and calibration verifications, you name it, on top of reporting requirements, industry, and hauled in waste analysis. They find a way to make it work and we are better because of it. Our industrial pretreatment program is our seatbelt and keeps the plant safe and operating smoothly. At times it may seem out of sight and out of mind, but is critical to our success. And lastly, the administrative folks somehow manage to keep this joint organized and on track. A lot is asked of the staff here and if the direction isn't uniform then we don't succeed.

My name may be on the award, but it is (without a doubt) a group effort and each and every member here gives us the opportunity to be successful. It is truly an honor to work with these individuals. CS