CASE STUDY

Application: Wastewater treatment

Customer: Industrial/Municipal

Location:
City of St. Helens, Oregon

Problem:
High electrical costs in shared industrial/ municipal wastewater plant

Solution:
Install 7 SolarBee SB10000 v18 mixers to reduce runtime, improve mixing

Result:
Aeration runtime reduced 50 percent; nearly complete mixing to 20 feet

City of St. Helens, Boise Paper team up to reduce aeration horsepower over 50 percent in shared wastewater treatment plant

Rebate from Columbia River PUD and support from the Bonneville Power Administration's Energy Smart Industrial program contributes to two-year payback; city poised for new economic growth.

ST. HELENS, OREGON, USA – Along the banks of the Columbia River northwest of Portland, the city of St. Helens has seen the growth of several industries over its 160-year existence: lumber, mining, quarrying, manufacturing and shipping, as the city was originally established as a port. The city and its industries are used to working together in many ways for the benefit of the community. One of the more unique collaborations is that St. Helens (population 13,000) and the town's major industry, Boise Paper, share the wastewater treatment plant and even the EPA-required NPDES (National Pollutant Discharge Elimination System) permit along with it. The two organizations work together closely to meet mutual goals, the main one being to operate the plant as effectively and cost-efficiently as possible.

Toward this goal, a recent project to reduce the cost of aeration in the 42-acre lagoon led to the installation of solar-powered, long-distance circulation mixers from SolarBee, Inc. The city and the mill not only cut their energy costs but the project also qualified for a rebate from their serving electric utility, Columbia River PUD, with support from the Bonneville Power Administration's Energy Smart Industrial (ESI) program (see sidebar). Aeration runtime costs are down more than 50 percent and payback in just two years is anticipated.

The control room at the St. Helens wastewater treatment plant offers a view of the lagoons and the mill.

Secondary lagoon is focus of energy-reduction project

The St. Helens wastewater treatment plant was built in 1970 under terms of an operation and use agreement. Before 1970, the mill removed suspended solids with a primary clarifier and discharged into the river. Because a shared wastewater treatment plant made sense, Boise Paper donated the land to the city, and the city built the plant with municipal bonds. With the new plant, the mill gained secondary treatment and the ability to reduce biochemical oxygen demand (BOD) load. The city and the mill have shared the NPDES permit since 2004.

The current wastewater treatment plant consists of two ponds: a three-acre primary lagoon that receives loading from the city and smaller industries, and a 40- acre secondary lagoon that receives effluent from the city's primary pond and from the mill's primary clarifier. The secondary lagoon is divided into three zones by baffles. Prior to the energy reduction project, 24 mechanical surface aerators in the first two zones ranged from 50 to 150 hp and operated approximately 2100 hp/day, effectively making them partial-mix zones. The aerators were alternated to maintain thorough mixing: five to six aerators ran constantly in Zone 1 and one aerator in Zone 2. A SCADA control system rotated the aerators automatically depending on the level of dissolved oxygen. Zone 3 is a quiescent area, where the solids are allowed to settle. The secondary effluent is discharged into the Columbia River, past Sauvie Island 650 feet into the channel.

The size of the lagoon was adequate for the needs of the mill and the city when Boise Paper operated as both a pulp and paper mill. "We used to contribute 98 percent of the BOD load and 35 million gallons of water a day," said Alison Dean, environmental engineer with Boise Paper. "Because we were such a huge contributor, we basically treated the secondary treatment as though it was totally our cost. The mill paid for maintenance and repair even though the city owns it."

But times changed. Boise shut down its pulp processing operations in January 2010 and today operates solely as a paper mill. According to Aaron Kunders, superintendent of the St. Helens wastewater treatment plant, "We're now down to about five million gallons a day of flow from 35 million gallons a day. The mill was giving us between 50,000 to 60,000 pounds of BOD a day and now we're getting about 1,500 lbs. Despite the significant reduction in loading, we had a great system and didn't want to have to block off part of it because we weren't using it."

SolarBee solar-powered mixers help reduce aeration runtime and improve mixing.

Aaron Kunders, superintendent, St. Helens wastewater treatment plant, expects to turn off the aerators even more and allow SolarBee solar-powered units to do the mixing work for the lagoon.

Solar-powered circulation provides biggest payback

When the mill reduced its loading on the wastewater treatment plant, the focus changed from maintaining the aerators to reducing the electricity required to run them. "Boise Paper was working on a variety of energy reduction projects," said Dean, "including reducing energy at the wastewater treatment plant. We had been able to decrease aeration down to the point where mixing was the limiting factor. The secondary treatment lagoon was still expensive to operate, and we searched for ways to reduce those costs."

Cascade Energy Engineering, a BPA ESI program implementation partner, conducted a study at the request of, Columbia River PUD, to consider energy-saving solutions at the plant. It studied seven months of operational data from the plant's SCADA system, as well as input from plant personnel.

Kunders, who has been at the job for 11 years, was familiar with SolarBee mixers from his first years at the plant. "Back then, we looked at SolarBee mixers to help reduce sludge. At that time, however, the budget went toward maintaining the aerators. When the focus shifted to energy savings, I brought up SolarBee products and thought we should look into them."

Engineers considered three options in their study report (total cost consideration follows):

1) Replace a portion of the existing surface aerator propeller blades to a lower pitch. This would reduce aeration power but also reduce mixing.

2) Replace a portion of the existing surface aerators with aspirating aerators. This would provide adequate aeration, but would create only localized mixing due to the small impellers used.

3) Replace a portion of the existing surface aerators with solar-powered mixers. This would reduce the runtime of existing aerators or the number of aerators while also improving mixing.

Savings and Cost Summary

Cost of Energy:	$0.0406 /kWh
Cost of Demand:	$4.400 /kW

EEM No.	Description	Include in Package	Annual Energy Savings (kWh/yr)	Monthly Demand Savings (kW/mo)	Annual Energy Cost Savings ($)	Annual Demand Cost Savings ($)	Annual Total Cost Savings ($)	Cost Eligible for Incentives ($)	Pre-Incentive Payback (years)
1A	Install lower pitched propeller blades	Yes	119,553	3.0	$4,854	$158	$5,012	$13,750	2.7
1B	Install aspirating aerators	Yes	91,747	2.0	$3,725	$106	$3,831	$187,950	49.1
1C	Install solar powered aerators	Yes	1,375,518	44.0	$55,846	$2,323	$58,169	$384,344	6.6
TOTALS FOR RECOMMENDED MEASURES			**1,586,817**	**49.0**	**$64,425**	**$2,587**	**$67,012**	**$586,044**	**8.7**

Note: Demand savings were calculated as 50% of the energy savings. Demand charge is from 6am to 10pm daily, except Sundays.

Incentive Summary

Energy Incentive Rate	$0.25 /kWh
Incentive Cap, % of Project Cost:	70% /kWh

		Columbia River PUD/BPA Incentive Calculation				
EEM No.	Description	Incentive Cap, Project Cost ($)	Incentive Cap, Energy Savings ($)	Final Incentive ($)	Cost After Incentive ($)	Final Payback (yrs)
1A	Install lower pitched propeller blades	$9,625	$29,888	$9,625	$4,125	0.8
1B	Install aspirating aerators	$131,565	$22,937	$22,937	$165,013	43.1
1C	Install solar powered aerators	$269,041	$343,879	$269,041	$115,303	2.0
TOTALS FOR RECOMMENDED MEASURES		**$410,231**	**$396,704**	**$301,603**	**$284,442**	**4.2**

Fraction of Project Cost Covered by Incentives:	51.5%

Rebate from Columbia River PUD and support from BPA's Energy Smart Industrial program makes the entire project affordable

The Bonneville Power Administration (BPA), part of the U.S. Department of Energy, is charged to act as the steward of the Federal Columbia River Power System and markets wholesale hydroelectric power to the public utilities of the Pacific Northwest. Serving a region with12 million residents, BPA markets and transmits the power generated by 31 federal dams in the Columbia River Basin. Columbia River PUD, the utility serving St. Helens, is one of BPA's 140 utility customers, and is an active partner in implementing regional conservation programs.

To help keep power rates low and act as stewards of the Northwest environment, BPA acquires energy efficiency as a power resource. As part of this mission BPA launched the Energy Smart Industrial (ESI) program to assist in the implementation of cost-effective, energy efficiency programs in the industrial sector. The ESI program has helped to nearly double the industrial energy savings in the region with a 12 aMW load reduction in fiscal year 2010 and a projected reduction of 15 aMW in fiscal year 2011.

BPA' ESI program pays financial incentives to BPA's participating NW public utilities, like Columbia River PUD, so that they can reimburse some of the cost associated with the installation of cost effective conservation measures.

According to Layne McWilliams, the ESI program's water/wastewater sector specialist, "Through the ESI program, BPA is making a concentrated effort to find and implement energy conservation projects within the water and wastewater systems in BPA's territory. Our goal is energy conservation, and the St. Helens project is a great example of how a facility can do its job – providing excellent effluent quality – but do it much more efficiently. (BPA's ESI) program offers no-cost assistance to facility owners, operators, vendors, and consultants to help identify opportunities, and I encourage folks to think outside the traditional conservation box of 'VFDs and lighting.' Certainly those are important components, but there are savings to be found in all kinds of projects. St. Helens is one project in one small town – think of the opportunities region-wide."

For more information on obtaining assistance from the ESI program for your water or wastewater system, contact Jennifer Eskil at jleskil@bpa.gov or Layne at layne.mcwilliams@energysmartindustrial.com or 971-244-8581. Program information is available at www.energysmartindustrial.com.

According to the study, the lower-pitched propeller blades would save 119,553 kW/yr; the aspirating aerators would save 91,747 kW/yr; and the solar-powered mixers would save 1,375,518 kW/yr[1].

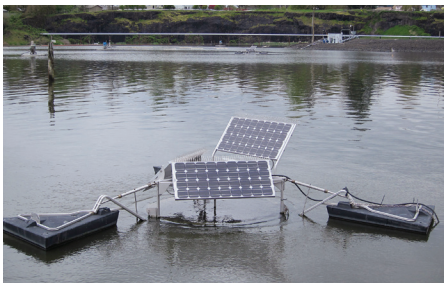
Solar-powered mixers cut more than 50 percent of aeration horsepower

The goal with this project was to increase system efficiency and enhance organic sludge digestion.

"To me, the choice was obvious," said Kunders. "Due to the energy savings and the resources available through the ESI program, Columbia River PUD was able to provide a 70 percent rebate for the cost of the mixers. It brought the price so far down that our payback was two years. In two years we have a payoff and in four years we make that money back. Instead of these other little projects we were thinking of, this one cost a lot more up front, but it also has the biggest return." (For information on BPA's ESI program, see sidebar.)

The solution was to install seven SolarBee SB10000 v18 machines, five of them in Zone 1 and two of them in Zone 2. The solution was based on an influent flow rate of 12 MGD and average sludge depths of 6.5 feet in Zones 1 and 2 and 13 feet in Zone 3. The SolarBee mixers are spaced at approximately 4 acres. Each SolarBee mixer can displace between 30 and 60 hp of aeration.

[1] Source: Project Assessment Report, Cascade Energy Engineering, Feb. 10, 2010



SolarBee's patented long-distance circulation technology creates a near-laminar flow pattern that completely mixes the water column and improves distribution of dissolved oxygen

Although the long-distance mixing effect of SolarBee units can also reduce BOD, "We weren't going for that," said Kunders. "We were going for the energy savings."

"Right now we're saving over 50 percent of horsepower," he said. "We were at 550 hp/day before we added SolarBee mixers, and now we're at approximately 250 hp. Plus, we're getting nearly complete mixing at up to 20 feet deep in the 28-foot secondary lagoon. Typical aerators only mix the top five to six feet. And we're not done turning off the aerators. We take them down in stages. We can still turn them off a little bit more but we don't want to upset the lagoon. At first we were saving 40 percent, now we're saving over 50 percent. Down the road we may turn them off more, but probably not until fall. During the summer, we take more advantage of the algae in the water. It's producing oxygen so we bring up everything from the bottom to mix with the oxygen."

Successful results prompt installation in city's primary lagoon

The success of the project prompted the city to install two more SolarBee mixers in the primary lagoon, which receives loading from the city and a few smaller industries. "The two additional SolarBees will cause us a little more maintenance because there's a lot more debris in that lagoon—rags and stuff—but we're hoping to shut off at least one aerator a day throughout the year," said Kunders.

Kunders says that the biggest payoff of the project is for taxpayers. "The cost for all these SolarBee mixers was offset so the cost doesn't have to go to our taxpayers. Instead of paying 100 percent of it, the city probably paid 10 percent of it (between the rebate and the mill's contribution), which is incredible. The citizens got a great deal on it."

With the wastewater treatment plant now redesigned for cost-efficient operation, St. Helens is poised for industrial growth, and the local economic development association is actively seeking industry. Already there's talk of building a new port terminal to accommodate coal exports shipped from Wyoming to China. The partnership has paid off for residents, city and mill—and for the community's future economic well-being.

About SolarBee™

SolarBee, Inc., a division of Medora Environmental, Inc., manufactures and installs solar-powered, long-distance water circulation equipment. Introduced in 2001, the floating, up-flow circulators can move up to 10,000 gallons per minute from depths of more than 100 feet with a solar-powered pump. SolarBee circulators help solve water-quality problems worldwide in freshwater lakes, wastewater lagoons, storm-water ponds, estuaries, potable and recycled water storage tanks and other reservoirs.

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Circulating the World's Water

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