CASE STUDY:
MUNICIPAL WWTP - INSTALL OF BIOS AND PAL CONTROL SOLUTION
CITY OF LEBANON, PA
INSTALL DATE: JUNE 2012

SYNOPSIS
Advanced treatment including BNR (Biological Nutrient Removal) facilities requires precise operational control to produce the desired result. Next-generation, intelligent control solutions provide the know-how and precision automation necessary to operate these facilities. With almost 30 online instruments, intuitive user interfaces, predictive and adaptive logic, and multiple fail-safes and overrides “very few changes are required by the system when in auto and we are exceeding our original goals [...] in large part to the robust system designed by BioChem.” – Frank DiScullio Jr., Wastewater Systems Director

BACKGROUND
In June of 2012, the City of Lebanon Authority began a BNR upgrade project to reduce their region’s environmental impact on the Chesapeake Bay. The plant’s goals were to reduce Total Phosphorous to 0.8mg/L and Total Nitrogen to 6mg/L. Total Nitrogen objectives are required to support a TMDL (Total Maximum Daily Load) of 146,000 pounds per annum or approximately 8mg/L at the plant design flow.

To satisfy these increasingly stringent effluent requirements, an Integrated Fixed Film Activated Sludge (IFAS) process with anoxic/aerobic swing zones and polishing denitrification filters was constructed to provide the necessary BNR treatment in the small plant footprint available. Coarse bubble diffusers were used in the IFAS zones for air scouring and increased mixing whereas fine bubble diffusers were provided in the swings zones for energy efficient supplemental aeration.

CHALLENGE
Complex, advanced treatment facilities including BNR plants frequently require a level of operational precision that is beyond the capabilities of traditional plant staffing. Simple feedback control systems traditionally employed to automate similar processes frequently sacrifice precision and accuracy for reliability and cannot typically be depended on to facilitate the achievement of plant effluent goals. The Lebanon facility was particularly challenging in this respect as it consisted of multiple different biological treatment processes and utilized both fine pore and course bubble aeration hardware.

EXECUTION
The BIOS and PAL Control Solutions were installed to tackle the challenges in this project. BioChem’s BIOS (Bioprocess Intelligent Optimization System) and PAL (Predictive Aeration Logic) provide integrated process and operational control of the entire biological process.

BioChem is the digital technology enabler of “Symphony” – an operations management system for biological processes.
EXECUTION CONTD.
Control of key high frequency operating functions includes:

- Determination of optimal DO set-points for all biological treatment zones including the operating function of swing zones
- Control of both coarse and fine bubble systems
- Reprogramming single-stage blower MCP for flow based operation
- Control of internal mixed liquor recycle flows
- Control of trickling filter bypass for denitrification carbon balance
- Control of supplemental chemical feeds

RESULT
The PAL and BIOS control systems together conduct the secondary treatment process to exceed the plant’s daily TN and P effluent goals. In 2015, the plant discharged a total of 65,471 pounds of nitrogen compared to its permitted limit of 146,000 pounds, and did so while reducing aeration and energy requirements between 40%-47% vs. manual control.

**BioChem has given the City of Lebanon Authority the ability to look at historical trends by providing an additional computer and monitor inside the control panel. This has been very beneficial in troubleshooting. Recently, we had an air valve that was torque tripping every couple of hours and with BioChem’s backup control, the valve would go to 50% to provide sufficient air to that zone even though the valve had malfunctioned. We could use the historical trends to see what was happening and fix the problem.**

**BioChem was very easy to work with from the beginning. I recall changes that were made during our first trip to their facility for Factory Testing. During startup, they would work to make sure we understood how to operate the system and make changes to suit our needs. When they weren’t at our facility, they were quick to respond to phone calls, emails and text messages.**

**Our Operators find the Bioreactor Process Control System is very easy to navigate and make changes. However, very few changes need to be made when everything is in Auto. Today, we are exceeding our original goals and can reduce Total Phosphorous to as low as 0.4 mg/L and Total Nitrogen to 3 mg/L in large part to the robust system that was designed by BioChem.**

- **Satisfied Customer**
  
  Frank DiScuillo Jr., Wastewater Systems Director  
  City of Lebanon Authority, Lebanon, Pennsylvania
CASE STUDY:
INDUSTRIAL WWTP - PREDICTIVE AERATION LOGIC (PAL) APPLICATION
CITY OF QUINCY, WA
INSTALL DATE: JUNE 2015

SYNOPSIS
Energy efficient blowers and BioChem’s PAL control system were installed at this industrial wastewater treatment plant case. These combined technologies are providing the plant a 57% savings in energy. That is equivalent to a $97,000 reduction in electric power use per year. Thus, the investment including rebates from the Grant County Public Utility District will be fully recovered in just over 3.5 years.

BACKGROUND
The plant treats just over 3MGD using two alternating-duty, sequencing batch reactors (SBR). The project was originally initiated by the failure of one of the plant’s 600hp, multi-stage centrifugal blowers. Based on BioChem’s recommendation, two 320hp positive displacement blowers with variable frequency drives were installed; so that the output of the blowers could be paced to the variable loads associated with the waste stream and SBR process. BioChem provided its patented, self-tuning PAL control software, equipped the main control panel with customized HMI, and integrated the plant’s local blower and other control room functions to this panel using Ethernet and Modbus RTU communication. BioChem partnered with Pace Engineering and Atlas Copco on this project.

CHALLENGE
This project presented various challenges; mostly having to do with the physical space to locate the blowers, different communication protocols within the plant, and the need to program an airflow “floor” into the control algorithm in the interest of maintaining minimum mixing even during periods of otherwise low process oxygen demand. These minimum aeration rates for mixing had to be customized for the unique shape and aerator characteristics of each basin. These challenges were well within the grasp and technical expertise of BioChem engineers. Even though SBRs are generally among the least complicated of treatment processes, and even though this plant’s cost of energy is less than half the national average, the savings were still dramatic in size.

EXECUTION
BioChem’s PAL (Predictive Aeration Logic) Control Solutions were installed to tackle the challenges in this project. BioChem is the digital technology enabler of “Symphony” – an operations management system for biological processes.

www.symphony-water.com

Operations Management System for Biological Processes
CASE STUDY: CITY OF QUINCY, WA
INDUSTRIAL WWTP - PREDICTIVE AERATION LOGIC (PAL) APPLICATION

EXECUTION CONTD.

- BioChem designed and provided the main control panel supporting Modbus, Ethernet IP and analog 4-20mA communication protocols, tying all systems seamlessly together.
- Installed and customized (according to minimum mixing requirements) its patented, energy saving PAL control software.
- Completed full integration and commissioning with less than a week on site.
- Performance results were monitored over a four-month monitoring and verification period against a prior year baseline.

RESULT

Observed and documented (Pace Engineering) power savings of 57% were achieved with no degradation of process performance. These savings, which translate to $97K annually. That saving, coupled with a $240K rebate awarded by the public utility, provide a payback period on the entire project (blowers, VFDs, instruments, software) of just over 3.5 years.

Quincy Energy Savings Projections

Quincy Power Saving

<table>
<thead>
<tr>
<th></th>
<th>2013 Power Use (kWh)</th>
<th>2015 Power Use (kWh)</th>
<th>Power Reduction (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun</td>
<td>424,200</td>
<td>171,000</td>
<td>253,200</td>
</tr>
<tr>
<td>Jul</td>
<td>401,400</td>
<td>177,600</td>
<td>223,800</td>
</tr>
<tr>
<td>Aug</td>
<td>321,600</td>
<td>148,800</td>
<td>172,800</td>
</tr>
<tr>
<td>Sep</td>
<td>347,400</td>
<td>138,000</td>
<td>209,400</td>
</tr>
<tr>
<td>Total (Jun - Sep)</td>
<td>1,494,600</td>
<td>635,400</td>
<td>859,200</td>
</tr>
</tbody>
</table>

Quincy Cost Saving

<table>
<thead>
<tr>
<th></th>
<th>2013 Power Cost</th>
<th>2015 Power Cost</th>
<th>Cost Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun</td>
<td>$11,670</td>
<td>$4,704</td>
<td>$6,966</td>
</tr>
<tr>
<td>Jul</td>
<td>$11,170</td>
<td>$4,942</td>
<td>$6,228</td>
</tr>
<tr>
<td>Aug</td>
<td>$9,554</td>
<td>$4,421</td>
<td>$5,133</td>
</tr>
<tr>
<td>Sep</td>
<td>$8,995</td>
<td>$3,573</td>
<td>$5,422</td>
</tr>
<tr>
<td>Total (Jun - Sep)</td>
<td>$41,389</td>
<td>$17,640</td>
<td>$23,749</td>
</tr>
</tbody>
</table>

Operations Management System for Biological Processes