City of Hartford Water Pollution Control Facility

50th Annual W.W.O.A. Conference
October 11-14
LaCrosse Center/Radisson Hotel
Inside This Issue…

- Presidents message / Page 3
- Hartford WCPF overview and phosphorus approach / Page 4
- North Central steering committee minutes / Page 22
- Chilton hosts Lake Michigan meeting / Page 23
- Superior activates sludge at a low cost / Page 25
- Start thinking about the operators competition / Page 26
- Mark your calendars – Important dates coming up / Page 32
- 2016 Technical Committee update / Page 32
- Past WWOA Presidents – Where are you? / Page 34

The Clarifier is the publication of the Wisconsin Wastewater Operators’ Association and is intended to inform and educate the membership on issues related to the treatment and control of wastewater. The Clarifier is produced five (5) times each year: February, April, June, September, and December. All members are encouraged to contribute to the mission of the Clarifier.

The Wisconsin Wastewater Operators’ Association is a non-profit organization dedicated to educating, informing, and advancing the wastewater profession. WWOA has approximately 2,000 members divided throughout six regions: Southeast, Southern, Lake Michigan, North Central, Northwest, and West Central.
Enjoy the winter; Spring will get here (soon enough); Think ahead a special conference!

The mild December combined with a co-worker riding his motorcycle until almost the New Year, has caught me off guard and I must say have struggled to even think about a February President’s message with this weak start to winter! Once again my love for winter is being held at bay with a lack of snow and a roller coaster of cold to mild temperatures. I know, probably a fair share of you are wishing for an end to the winter wonderland already, but never fear, by the time this is out in print there will only be a couple months till you can be refreshed with the spring air and peace of mind that it will only get warmer with the seasons change. BUT, until then I hope we get some good old’ fashion snowstorms for my fellow winter enthusiasts to enjoy! You know the kind that makes you wonder where the heck one is supposed to put any more snow! With that thought, I want to send out my sincere appreciation to all fellow WWOA members who face the challenging role of plowing snow in addition to operating and maintaining a Wastewater Treatment facility. Winter brings with it the reality of diverse operational challenges that go with the northern territory we reside. Even though many other occupations may shut down with the extremes our climate may provide, our industry does not and we must continue to keep our facilities functioning in whatever Mother Nature deals us. In my perspective, these challenges we face in the winter months provide us an opportunity to learn and build our skills and thus make us the best in the industry being able to cope with such a wide array of scenarios. Regardless, please remember to work safely and take the necessary precautions to prevent injuries when out on the snow/ice and working in the cold!

To catch you up on some recent happenings, the Board of Directors had their first meeting in December. Through the diligent efforts from all the board members, we were able to deliver a balanced budget to lead us into our special 50th anniversary conference in La Crosse next October. Ideas and details were developed and discussed to highlight this special year. Vice President and Technical Committee Chair, Jeff Bratz, is in progress of putting together a special opening session. In February, he is leading a group of industry specialists in selecting a wide variety of technical sessions to fill an array of interests. To cap it off, the award banquet will be followed with a little variation in entertainment this year that you will surely not want to miss! If you have not already, I encourage you to think ahead and secure your accommodations as soon as possible as the reserved host hotels are filling up fast!

Operator training committee Co-chairs, Don Lintner and Jeff Smudde (along with a good deal of help from executive secretary Karen Harter), have joined in with the Wi section of the American Water Works Association to put on the 11th Annual Midwest Water and Wastewater Operators Expo in WI Dells. Jeff Smudde and Sharon Thieszen have aided in developing an always educational Government Affairs seminar on February 25th. Don Lintner and I have also combined efforts with a select group to set up this years’ Spring Biosolids Symposium in Stevens Point on March 22nd. If you have not been able to take in any of the CMOM training sessions yet, there are still a few more coming up in select locations. Check the out the current WWOA website and the events calendar under the Members tools tab for those and more up to date regional training opportunities!

If you have not thought about it yet, please work at getting in those nomination papers for those around you for the WWOA awards available! Don’t wait and push the deadlines, get them in early! Details for all awards are at WWOA.org. If you have any questions, contact this year’s Award Chair and President Elect, Sharon Thieszen. If team building is something of interest, look into putting together a team for the Operator’s Competition at the conference. If you think you might be interested but not sure about how to get a team together, touch base with your regional officers as they can offer some guidance on what is involved. These are just a few things I thought to highlight to get you forward thinking! I can’t divulge all the special happens yet for Conference “L” yet and need to keep some suspense for my next article! How else am I supposed to get anyone to read my posts?!

Your President, Lyle Lutz
The City of Hartford owns and operates a Water Pollution Control Facility (WPCF) for wastewater treatment before discharge to the Rubicon River. The Rubicon joins the Rock River approximately eight river miles downstream of the outfall.

The City of Hartford is located in Washington County, WI. Hartford’s population is 14,403. The City has a large manufacturing base for employment, with several metal finishing facilities and a tannery located in the City. The WPCF also serves the Rubicon Sanitary District to the west of the City and the Pike Lake Sanitary District to the east of the City. Grande Cheese operates a manufacturing facility in the Rubicon Sanitary District.

The original WPCF was constructed in the 1950s. Through the years and up to 1997, the WPCF was upgraded with smaller scale projects. In the early 1990s, comprehensive facility planning took place for a major upgrade. In 1997, construction started to convert the existing package plant into an extended aeration activated sludge treatment facility. Construction for this project was completed in 1999. The WPCF provides advanced treatment including nitrification/denitrification and phosphorus removal.

Process Description
Unit processes for liquid treatment includes the following: screening with a 1/4-inch rake screen, influent pumping with three dry-pit submersible pumps, flow metering with magnetic meters, grit removal with three free vortex separators and a decanter system, organic treatment in a three-channel oxidation ditch in the Orbal® configuration using a series of ten surface-mounted disc aerators (six disc aerators span the outer and middle channels, four aerators span the inner channel only), final clarification with two

continued on page 6
The New Slimmer USAGBlueBook®
is still BIG on Selection!

Don’t let the smaller footprint fool you! USAGBlueBook’s new catalog uses an environmentally friendly paper that slims down our book—but not our selection. From aeration to zinc testing and everything in between, USAGBlueBook still offers everything you need for water and wastewater operations and maintenance!

28 PRODUCT CATEGORIES

- Aeration
- Chart & Data Recorders
- Chemical Feed
- Collection Systems
- Electrical
- Flow Metering
- Gauges
- Hose
- Hydrants
- Lab Chemicals
- Lab Equipment & Supplies
- Lab Testing
- Level & Pressure
- Locating & Leak Detection
- Maintenance
- Office Products
- Pipe
- Plugs
- Process Analyzers
- Pumps
- Reference
- Safety
- Sampling Equipment
- Tanks
- Tools
- Valves
- Water & Wastewater Treatment
- Workwear

Over 64,000 Products • Personal Customer Service
Expert Technical Support • Nationwide Distribution Network
100% Satisfaction Guarantee!

USAGBlueBook®
A PROUD SUPPLY COMPANY

Printing on environmentally friendly, 100% recyclable paper is only part of the story. By reusing shipping boxes, using responsible mailing practices and offering FREE electronic billing services, USAGBlueBook is doing its part to help protect the environment.

Request your FREE catalog today! Call 800-548-1234 or visit www.usablu.orgeweb.com
The CNX includes our new impeller which has a high efficiency in its operation range.
The CNXH achieves a high discharge head by employing our new single vane enclosed impeller.
The pass through capability has improved compared to our conventional CN type impeller.

High Discharge Head Type
(Single Vane Enclosed Impeller)

Large Capacity Type
(Double Vane Enclosed Impeller)

ShinMaywa(America), Ltd.
6135 Park South Dr.Suite 510, Charlotte, NC 28277
■Phone: (704) 945-7112 ■Fax: (704) 945-7101
e-mail: pump@shinmaywaamerica.com
http://www.shinmaywa.co.jp/america/

The WPCF also has a 2-meter wide belt press. The belt press is presently not needed to meet the existing six month biosolids storage requirement and is therefore not used.

Table 1 below summarizes the design and existing flow rates and pollutant loadings.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ave/ Peak</td>
<td>Biological</td>
<td>Total</td>
</tr>
<tr>
<td></td>
<td>Daily Hour</td>
<td>Oxygen Suspnd</td>
<td>Ammonia Total</td>
</tr>
<tr>
<td>Flow Flow</td>
<td>lbs/day</td>
<td>lbs/day</td>
<td>lbs/day</td>
</tr>
<tr>
<td>MGD MGD</td>
<td>kg/day</td>
<td>kg/day</td>
<td>kg/day</td>
</tr>
<tr>
<td>Design</td>
<td>3.6</td>
<td>12.0</td>
<td>10,000</td>
</tr>
<tr>
<td>Existing</td>
<td>2.2</td>
<td>9.0</td>
<td>2,400</td>
</tr>
<tr>
<td></td>
<td>6,500</td>
<td>2,900</td>
<td>470</td>
</tr>
<tr>
<td></td>
<td>1,350</td>
<td>470</td>
<td>110</td>
</tr>
</tbody>
</table>

Since the 1999 upgrade, there have been very few equipment updates. The main upgrade was the new...
FAST, TURNKEY INSTALLATIONS
Efficient Professional Crews

Single-Use Applications
- Storm water run-off, equalization and trickling filter
- Sludge digestion
- Sludge storage & mixing

Total System Applications
- Sequential Batch Reactor (SBR)
- Package treatment plants
- Anaerobic sludge digestion systems
- Conventional large volume treatment

Cady Aquastore, Inc.
Serving Eastern Wisconsin
Phone: 815.899.5678
Fax: 815.899.5681
Website: www.cadyaquastore.com
Email: daveh@cadyaquastore.com
influent fine screen installed in 2013. The WPCF SCADA system has also been updated throughout the years to keep up with technological change. In 2015, the City moved to a cellular-based telemetry system.

Permit Issuance and Compliance Strategies
The WPCF received its Wisconsin Pollutant Discharge Elimination System (WPDES) permit renewal in July of 2012. Hartford was one of the first municipalities in Wisconsin to receive its new permit with the final water quality based effluent limit (WQBEL) for total phosphorus (TP) of 0.075 mg/L. The 0.075 mg/L level is a 365-day average value. Hartford has an interim limit of 0.6 mg/L averaged over a six month period. The draft permit contains a nine year phosphorus compliance schedule.

The WPDES permit also included mass limits for TP and Total Suspended Solids (TSS) from the Rock River Total Maximum Daily Load (TMDL) rule finalized by the Environmental Protection Agency in 2011. The mass limits are monthly values and are variable. When calculated as concentration limits based on the number of days per month and the average daily flow, the limits are less stringent than the TP WQBEL and the normal TSS limit. The TMDL based TP limit is even less stringent than the interim TP limit of 0.6 mg/L. The City must meet the most stringent limit in accordance with Wisconsin Administrative Code. Therefore, the City presently has excess TMDL-based credits for TP. The City is considering using those credits for the TP reductions needed in their Municipal Separate Storm Sewer System permit.

The draft permit also included proposed compliance schedule for effluent temperature. The City conducted a dissipative cooling study to demonstrate mixing and temperature dissipation near the outfall in the Rubicon River. The proposed temperature compliance schedule was removed from the draft permit in light of the results of the study.

The City conducted several studies in 2012 and 2013 to analyze the best way to comply with the WQBELs for TP. The first study the City conducted was a feasibility study for Site Specific Criteria (SSC). The idea of this study was to evaluate historical water quality and fish data for the Rubicon River to determine if SSC should be considered as a compliance method. The City gathered data available from the Rubicon River upstream and downstream of the WPCF outfall. The WDNR Surface Water Integrated Monitoring System (SWIMS) was accessed for TP levels in the Rubicon

PROCESS EQUIPMENT REPAIR SERVICES – Our name says it all.

Our team provides equipment repair and rebuild services to the water and wastewater treatment industry. With over 30 years of experience, our staff has installed, rebuilt and/or repaired the following equipment:

- Mechanical Bar Screens
- Conveyors
- Grit Removal Systems
- Clarifiers
- Aeration Equipment
- Trickling Filters
- Digesters
- Flocculants
- Sand Filters
- Screw Pumps
- Airlift Pumps
- Trash Rakes
- Traveling Water Screens
- Floatation Thickeners

... And More.

We offer professional guaranteed service. We will provide a quotation including equipment requirements and a firm price for the project.

Our customized services allow you the option of having our trained staff work with your personnel or we will provide total turnkey service to complete your equipment installation, repair, or rebuild needs on a timely, competitively priced basis.

Contact Process Equipment Repair Services today, for all your equipment needs!

Phone 262-629-1059 • Cell 414-412-4403 • Fax 262-629-1059
Email PERSLaMont@aol.com
5991 Division Rd. • West Bend, WI 53095
Reducing Costs & Meeting Regulations All Across Wisconsin

- Automatic daily calibration
- Replace reagents only once per year (not every 2-4 weeks)
- Reduce chemical costs

JOIN
Brookfield
Grafton
Hartford
Jackson
Medford
Merrill
Sun Prairie
Watertown

...in monitoring your Ortho P while cutting chemical costs.

262 241 1199
mulcahyshaw.com | info@mulcahyshaw.com

N57 W6316 Center Street
Cedarburg WI 53012
River. The SWIMS data was very sparse and also very dated. The monitoring data that was available from within 15 years did not contradict more recent data the WDNR used to set the water quality standard in the Rubicon River. Also, Hartford coordinated with the WDNR fish biologist for the Rubicon River and evaluated Indices of Biotic Integrity (IBI) scores for fish and macroinvertebrate. The scores indicated that fish and other aquatic organisms were in poor to fair condition in the river. Through consideration of the SWIMS and IBI data and with coordination with WDNR, it was determined that SSC was not a feasible compliance method for the City.

The City also conducted a NR 217 Watershed-Based Compliance Feasibility Study. This study estimated the quantity of credits available in the watershed using filter strips on agricultural land upstream of the WPCF. The City used existing information from the Washington County Land & Water Conservation Division where specific locations of future filter strips were identified in the Rubicon River watershed. Washington County used the SNAP PLUS program to model the filter strips for a sample farm where soil phosphorus data was abundant. The credits from the filter strips could be used in a future water quality trading program with trade ratios applied to account for uncertainty. The study also identified costs for a WPCF upgrade using tertiary filters to comply with the future TP WQBEL. Unit costs of a plant upgrade using tertiary filters were estimated to be $109/pound, while credits from filter strips were estimated to be $39/pound TP. However, in consideration of trade ratios and the limited amount of credits available in the watershed, this study determined that WQT could only be used if the WPCF could reduce TP effluent levels to 0.15 mg/L. Credits from the filter strips would then offset the load from an effluent TP concentration of 0.15 mg/L to 0.075 mg/L.

The City also conducted a feasibility study of consolidating with the Village of Slinger (approximately 8 miles to the east) for wastewater treatment. In this scenario, Slinger, which already has a wastewater treatment facility, would pump their wastewater to the City of Hartford for treatment. Although there were cost savings from this arrangement, the savings were not large enough to justify consolidation.

Hartford completed three of the reports required in their permit’s phosphorus compliance schedule. These three reports were the Operations and Needs Review, Facilities Planning Study Status Report, and the Preliminary Facilities Plan. Through planning and optimization activities outlined in the first two reports, Hartford is meeting its future WQBEL of 0.075 mg/L for TP. The Preliminary Facilities
It’s the synergy that comes from supplying both pump equipment and electrical controls to operate those pumps. It’s the one stop shop for selection and sizing as well as after-market service to the end user.

We sell solutions that provide the highest operational efficiency. We have premium-efficient pumps and motors along with advanced control strategies to reduce energy costs.

We understand your needs and the dynamics of your situation. We’ll develop customized solutions and enhanced services that you can’t find anywhere else. With one call, find out why L.W. Allen pumps and Altronex control systems have become the leading provider of pumps, controls, technical assistance and superior customer service.

Reduce your energy costs and save time. Call (800) 362-7266.
Plan compared the existing phosphorus removal scheme with removal processes using various filters.

A variety of optimization activities have allowed the WPCF to reach the 0.075 mg/L level average over six months. These activities are outlined below:

1. Online Orthophosphorus Analyzer: The influent TP loading is variable due to the industrial loading. An analyzer was installed downstream of the final clarifier effluent with the values reported back to the SCADA system where they are plotted. The analyzer is not paced to the chemical metering pumps; however, plant staff monitor the values on SCADA several times per day and make minor adjustments to the chemical dosage.

2. Constant Chemical Feed: The City replaced one metering pump with a smaller pump that allowed constant chemical feed. The original pump minimum setting provided too much chemical so it was on a timer operation. The City has noticed that the chemical phosphorus removal process has improved with the smaller pump and constant feed.

3. Industrial Coordination: Two industries were identified as significant TP contributors. These were a cheese factory and a metal finishing plant. The City had several meetings with each industry to make them aware of the phosphorus issue the City was facing. Each industry was able to make changes to process and cleanup chemicals. The discharge concentration from each industry was reduced from approximately 100 mg/L to 40 mg/L.

4. Biological Phosphorus Removal Enhancement: The oxidation ditch aerators were changed from an on/off configuration to a variable speed configuration with new drives. This change helped reduce wear on the shafts and couplings and was used to enhance biological phosphorus removal. Having variable speed aeration also allowed the plant much better process control. The controls through the SCADA system were reprogrammed to accommodate...
energenecs

Water
Wastewater
Controls
Renewables
Service

From world-class process equipment to professional SCADA system services – partner with us confidently.

Wisconsin
Illinois
U.P. Michigan
Minnesota

www.energeneecs.com  800.343.6337
the variable speed drives. The controls are set to maintain a dissolved oxygen (DO) concentration level of 0.5 mg/L in the middle channel and 1.5 mg/L in the inner channel. Hartford has its own public power utility. Wisconsin Public Power Inc. awarded the City a grant in the amount of $24,000 for changing to variable speed drives on the ten disc aerators. The variable speed drives, new controls and reduced aeration in the outer channel is also saving approximately $30,000 per year in electrical costs.

Roughly 70 percent of the discs were removed from four outer channel units. For the two additional units that spanned the outer channel, the discs were not changed. These discs provide the required mixing in the channels of 0.75 feet per second to keep solids in suspension. These aerators are not used to maintain the DO level in the middle and inner channels. With the reduction in the number of outer channel discs and the increased control of aerator speed, anaerobic conditions are achieved in the outer channel. This allows the phosphorus accumulating organisms to release stored phosphorus. This phosphorus and more (luxury uptake) is then taken up by the microorganisms in the aerobic middle and inner channels. An oxidation reduction potential probe (ORP) was installed in the outer channel. This value is relayed and plotted in the SCADA system. Plant staff monitors this value several times during the day. This value is variable due to the changing BOD load from industries. It ranges from -100 mV to -300 mV. A schematic of the oxidation ditch is shown below.

Aerator Variable Frequency Drives

5. Use of a Rare Earth Chemical as a Coagulant for Phosphorus Removal: The City has replaced the ferrous chloride chemical with a cerium chloride solution. The use of this chemical has proved more efficient than ferrous

continued on page 16
FORGET CLOG-FREE PROMISES 
INTRODUCING A 24-MONTH GUARANTEE

Good news. If you are tired of unexpected call-outs and empty promises, you’ll appreciate this concrete offer. Starting now, we are offering a 24-month clog-free guarantee on Flygt Experior®, covering any Flygt N-pump up to 105 hp equipped with our Flygt SmartRun® intelligent control. The self-cleaning N-pump solution is optimized to work with our control system, preventing clogging and saving up to 50% on your energy bill. Sound interesting? Contact your local Flygt representative.
chloride. Using ferrous chloride, the City would add approximately 160 gallons per day to reach an effluent TP concentration of 0.45 mg/L. The City uses the approximately 40 gallons per day of cerium chloride, in conjunction with enhanced biological phosphorus removal, to reach a concentration of 0.1 mg/L. In addition, the product allows the facility to maintain a thicker mixed liquor concentration of up to 2,800 mg/L in the winter. In

Results of Optimization Actions

The biological phosphorus removal enhancement and use of a rare earth chemical coagulant are the two items that account for most of the increased phosphorus removal at the WPCF. The above improvements were initiated in the summer of 2014. The online orthophosphorus analyzer was started in July, the continuous chemical feed was in place by May, and industrial improvements were in place by July. Biological phosphorus removal enhancement was in place by early August, and use of the rare earth chemical in place of ferrous chloride started in August, a couple weeks after the oxidation ditch improvements were online for biological removal. Hartford wanted to test out the

continued from page 14
The OPTIFLOW 270™ baffle fits inside the grit chamber at the exit, directing the flow toward the hopper for an additional pass along the chamber floor for superior grit removal. This reduces the weir effect at the outlet, keeping more fine grit within the chamber and improving the toroidal flow path.

### Grit Removal Efficiency Comparison

<table>
<thead>
<tr>
<th></th>
<th>50 mesh grit (300 micron)</th>
<th>70 mesh Grit (210 micron)</th>
<th>100 mesh grit (150 micron)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PISTA® 270™</td>
<td>95%</td>
<td>85%</td>
<td>65%</td>
</tr>
<tr>
<td>Any 270° unit with OPTIFLOW 270™</td>
<td>95%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For More Information, Contact Representative

Smith & Loveless Inc.
Above All Others.

[energenecs](http://www.energenecs.com)

(800) 343-6337 • www.energenecs.com
optimization measures through several seasons of warm and cold weather. For this reason, a phased approach with the various optimization activities was not used.

Based on WPCF test results after the biological phosphorus removal enhancement was implemented but before the use of the rare earth chemical, the facility was able to reach an effluent TP level of 1.0 mg/L to 1.6 mg/L. The facility does not have to worry about scale formation in downstream pipes transporting biosolids because anaerobic digestion is not used at the facility. In addition, side streams where a high concentration of TP is routed back to the wet well is not an issue at Hartford. There is water that is routed back to the headworks from the sludge gravity thickener/aerobic digester, but decant from the final liquid sludge tank is not drained to the headworks.

Figure 1 shows the influent TP and orthophosphorus levels to the WPCF based on 24-hour composite sampling. Notice...
the variability to the influent concentrations from industrial sources.

Figure 2 shows effluent levels for TP, orthophosphorus (left axis) and TSS (right axis). The test results are based on 24-hour composite sampling. The dosage for cerium chloride was reduced in October of 2014 to determine the sensitivity of the product. Starting in December of 2014, the dosage was increased to approximately 100 gallons per day. In March of 2015, the dosage was reduced to approximately 50 gallons per day to save money.

Figure 3 shows WDNR-reported test results during the trial period. The WPCF made an effort to be very transparent with the DNR during the trial. The City reported much of the testing data that was above and beyond the testing requirements in their permit.

continued on page 20
The WDNR is still evaluating the rare earth product. Factors they have considered include effects on WET testing, acute toxicity, chronic toxicity and any adverse impact to soil from biosolids applications. None of these factors appear to be a problem, although the long term effects of the product on soil health are not clear. The WDNR has been collecting data from Hartford and other municipalities that are testing the rare earth product. In addition, they have been coordinating with the manufacturer and the State Lab of Hygiene. The WDNR has indicated that they may be in a position to approve the product in the spring of 2016.

Based on the promising results, the existing treatment optimization process was included as an alternative in the Preliminary Facilities Plan along with upgrades involving various filters. Not surprisingly, the net present value cost of existing optimization was the lowest among all alternatives considered. The WPCF feels the other advantages of the optimization activities are important as well.

The City of Hartford is considering proceeding on a long term basis with the existing optimized phosphorus removal process. The City’s next step in its permit phosphorus compliance schedule is the Final Facilities Plan. If Hartford reports that they can meet the WQBEL with its optimization measures, the WDNR will likely implement the final WQBEL in their next permit to be issued 2017.

If the cerium chloride solution becomes unavailable or too expensive in the future, a secondary alternative of disc filters has been identified. The disc filters would replace the anthracite filters in the existing filter building. No additional building or pumping station would be required at the WPCF. In addition, much of the concrete superstructure for the anthracite filters can be reused. The disc filters would reduce TP and TSS. The filters are sized for 75 percent of the peak hour flow of the facility. It is anticipated that sizing will allow the WPCF to meet the WQBEL.

It is anticipated that the existing optimization measures using a traditional coagulation such as ferrous chloride, ferric chloride or alum would allow the facility to reach an effluent level of 0.15 mg/L. The City could also use a water quality trading program in the future as insurance in case the cerium chloride product would no longer be available. The trading program would offset the load equal to the
SEVERE DUTY SEPTAGE RECEIVING

RoFAS Sludge Acceptance Plant

Handles unusual solids loading
High Capacity shortens download time
Automated hauler access option
Enclosed design for odor control
Robust construction

Represented by
Steve Berggruen
Energenecs
Steve.Berggruen@Energenecs.com
262-377-6360

Learn more at huberforum.net/rofas
difference in concentration from 0.15 mg/L to 0.075 mg/L. To protect public health, the environment and the receiving waters of the Rubicon River, the City of Hartford Sewer Utility provides exceptional wastewater collection, treatment and related services to the City of Hartford and surrounding service areas in a wise and cost-effective manner. With pride, passion and dedication, Hartford's well trained staff is committed to providing a better environment today and for future generations.

Staff left to right: Brad Behringer, Dave Piquett (Utility Director) Sue Roethle (Admin Asist) Back Row: Dave Zimmerman (Lead Operator) Dan Dentice, Al Dais

Dec. 3, 2015 North Central Steering Committee, Mosinee

Attendees: Rich Boden, Ken Bloom, Travis Dulek, Joe Gehin, Katie Gruber, Chris Helgestad, and Andy Ott.

Andy Ott called the meeting to order at 11:45 am. He welcomed Travis Dulek, the newly elected Steering Committee member. Andy Ott was also reelected. Katie Gruber and Chris Helgestad reported on the Regional Officers Meeting held at the Kalahari during the Annual Conference. Highlights included (1) a recommendation to include a $5 upcharge for nonmembers at regional meetings, (2) the extension of online registrations to regional meetings, and (3) cautions about carrying excessive non-allocated fund balances.

A motion by Chris Helgestad to include the $5 upcharge in our 2016 meeting lineup was seconded by Katie Gruber. The motion was approved.

Officers were selected for 2016 as follows:
Andy Ott – Chairman
Katie Gruber – Vice Chairman
Ken Bloom – Treasurer
Chris Helgestad – Secretary

Discussion occurred about our 2016 meeting lineup. AgSource in Marshfield has agreed to host the winter meeting. Possible topics and presenters were discussed. Lakeland Sanitary District is interested in hosting our spring meeting. Medford is at the top of our list for prospective summer meeting sites, with the potential for a joint meeting with the West Central Region.

Katie Gruber reported on the success of the operator’s competition sponsorships. Discussion occurred about switching from hard hats to t-shirts as advertising opportunities for the sponsors.

Katie Gruber reported on the operator's competition in general, recognizing the six members of the two teams representing the North Central Region at the Annual Conference. The Turdles team members included Jason Schill from Merrill, Ryan Giefer from Stevens Point and Adam Clark from Stevens Point. The Sewer Rats team included members Joel Goham from Marshfield, Mitch Nosbisch from Marshfield, and Jake Charron from Marshfield. Ken Bloom will distribute gifts cards for the competitors as has been done in the past.
Chilton hosts Lake Michigan District meeting in December

The December 10th Lake Michigan District meeting in Chilton was a huge success with 87 operators and DNR personnel in attendance, along with 12 vendors. A special thanks to Strand Associates for sponsoring the treats during the breaks.

Gerald Vanne, Mayor of the City of Chilton, welcomed everyone to the City.

Following the welcome by the Mayor, Joe Nicks and Art Harrington of Godfrey & Kahn presented Navigating the Procedural Thicket: Challenging Effluent Limits in a WPDES Permit. Joe and Art discussed the effects the new or lower Water Quality Based Effluent Limit for phosphorous are having on wastewater treatment facilities (WWTF) and municipalities. They explained the process for challenging the new phosphorus limits when a WWTF believes they are unjust or unattainable.

Joe and Art stated the Wisconsin Department of Administration, subject to EPA approval, may approve a variance. The variance would not prevent the WWTF from meeting the new limits, but just delay the date for complying. However, the variance would come at a cost of up to $640,000 per year that the variance is in effect. Joe and Art discussed the correct procedure for challenging the WPDES permit and the suggested negotiating strategy to follow for dealing with the DNR.

Next on the agenda was Bruce Bartel of NEW Water. Bruce presented on the current Resource Recovery and Electrical Energy (R2E2) Project. Background information for the project was given, which included the three main drivers for project. Bruce stated the main drivers were aging infrastructure, environmental regulations, and increased capacity needs. What alternatives considered were presented and reasoning for the final equipment selections was explained for the solids handling process. The selected alternative was to replace the existing solids handling at the Green Bay facility.

The first main component to be constructed with the R2E2 project is anaerobic digestion (mesophilic) equipped with two caterpillars I/C engines for converting the biogas to electricity. Dewatering will be accomplished by three Centrisys centrifuges and one Centrisys thickening centrifuge. One Haarslev scalping dryer will be installed for solids drying. A fluid bed incineration process manufactured by SUEZ equipped with the state of the art air pollution control equipment will be used incinerate the dried solids. Bruce stated the last benefit of the R2E2 project will be nutrient recovery system where struvite will be sold to generate a revenue stream.

Jake Becken called the WWOA LMD business meeting to order. Last quarter’s minutes and Treasurer’s report were approved. Aaron Eichhorst was elected unanimously to the Vice Chair position. Richard Sachs of the WDNR stated the CMOM program submittal deadline is August 1, 2016.

Jack Saltes will be conducting 12 free training sessions across the state from December through February. However, space is limited at the training session so you need to RSVP. The dates of these training sessions were e-mailed out to all operators. Please contact Richard Sachs if you have misplaced the locations and dates.

Tom Crouse of Donohue & Associates presented on A Fly in Your Ointment. Tom described the approaches used to

continued on page 24
identifying why TSS exceeded permit limits in January 2011 at Lakeland College. Results of the investigation showed increased sludge volume index with a sludge age of over 15 days. However, the microscopic examination showed filaments. In 2011, steps were taken to address the filaments, which consisted of lowering SRT to 5 days and automating the aeration to create a more uniform dissolved oxygen concentration. Effluent quality improved going into summer break. During January 2012, effluent TSS exceeded permit limits again.

In June of 2012 the operator reads an article in the TPO magazine relating to clarifier observations caused by the midge fly. It was determined that the midge fly larvae at Lakeland College was developing a sticky cocoon in the sludge and on the walls of the clarifier. This caused the clarifier to become a sticky mass with anaerobic conditions. Sludge floated in large clumps as straggler floc. The operators began using Aquabac XT3 to control larvae and eggs while low light, fog clarifier room, and keeping plant clean helped control adult flies.

The last presentation was by Mark Bauer of OneWater. Mark’s presentation was titled Hybrid Attached Growth Technology. The presentation described how the Algaewheel system can meet the challenges of small and seasonal treatment facilities. Algaewheel uses photosynthesis to cultivate a diverse ecological environment.

A strong symbiosis between algae and bacteria makes the system very efficient and resistant to fluctuation. Mark finished the presentation by discussing successful projects at Cincinnati Nature Center, Indiana Dunes, and Summit Lake State Park.

Sacha Tetzlaff of Strand Associates gave a presentation on the history of the previous plant upgrades, flows, loading, plant limits, treatment processes, and major components of the latest upgrade of the wastewater treatment plant. A plant tour followed the presentation.

The next meeting will be in Clintonville on February 18, 2016. Special thanks to Tim Keuler and the Chilton WWTP operators for hosting this meeting.

Minutes submitted by:
Josh Steffeck
Lake Michigan District Secretary/Treasurer

Rich Boden was recognized for his work on the steering committee over the past 12 years. Rich has been a strong supporter of the WWOA at both the regional and state levels for many decades, providing leadership at both levels. More recently, Rich was instrumental in revitalizing the North Central Region with the formation of the six person steering committee model and served as its secretary through four terms. A plaque commemorating Rich’s service was presented by Ken Bloom.

Discussion occurred about the inclusion of special classes in our 2016 meeting line up. Ken Bloom offered to contact NCL about the potential to host a laboratory themed class. General consensus was that it was too early to invite Tony Glymph back in 2016, but that perhaps some kind of special class rotation could be set up to take advantage of NCL’s willingness to share their facility.

Ken Bloom presented the Treasurer’s report. The Region had a fund balance of $4376.37 as of the date of the meeting. Discussion occurred about the State Board’s recommendation to limit non-allocated fund balances. General consensus was that, at several thousand dollars per meeting, our fund balance was appropriately sized. The meeting was adjourned at 1:55 pm.

Submitted by Chris Helgestad, NCR Secretary
Low Cost Activated Sludge Optimization—A Superior Approach

Steve Roberts, Superior Environmental Services Division; Jon Shamla, Superior Environmental Services Division; Mark Unger, Superior Environmental Services Division

Ed Nevers, Donohue & Associates; Eric Lynne, Donohue & Associates; Bill Marten, Donohue & Associates

Editor’s comment: This article is based on a presentation I saw at the annual conference. I thought it was a great example of operators working closely with engineers to make improvements. I asked Bill to write this article and I encourage other operators to provide information on their plants. You never know what your fellow operator needs. Thank you to the City of Superior and Donohue folks for your contribution to the Clarifier.

The City of Superior, WI, is located on the southwest shore of Lake Superior, at the northwest tip of Wisconsin. The City’s Environmental Services Division (ESD) is tasked with managing and operating the wastewater collection and treatment systems that serve the City and a satellite system. These facilities include a 150 mile collection system – comprised equally of combined and separate sewers including sixteen lift stations, and four wastewater treatment facilities – three combined sewer treatment plants (CSTPs) and the Main wastewater treatment plant (Main WWTP).

The ESD operates these facilities with the goal that the CSTPs primarily serve as wet weather storage for flows to later be sent to the Main WWTP for full treatment. The Main WWTP was rated for an average day flow of 7.6 million gallons per day (mgd), with liquid treatment consisting of fine screening, grit removal, raw wastewater pumping, primary clarification, conventional (non-nitrifying) activated sludge and disinfection. Total flows average around 4.7 mgd with peak flows during wet weather.
weather events (storms, snowmelts) capable of exceeding 200 mgd.

The Main WWTP influent flow averages approximately 4 mgd, but has been challenged to sustain effective capacity for extended periods of peak flow, primarily due to process variability in the activated sludge system. Through the years plant staff have learned to work with this variable capacity by relying on one of the CSTPs for treatment of flows in excess of the effective capacity of the Main WWTP’s activated sludge process at the time of, and following, each high flow event.

In 2010 the City hired Donohue & Associates to perform a hydraulic and treatment capacity evaluation of the Main WWTP, using calibrated hydraulic and process (Biowin) modeling as well as review of operational records. The evaluation confirmed the plant’s activated sludge system was the main factor limiting treatment capacity, and identified a number of improvements that could be used to maximize its capacity. The improvements ranged from relatively low cost items to optimize the existing infrastructure to a $40M+ full process expansion.

Key Capacity Bottlenecks
The capacity optimization evaluations identified the following as key bottlenecks that were contributing to activated sludge capacity constraints:

- Unequal flow split of aeration tank effluent/mixed liquor (ML) to the plant’s four rectangular final clarifiers. The ML would make a 180 degree turn into a final clarifier inlet channel and then split off into the four clarifiers through gate valves along the length of this channel. Plant staff would attempt to balance the flow to the clarifiers by throttling/adjusting the gates but the hydraulics and flow splits constantly change as plant flows change – so this method of clarifier flow control was challenging.

- Inability to control return activated sludge (RAS) removal from the four final clarifiers – the plant had only two RAS pumps, pulling RAS from four final clarifiers at the same time, and a single RAS flowmeter. As a result plant staff didn’t have the ability to effectively control or measure RAS withdrawal from any of the clarifiers. Plant staff tried to rebalance solids withdrawal from each clarifier by throttling plug valves from each clarifier RAS line on the suction side of the pumps – but this was largely ineffective since efforts to balance the solids withdrawal would inevitably be followed by another unbalanced condition.

- Highly variable ML settleability and its effect on the solids loading capacity of the final clarifiers – sludge volume indexes (SVIs) could range from below 100 mL/g to above 300 mL/g due to presence or absence of frequent filamentous organisms and/or slime bulking, and this variability greatly affected the plant flows that the final clarifiers could treat.

Optimization and Implementation
A number of low cost improvements were identified for implementation, to try and address these capacity bottlenecks, including:

- RAS Pumping Improvements – installing automated actuators on the suction valve from each final clarifier to its paired RAS pump and modifying the RAS pump discharge lines to install a second RAS flowmeter – so the discharge of each RAS pump could be measured. These improvements are illustrated in Figure 1.

With these improvements plant staff can now better control RAS removal from individual clarifiers through timer controls on the suction withdrawal valves – alternating between final clarifiers, and with a RAS flow meter.
dedicated to each RAS pump are also better able to quantify RAS withdrawal from all the finals.

• SRT Control and Microscopic Analysis – RAS pumping improvements allowed the mode of operation of the activated sludge system to transition from pounds-under-aeration to constant SRT. Donohue provided the City an Excel-based spreadsheets to control the activated sludge process based on a target solids retention time (SRT)/sludge age. The change to SRT control stabilized the activated sludge biomass and performance. Microscopic analysis was implemented to monitor mixed liquor characteristics.

• RAS Chlorination Improvements – RAS chlorination facilities were assembled by City staff and a dosing calculator was provided to the City. Preventive dosing of chlorine is provided continuously to inhibit excessive filament growth. A higher dose of chlorine may be fed to combat SVI degradation when microscopic analysis reveals an increase presence of filamentous organisms.

The combination of SRT control and RAS chlorination to prevent filament outbreaks resulted in significant improvements in sludge settleability and effective capacity.

• High Flow Step Feed – a new high flow step feed splitter box was installed on the primary effluent line to the aeration basins. Under normal conditions all PE flow travels to Aeration Basin 1, with Aeration Basin 1 feeding Aeration Basin 2, which in turn feeds the final clarifiers. The new step feed provision includes an adjustable gate which directs some PE to a new contact zone at the effluent end of Aeration Basin 2, just upstream of the final clarifiers, as shown in Figure 2.

Plant staff can now set a flow rate above which primary effluent is split off in step feed mode to the Aeration Basin 2 contact zone. This allows the plant to carry higher MLSS concentrations in Aeration Basin 1 and the first portion of Aeration Basin 2, as needed for SRT solids inventory control, but to dilute the MLSS concentration upstream of the final clarifiers to minimize the solids loadings on the finals.

• Final Clarifier Flow Splitter – replacing the aeration effluent/ML feed channel to the final clarifiers with a new flow splitter box using equal sized/elevation weirs to ensure equal flow distribution to each final clarifier under all flow conditions. The splitter box, shown in Figure 3, was designed with two extra weirs for future clarifiers.

• Flocculating Inlet Modification – Upon startup of the new facilities, plant staff noticed a significant difference in the inlet appearance of Clarifier 4, as compared to the other three, typical of Figure 4, which shows much less inlet turbulence and mixed liquor at the surface of Clarifier 4 (farthest to the right in the figure), in terms of how far it extended into the clarifier. This gave rise to suspicion among plant staff that hydraulic differences in delivery of flow to the clarifiers (Clarifiers 1-3 were hard piped while Clarifier 4 was piped to discharge into the now empty existing ML channel – see Figure 5) was contributing to differences in settling performance between the clarifiers.

continued on page 28
Plant staff performed 3-dimensional modeling (see Figure 6) of the inlet arrangements for the three “hard-piped” inlets and the small section of inlet channel at Clarifier 4. Observation and simulation show significantly dissipated hydraulic energy and helped to re-floculate the inlet solids – resulting in reduced inlet turbulence and more rapid solids settling at Clarifier 4’s entrance, as compared to the other three.

The existing inlet channels into tanks 1-3 were modified to create a flocculation and energy dissipation chamber before discharging into the tank. The results speak for themselves – the energy dissipation and enhanced flocculation of the flocculating inlet modifications (FIMs) have improved an already good situation even more – as evidenced by Figure 7, which shows the results with three of the four clarifier inlets configured this way (the three on the right side of the picture). The visual evidence when comparing Figures 5 and 7 is clear. This improvement shows the benefit of recognizing, evaluating, and implementing opportunities for ongoing plant optimization.

**Results**

Construction and implementation of the optimization projects nearly doubled the sustainable effective capacity at the Main WWTP. Several collection system improvements implemented by ESD have taken advantage of this increased capacity. The net results of these low cost improvements include:

- A significant reduction of water-in-basement incidents attributable to wet weather surcharge of sanitary or combined sewers.
- Tremendous reduction in sanitary sewer overflows (SSOs). The City historically averaged 10 wet weather SSOs in
DON'T WAIT UNTIL IT'S TOO LATE.

Years of chemical treatment have aged your clarifier!

Restore your clarifier to original performance with Crane Engineering’s 100% TURNKEY Clarifier Rehabilitation service.

Crane’s Clarifier Rehab Service Includes:
- Complete Clarifier Tank Rehabilitations (Concrete or Steel)
- Clarifier Drive Rebuilds
- Clarifier Drive Retrofits/Exchanges
- In-Place Drive Repairs
- Structural Repairs
- Piping Repairs and Replacements
- Skimmer Arm and Beach Repairs/Replacements
- Center Column Replacements/Repairs
- Painting/Coating
- Troubleshooting/Inspections

“A couple years ago, we noticed we had paint failing on our clarifiers. We put the job out to bid, and Crane Engineering was the most cost effective option for all three clarifiers. They were very professional, knew exactly what to do, and hardly asked us for anything. So far they’ve completed two clarifiers for us, and are working on a third. If we had to do it again, my first call would be to Crane Engineering.”

-- Wisconsin Wastewater Operator

Call 920-733-4425 or go to craneengineering.net
recent years, and experienced a 50% reduction in SSOs in 2014 and a 100% reduction (no SSOs at all) in 2015.

- Attaining ESD’s goal of maximizing treatment at the Main WWTP and minimizing CSTP discharge volumes (when the storage at the CSTPs is full and CSTP treatment/discharge must be implemented).

- Zero combined sewer overflows (CSOs) since 2012.

Bottom Line – Cost Savings

Initial estimates to expand the plant’s capacity to achieve full nitrification with state of the art new clarifiers were over $40 million, with new clarifiers alone representing $10 million of that. The improvements discussed above have cost the City approximately $1 million, broken out as:

- RAS Pumping Improvements - $234,000
- SRT Control and Microscopic analysis – No Cost
- RAS Chlorination Improvements - $5,000 (performed by ESD staff)
- Final Clarifier & High Flow Step Feed Splitter Box Improvements - $760,000
- Final Clarifier Flocculating Inlet Modifications (FIMs) - $15,000 (performed by ESD staff)

The resulting savings have allowed ESD the ability to direct more resources to the root of its wet weather challenges, collection system improvements, while maximizing the return on the dollars it has spent on full treatment capacity.

Future Opportunities

With the improvements in service, the City has been able to take advantage of the increased effective capacity. In April 2014, the Main Treatment Plant was able to effectively treat the highest volume of water on record, which was 15% higher than the previous record.

In November and December of 2015, the City was able to break the record for the most amount of water treated through the Main Plant in those months. As the City gains more experience with optimizing the new infrastructure, the intention is to continue to challenge the system and identify additional improvements, and to continue efforts to reduce the risks of sanitary sewer overflows and water-in-basement incidents.

On occasion the Main WWTP is challenged by low food to microorganism (F:M) ratios in the complete mix aeration basins, which can contribute to ML settleability challenges. As such future short term improvements will focus on modifications to biologically control settleability through such things as converting Aeration Basin 1 from a complete mix to a plug flow configuration, possibly later followed by addition of selector zones upstream of the aeration basins.

Through such continued low cost modifications the Superior ESD will continue its proud, proven and cost/value effective stewardship of the City’s water environment.
Dorner Municipal Products & Services
Valves – Instruments & Controls – Piping Accessories – Specialties – Service

Valves: Air Release, Altitude, Ball, Ball Check, Butterfly, Check, Cone, Control, Diaphragm, Float, Foot, Gate, Globe, Knife Gate, Mud, Pinch, Plastic, Plug, Ported Gate, Pressure Reducing, Pressure Relief, Solenoid, Triple Offset, Telescopic, Vacuum and 3-Way

Actuators: Electric, Electro-Hydraulic, Battery Back-up, Fail Safe, Hydraulic, and Pneumatic

Gauges: Pressure and Temperature

Instruments: Positioners and Venturi Tubes

Piping Accessories: Couplings, Expansion Joints, Heat Tracing, Drum Heaters, Pipe Supports, Saddles, Strainers, Valve Boxes, Pipe Markers and Valve Tags


Service: In-Shop and Field Services, Repair, Start-up, Training, Custom Design and Calibration

Main Office & Warehouse: N61W23043 Silver Spring Drive PO Box 189 Sussex, WI 53089-0189
Phone: (262) 932-2100 Fax: (262) 932-2101 E-mail: sales@dornerco.com Web: www.dornerco.com
Illinois Office: 1955 Sunny Dell Court Yorkville, IL 60560 Phone: (630) 553-6932 Fax: (262) 932-2101
2016 Technical Committee

From: Jeff Bratz – 2016 Technical Committee Chair

As I write this report for the 2016 Annual Convention Technical Committee, presentations for next October are coming in at a quick pace. They are very interesting and cover many areas requested in the questionnaires.

The Technical Committee Meeting is scheduled on Thursday, February 11, 2016 at the Marriott Madison West Hotel and Convention Center, 1313 John Q. Hammons Drive, Middleton, WI 53562.

The Board of Directors has had a meeting in LaCrosse, at the Radisson, to continue preparation for the 50th Anniversary of the WWOA Annual Conference. More news to come in the next issues of the Clarifier.

Jeff Bratz, Chair
2016 Technical Committee

Spring Biosolids Symposium
March 22, 2016
Holiday Inn and Convention Center, Stevens Point, WI
Hotel reservations open
On-line Registration opening soon. Check out the WWOA website calendar for hotel and Symposium information.

2016 WWOA Exhibitor Registration Now Open
You can register on-line or via mail.
Early registration runs Jan. 4, 2016 through June 30, 2016
Join us for an exceptional conference & expo.
Check out the WWOA website for more info and to register.

For more information on the Spring Biosolids Symposium or 2016 WWOA Exhibitor Registration contact Karen Harter, WWOA Executive Secretary 608-355-3081 Secretary@wwoa.org

NOT YOUR TYPICAL
Treatment Plant Consultants

Our well-rounded team has decades of experience as water and wastewater superintendents, treatment operators, engineers and regulators. We don’t stop at planning and design services. Instead, we apply our inside knowledge of what it takes to run a plant to help you keep your water and wastewater systems operating efficiently and safely.

Contact Troy Gallagher to learn more about how we can make your treatment system more efficient.

Mead & Hunt  troy.gallagher@meadhunt.com  906-273-1568

VEGAPULS WL 61
Radar Sensor for Level Measurement of Water and Wastewater

- Extensive mounting options allow for simple integration into any area of the facility
  - Mounting strap
  - Mounting bracket
  - Compression flange
  - Cable suspension
  - Ceiling reflector
  - Integral threads
- Easily adjust the sensor during startup with installation possibilities ranging from wall mounting at any angle to suspension from the sensor cable
- Radar signals can pass through plastic and fiberglass, ideal for external mounting on chemical tanks

VEGA’s combination of speed, excellent support, and reliable performance ensures we are the right partner for your level measurement needs.
Past WWOA Presidents – We Need to Hear From You!

We are in the process of assembling a WWOA 50th Golden Anniversary Commemorative Book for the 50th Annual Meeting this fall in La Crosse. Ken Sedmak has extended an invitation by email for the Presidents of the last 25 years to submit their thoughts for publishing in the book much the same as was done in the 25th Silver Anniversary Commemorative Book in 1991.

Ken’s request is as follows:

We are celebrating the 50 year anniversary of the WWOA in 2016 at La Crosse. As a part of the celebration we are updating the 25th anniversary booklet to include the recent members and activities of this great organization. As a part of the update we need all the past 25 presidents to write their memories as president.

The memory should be about 300 words and also contain your picture. Please send me the memory as a word file on or before January 31, 2016. I will compile the documents and send them to Jon Butt for incorporation into the archive of the WWOA 50th anniversary commemorative booklet. My email is ken@sedmaks.com

As of early January he has only heard from less than half of you. We want and need your contribution to make the 50th as memorable as the 25th. The deadline will be extended to March 1st for those of you who read this in the February issue of the Clarifier.

Please take time to contribute to this great organization that has served its members so well for the last 50 Annual Conferences. If you are unable to send your thoughts as a Word file, call Dan at (920) 434-2739 or Ken at (920) 889-3548 and we’ll work out something.

Ken Sedmak and Dan Busch
WWOA 50th Anniversary Committee

We move water.

Full Service Process Control Integration and Service Expertise for Fresh Water and Wastewater Treatment Plants

Aeration
Alarm Systems
Calibrations
Chemical Feed Systems
Controls
Cross Connections
Instrumentation Devices
Level Measurement
Lift Stations
Process Equipment
Pumps/Rotary Equipment
Remote Monitoring
SCADA/Telemetry Panels

B&M Technical Service, Inc.
715.228.7604    bmtechservice.com
increased productivity
lower maintenance costs
lower cost of ownership
lower operating costs
high performance panel diffuser

The EDI STREAMLINE® panel utilizes innovative integral diffusers, tubular membranes and inline support components to deliver a new level of simplicity and service like never before available. STREAMLINE® can be configured to any industrial or municipal application, tank size or geometry. STREAMLINE®'s efficient geometry supports low flux rates resulting in ultra high OTE performance with engineered materials for maximum chemical, temperature and UV resistance for reduced fouling and optimum performance. With 1000's of installations worldwide, the STREAMLINE® panel has a long history of success.

Why is a round panel better than flat panel? Visit www.streamlinediffuser.com to see a side by side comparison.
Quality lab supplies
at prices YOU can afford!

- Free technical support for equipment and test procedures
- Next day delivery at ground prices in Wisconsin
- Unbeatable prices and service
  - BOD Supplies
  - pH Meters & Probes
  - DO Meters & Probes
  - TSS Testing Equipment
  - Glassware & Plasticware
  - Coliform Equipment & Supplies
  - BOD Standards & BOD Seed
  - Spectrophotometers & Colorimeters
  - Reagents, Titrants, Indicators & Standards
  - ISE Meters & Probes - Ammonia, Chlorine, Nitrate, Fluoride & Chloride
  - Stir Plates, Hot Plates, Microscopes, Sludge Judge, Sampling Scoops & Centrifuges

Call Today 1.800.648.7836
Visit us Online www.nclabs.com

Serving all your water & wastewater needs since 1985