

A BOD Breather

Oxygenation system reduces BOD for Tennessee poultry supplier

By Barry Calfee

Dissolved air flotation (DAF) is highly effective for removing fats, oils and grease (FOG) and total suspended solids (TSS) from wastewater, yet it is less effective for reducing biochemical oxygen demand (BOD). In many locales, that may not matter. In others, it could result in community issues or publicly owned treatment works (POTW) surcharges. The BOD treatment solution at Koch Foods involved a custom-designed Linde SOLVOX oxygenation system before the DAF unit.

As a poultry supplier to the fast food industry, Koch Foods LLC seeks to manage operations sustainably by adhering to regulatory requirements and guidelines, minimizing environmental impact and playing a positive role in the community.

Koch Foods' Morristown, Tenn., deboning facility produces more than 70 million lb of cut wings and boneless chicken nuggets, tenders and breasts every year. Situated in the hills of eastern Tennessee about 50 miles east of Knoxville, the plant operates 24 hours a day, six days a week, on three eight-hour shifts. More than 600 people are involved in the production process. The total process wastewater flow rate at the plant averages about 130,000 gal per day.

From 2007 to 2011, production rates at the poultry deboning plant increased about 50%, boosting the mass loadings of organics in the effluent. The raw wastewater from the poultry plant contains significant quantities of BOD, TSS and FOG.

The onsite wastewater treatment operation begins with a fine

screening system for solids. Effluent then passes through an equalization (EQ) tank with mechanical mixing and aeration, and finally into a DAF system for final separation of organics prior to discharge to the POTW. The DAF system includes a polymer-assisted flocculation unit to coagulate organics prior to the air flotation tank.

Despite the increase in plant production, routine compliance sampling showed the plant's pretreatment system performing well in 2012, with treated effluent concentrations averaging about 540 mg/L BOD₅, 5 mg/L FOG and 72 mg/L TSS. Further BOD reduction occurs as part of Morristown's municipal wastewater treatment process prior to clean water discharge into the environment. Nonetheless, the plant wanted to minimize BOD₅ concentrations above 500 mg/L to limit potential surcharges from the city. Achieving this goal would not only help Morristown reduce overall BOD abatement measures at the POTW, but it could help Koch Foods further minimize plant odor and environmental impact in the face of burgeoning demand for its poultry products.

Koch Foods contacted Larry W. Moore, Ph.D., P.E., a professor of environmental engineering at the University of Memphis, to further investigate BOD treatment solutions. The wastewater treatment complex outside the processing plant was analyzed on behalf of the city of Morristown and the Tennessee Manufacturing Extension Program (TMEP). This analysis also reviewed other treatment options to further reduce BOD cost-effectively. TMEP does not endorse or



Control panel



Custom-designed injection header



The plant's 6,000-gal liquid oxygen tank

warranty any specific method, product, process or service. It is an industrial assistance program designed to help industries make sound decisions regarding environmental management.

Reviewing System Performance

The screening operation facilitates removal of most large solids using a rotary drum fine screen, and removes about 25% of TSS. The wastewater is pumped into a 225,000-gal EQ tank that uses fine-bubble diffusers for aeration to minimize odors. Additional mixing is delivered from above with a downdraft impeller.

The 2012 effluent sampling implied that the screening device, flocculation/coagulation process and DAF unit were being maintained for high efficiency. Initial calculations estimated that the pretreatment system was achieving about 98% removal of FOG and 94% removal of TSS. Based on initial estimates of BOD5 concentration from the plant, overall BOD5 removal for the entire pretreatment process was estimated at 78%.

This performance was achieved even though overall mass loadings and BOD5 concentrations were estimated to be 120% higher than five years earlier. In addition, water conservation efforts maintained a relatively constant water usage while poultry production increased by 50%. (The fraction of product flavored with marinade also increased about 50%.)

For a baseline view of the process wastewater, seven different wastewater sources from the processing plant were analyzed to estimate their contributions of BOD5, soluble BOD5, TSS and FOG to the overall waste stream. Although there were limitations in the sampling due to variability of organic solids, testing revealed that the primary skinning operation was contributing more than half of the BOD5 (mass loading), about three-fourths of the TSS and almost all the FOG mass loading.

The wastewater treatment process is tested by Koch Foods at regular intervals every month. In the six months leading up to the new BOD control measures in July 2013, the conventional



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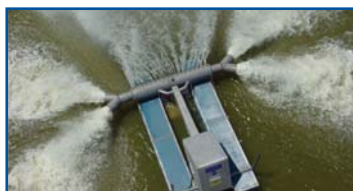


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DAF system averaged 903 mg/L BOD₅, highlighting the need for greater control.

Options for Reducing BOD

Koch Foods first considered acid treatment to drop the pH of the process wastewater prior to the DAF unit. This would provide a more complete breakdown of the oil-water emulsion than the current five-chemical regimen. It was estimated that acidifying the wastewater to pH 2.5 after the EQ basin would increase overall BOD removal of the pretreatment system to about 87%, and produce a final effluent BOD₅ concentration of about 330 mg/L. This provided a useful benchmark, but an acid-free treatment would be preferable.

Another conventional wastewater treatment method for BOD reduction is oxygenation. While the DAF unit can readily separate BOD solids, it makes only a minor impact on soluble BOD. The most common injection point is after the DAF unit. Moore suggested the aerated EQ tank ahead of the DAF unit as another option.

Koch Foods contacted Linde LLC of Murray Hill, N.J., to design and install a custom SOLVOX oxygenation system to replace the existing tank aeration. Because air is only 21% oxygen, enrichment with 100% oxygen could potentially provide an effective solution. Estimates indicated that the system also could operate as cost-effectively as acid treatment. In addition, it would eliminate the need for a new treatment tank, and avoid the associated storage and handling of hazardous chemicals. In short, SOLVOX provided a favorable environmental alternative that also was cost-effective.

In the six months leading up to system startup in July 2013, the effluent BOD₅ concentration had climbed to an average of more than 900 mg/L with the conventional DAF system. The target for the new oxygenation system was a 50% reduction. After the SOLVOX installation, effluent BOD₅ levels immediately dropped 90%. As expected, the system operates better in warm weather. **IWWD**

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