CASE STUDY

Application: Wastewater treatment

Customer: Municipal

Location:
City of Eden, North Carolina

Problem:
High electrical costs from aeration

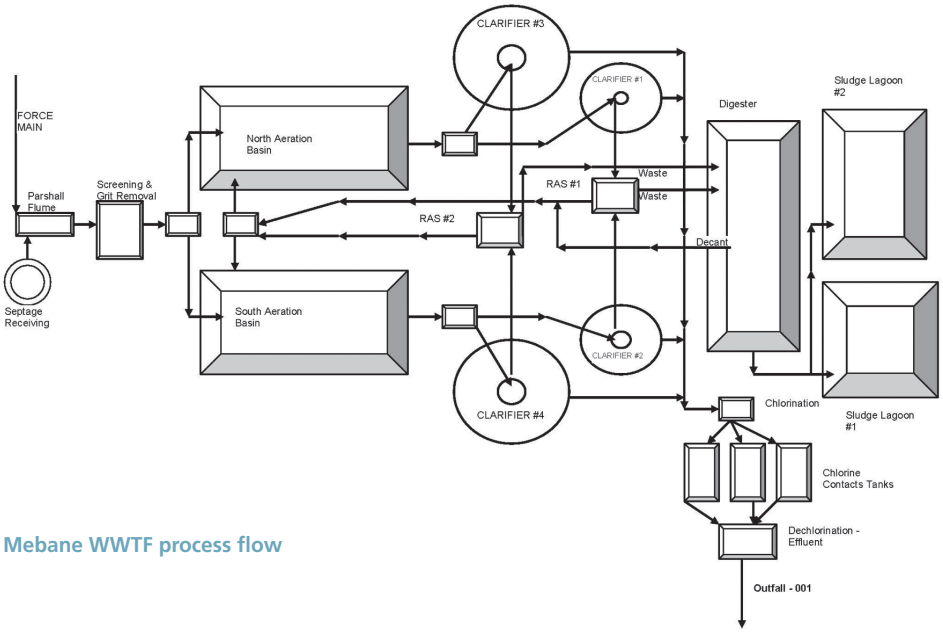
Solution:
Install SolarBee mixers to take over some of the mixing and oxygenation

Result:
Electricity cost reduced 50%

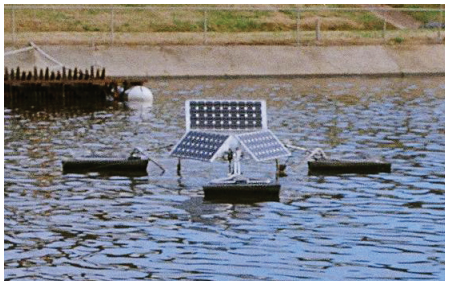
Eden, NC, wastewater treatment plant cuts aeration runtime almost in half with SolarBee solar-powered circulation technology

Activated sludge wastewater treatment plant cuts runtime of high-horsepower aerators, from 240 to 180 horsepower.

EDEN, North Carolina – There's a little piece of paradise in the foothills of the upper Piedmont area of North Carolina, but most folks here just call it Eden. Like many small towns, Eden is prized for its unique attractions—a vintage drive-in movie theater, annual bluegrass concert and rubber duck regatta to name a few—as well as proximity to big-city conveniences (Greensboro is about 30 miles to the south). Eden, with a population of 19,000, prides itself on embracing up-to-date technologies to ensure that basic services such as water and wastewater treatment are safe and efficient. The city's primary wastewater treatment plant was safe, but not as efficient as Superintendent Melinda Ward would like, due to the high cost of running the system's grid-powered aerators. She sought a solution that would reduce operating costs while complying with EPA requirements—or even improving on them—and she found her answer in solar-powered circulation technology from SolarBee. By taking over some of the mixing and oxygenation previously supplied solely by high-horsepower electric aerators, the solar-powered circulation units cut electric use almost in half and provided an 11-month payback. For Ward, that's paradise.



Mebane WWTF process flow



A SolarBee circulation unit installed in Eden, NC's activated sludge wastewater treatment plant helped reduce electric costs 42 percent.

Mebane Bridge activated sludge system

Activated sludge wastewater treatment plants are fairly common throughout North Carolina. The main WWTP serving Eden, the Mebane Bridge Wastewater Treatment Plant, treats about 3.5 million gallons of wastewater per day. The incoming wastewater is 80 percent municipal wastewater, 10 percent industrial wastewater and 10 percent raw water.

In the activated sludge process, a mixture of sewage and activated sludge is agitated and aerated. The activated sludge ("activated" in that the particles are teeming with bacteria and protozoa) is separated from the treated sewage by settling in the clarifiers and is then returned to the reactor basin to re-seed the new sewage entering the tank.

At the Mebane WWTP, a mechanical barscreen removes larger inert material, followed by a grit removal system (see diagram). Extensive aeration in the reactor basins reduces and removes biochemical oxygen demand (BOD). Most of the sludge or biosolids is returned to the reactor basins after settling in the clarifiers, while the rest is transferred to the digester for further processing. Clear water eventually leaves the clarifiers for chlorine disinfection, followed by dechlorination. The treated effluent is returned to the Dan River, meeting all State Permit Discharge requirements.

The South basin of the Mebane Bridge wastewater treatment plant, the main reactor basin where aeration is supplied for mixing, is an earthen impoundment measuring 1.74 surface acres with an operating depth of 13.5 ft and an average detention time of approximately four days. The South basin required 12 20-horsepower aerators for a total of 240-hp of aeration. This amount of aeration kept total suspended solids (TSS) in the 3,000 - 4,000 mg/L range, as required to meet EPA National Pollution Discharge Elimination System (NPDES) requirements.

"We ran brush aerators constantly to try and mix it all, but they could only mix and aerate the top half," said Ward. "The results were a high, wasteful level of dissolved oxygen at the top of the basin and a mass of sludge at the bottom that wasn't impacted by the treatment process."

Dissolved oxygen (DO) concentrations were 8-10 mg/L, much higher than needed, yet the aeration could not be turned down because it was needed to suspend the solids.

Ward considered several mixing options, most of which would have added to operating costs. She learned of SolarBee at a regional tradeshow, and after consultation with SolarBee engineers, installed one SolarBee SB 10000v18 unit and deactivated the three aerators closest to the solar-powered unit. Over time, she deactivated three additional aerators. "We could actually see the solids moving," she said. "It's amazing how the SolarBee mixer brings them up to the top of the basin." An additional but welcome benefit was better sludge settling at the clarifier, leading to reduced effluent TSS.

How SolarBee mixers work

SolarBee's patented long-distance circulation technology creates a near-laminar flow pattern that completely mixes the water column. The SolarBee unit installed at the Mebane Bridge South reactor basin consists of three floats that provide buoyancy for above water, near surface and underwater components. Solar panels, a low-voltage, gearless motor and control box are mounted on the above-water frame. A distribution dish, impeller and battery are suspended from the frame just below the surface. A three-foot diameter, flexible intake hose is attached to the frame at the base of the impeller.

The SolarBee unit transports about 10,000 gallons per minute of water to the surface. Approximately 3,000 gallons per minute of direct flow ascends through the intake hose; another 7,000 gallons per minute of induced flow ascends external to the hose. Water departs from the unit radially without turbulence, both above and below the distribution dish, mixing with other surface currents to redistribute water across the treatment area.

Results after one year of solar-powered circulation technology

Ward and the Eden wastewater team monitored effluent water quality parameters and electrical usage and cost for the first year of solar-powered mixing (June 2009 through May 2010) and compared the results with comparable data from the year immediately preceding (June 2008 through May 2009), when only aeration was used. The goal with the single SolarBee unit in one basin was to meet NPDES standards while reducing electricity costs.

The parameters measured were: wastewater influent (IN) quantity and effluent (EF) total suspended solids (TSS); biochemical oxygen demand (BOD); acidity or alkalinity (pH); dissolved oxygen (DO); ammonia nitrogen (AN); total nitrogen (TN);

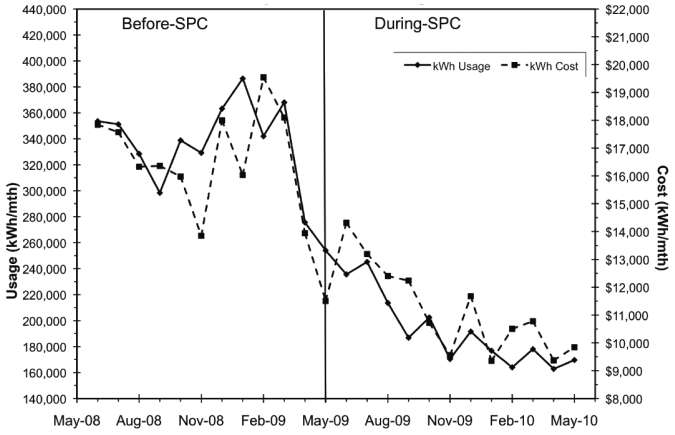
Melinda Ward, wastewater plant superintendent, Eden, sought a "green" solution that would reduce the high cost of running grid-powered aerators and improve mixing.

Table 1. Mean Monthly Parametric Values

	IN MG	TSS mg/L	BOD mg/L	pH su	DO mg/L	AN mg/L	TN mg/L	TP mg/L	FC units	kWh x1000	kWh Cost $
Pre-SPC	5.4	13.3	2.5	7.1	8.5	0.1	7.9	1.1	19.0	254	16,254
During-SPC	3.9	9.5	1.8	6.7	8.2	0.3	8.4*	0.3	3.8*	191	11,162

Inferential statistics were calculated using two-tailed Student t-tests. Statistically significant differences between mean Pre-SPC and During-SPC periods at $\alpha = 0.05$ are indicated in bold in the During-SPC row. Additional statistically significant differences at $\alpha = 0.1$ are indicated by asterisks (*).

Table 2. Monthly grid power usage and costs



NPDES limits:

TSS mean monthly = 30 mg/l, mean weekly = 45 mg/l;

BOD mean monthly = 30 mg/l, mean weekly = 45 mg/l;

pH daily 6-9 su;

AN mean weekly = 14.8 mg/l;

TN mean monthly = 12.7 mg/l.

total phosphorous (TP); and fecal coliform (FC).

During the first year of the study, water quality parameters were generally unchanged or improved (see Table 1). The effluent TSS concentration dropped significantly, while good DO levels were maintained.

The results from an efficiency point of view were much more dramatic. According to Ward's electrical bills, annual electricity use declined by 1,692,000 kWh, or 42 percent. Annual electricity cost decreased by $61,101, or 31 percent, as the cost of electricity rose. The cost savings on electricity resulted in a 10.7 month pay-back period, promising long-term cost savings for the citizens of Eden.

Because of the improvements in processing and operational efficiency provided by a single SolarBee solar-powered circulation unit, Eden now uses three units in the reactor basin, and an additional unit in the digester, to further optimize their system and savings.

"The city is very happy with the energy savings achieved through solar-powered circulation," said Ward. In addition to energy savings, the city eliminated 1,607,400 lbs of CO_2 emissions to air. The fact that Eden is also reducing its carbon footprint will help minimize global climate change and make this paradise even greener.

About SolarBee®

SolarBee Inc., a division of Medora Environmental Inc., develops, installs and services long-distance water circulation equipment to help solve water-quality problems. The award-winning and patented long-distance circulation technology has been successfully applied to prevent and control harmful blue-green algae in fresh water, reduce energy usage and control odors in wastewater, and to reduce nitrification, thermal stratification, and stagnation in potable water storage. The floating long-distance circulators can move up to 10,000 gallons per minute from depths of 3 feet to more than 100 feet and have been proven in hundreds of applications worldwide.

SolarBee®
Circulating the World's Water

3225 Highway 22
Dickinson, North Dakota 58601
701.225.7193
fax 701.225.9552

www.solarbee.com