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# Solar-Powered Circulation Technology Clears Out Blue-Green Algae

*by Ed Sullivan*

In June 2002, the City of Englewood, Colorado installed a SolarBee unit in its 80-million gallon drinking water reservoir for blue-green algae control.

As the annual onslaught of blue-green algae (cyanobacteria) blooms continues to plague fresh water lakes and reservoirs, the use of copper sulfate to control the problem has become dubious. After 50 years of pouring innumerable tons of copper into lakes and reservoirs, the use of this algaecide has increased resistance and resulted in consequential problems that require more expensive treatment and threaten marine habitats throughout the world.

Although naturally present in water, blue-green algae blooms occur as tranquil waters warm. Left untreated, these blue-green algae wreak havoc on the ecosystems of lakes and reservoirs and the streams that feed them. Sixty percent of Americans drink water that comes from lakes and reservoirs, many of which are afflicted by blue-green algae. The primary complaints about unsuccessfully treated blue-green blooms concern taste and odor. However, research suggests that long-term consumption of water containing high levels of blue-green algae toxins increases risk of illness and even liver cancer.

In the past, copper sulfate has been the chemical of choice for treating blue-green algae. But research findings, diminishing results and increasing costs have made dependency on this algaecide unrealistic. The use of copper sulfate causes blue-green algae cellular lysis (membrane collapse), thereby releasing any toxins the algae may contain — defeating the purpose of the treatment. As blue-green algae become increasingly resistant to copper sulfate, continuously

larger doses (thousands of pounds per week) are required for effective control. Furthermore, impacts on zooplankton and other life forms have led to increasingly stringent permitting requirements for its use.

When blue-green algae conditions warrant more extensive treatment of drinking water, many plants must also invest in expensive chloramine systems, since straight chlorine can produce unacceptable levels of trihalomethane (THM) and haloacetic acid (HAA), disinfection byproducts deemed carcinogenic by the EPA. Even chloramine-treated water that is stored in potable water tanks for long periods without an effective circulation system can release nitrofications that will result in a torrent of complaints about taste and odor.

**A non-toxic solution arrives**

Due to all the problems associated with stagnant water and chemical treatments, the principle of forced circulation of lakes and reservoirs has gained increasing interest in recent years.

"If you can create sufficient circulation, blue-green algae problems and other unwanted water conditions can be avoided or even corrected," says Joel Bleth, president of Pump Systems, Inc. (PSI), Dickinson, ND. "Sufficient circulation will minimize or eliminate the need for chemical and carbon treatments because it prevents blue-green algae takeover."

To provide reliable and flexible forced circulation, PSI developed SolarBee™, a floating self-contained system for use in lakes and reservoirs. Powered by solar modules, this system features an adjustable down-hose suspended from an anchored flotation unit. A single unit can draw up to 10,000 gallons of water per minute and spread it gently across the surface for continuous aeration 24-hours per day.

The system's mixing action prevents the takeover of blue-green algae and promotes a good crop of diatoms ("good algae") and zooplankton. Instead of constantly sinking to the bottom and being blocked from the sunlight, they continuously glide up and down in the mixing currents. At the same time, continuous circulation prevents the blue-greens from blocking the sunlight below the water surface.

When used to control blue-green algae growth, SolarBee units are positioned at problem locations with the unit's down-hose suspended to just above the thermocline. The water intake, from the relatively warm epilimniun layer, is pumped up the down-hose and spread across the water surface, providing beneficial turbulence and aeration. The resulting circulation of the epilimnium prevents the blue-green algae from staying at the top of the layer, so that diatoms are able to out-compete the blue-green algae.


The solar-powered circulation technology is available in several sizes and models that are applicable to fresh water, potable water and wastewater applications.

**Successful applications**

The ability of this technology to effectively eliminate blue-green blooms by maintaining surface water turbulence has been well-documented.

At Palmdale Lake in the high desert country of southern California, the Palmdale Water District had been using 2,000 to 3,000 lbs. of copper sulfate powder per week from March to September to control algae growth in its 4,130 acre-ft. of water.

"Besides being expensive, we wanted to avoid using excess copper," says Greg Dluzak, Palmdale Water District Production and Control Superintendent. "There are concerns about the oils and chemicals that algae release being toxic and possibly carcinogenic. Although this isn't established or regulated yet, it was another reason we wanted to find some other way of controlling the algae other than chemically treating it. So we were very pleased that a year after installing seven of these SolarBee circulation units (in 2002) we had greatly reduced the amount of copper that we were using."

"We also saw considerably more dissolved oxygen that was much more evenly dispersed throughout the lake," Dluzak says. "The water temperature was much more even, and we weren't getting our usual spring or fall turnover. The lake also looks much clearer than it did before, which makes it much easier to see the fish, too"

Another problem that often results from blue-green algae blooms is filter clogging at treatment plants. At the Palmdale plant this problem occurred almost continuously throughout the year.

"Since installing these new circulation units we have only experienced two or three weeks of excessive clogging of our filters during the algae growing season, per year," Dluzak says. "We're planning on upgrading our units to the new V12 model with the larger battery and solar panels, which will operate 24 hours per day as compared to the current units (without batteries) that only run during daylight hours, so we're hoping that the filter clogging will virtually disappear. Since we have to use treated water to backwash the filters, that's a loss of treated water that we don't see now - another savings."

**Englewood Water District faced a choice of draining the reservoir, scraping out the sediment and hauling it away – a process that would cost hundreds of thousands of dollars – or finding a less expensive approach. "We had heard that the solar-powered circulation system could aerate the water, get dissolved oxygen down to the reservoir bottom and break up the sediment," Coatman explains.**

**Managing sediment**

In June 2002, the City of Englewood, CO initially installed a SolarBee unit in its 80-million gallon drinking water reservoir for blue-green algae control. For years copper sulfate had been applied typically once or twice a week.

"Prior to installing the units we were putting in as much as 800 pounds at a time," says Don Coatman, Water Production Superintendent at Englewood Water District. "It was an all-day task. Since we installed the new forced circulation system, I've got a lot of copper sulfate I'd like to sell."

Another primary reason for installing the units was concern about the buildup of very dense sedimentation over a 50-year period.

If a lake or reservoir has unhealthy sediment or an unwanted sediment build-up, the system can be set up to solve that problem. To handle this problem, the system's down-hose is set below the thermocline and close to the bottom where it pulls large volumes of water and spreads them across the surface of the water. Since the water from the bottom (hypolimnion) layer is colder and denser than the top layer, it aerates for a relatively short distance (depending on temperature differential), and then sinks to the bottom again. This newly aerated water oxygenates the nutrients in the sediment, helping to break it up and alleviate anoxic bottom water conditions.

"This is where we did our sedimentation process until 2000, before we installed a separate building and process for that," explains Coatman. "Over the years there were attempts to clean the reservoir out with various types of dredges and an aerator, but these couldn't keep up with the sedimentation. By 2000 the sediment had built up to the point where in some areas of the reservoir you could almost walk on the water it was so shallow. So, we were running out of storage room."

Englewood Water District faced a choice of draining the reservoir, scraping out the sediment and hauling it away — a process that would cost hundreds of

thousands of dollars – or finding a less expensive approach. "We had heard that the solar-powered circulation system could aerate the water, get dissolved oxygen down to the reservoir bottom and break up the sediment," Coatman explains. "They were using this system at the water facility in Pueblo CO, primarily for blue-green algae control, and suggested that system might be an inexpensive solution to our problem."

In June 2002 Englewood installed a 10,000 GPM unit and positioned it in the area of the sediment buildup. "It's reduced sediment in our reservoir by probably 75 percent," Coatman says. "It has broken it down and distributed it out. Because the cleanup has eliminated the nutrients in the sediment, it also helped get rid of the blue-green algae problem at the same time."

The Palmdale (California) Water District had been using up to 3,000 lbs. of copper sulfate powder per week to control algae growth in its 4,130 acre-ft. lake until it put in a solar-powered circulation unit.

**Expanded options**

The Englewood Water District is also considering the installation of units in potable water storage tanks. "With large storage tanks of treated water you may have turnover problems," Coatman explains. "We use chloramine treatment and if the water sets in the tanks too long, nitrification will occur, which will cause severe taste and odor problems. So, by installing a water circulation unit, the turnover paddles in the enclosed tank (the solar unit is mounted outside) you'll keep that water moving, turned over. This type of system is also much cheaper than trying to put in baffle units or pipe extensions or various other remedies to the nitrofication problem."

**"Because the cleanup has eliminated the nutrients in the sediment, it also helped get rid of the blue-green algae problem at the same time."**

The Englewood Water District is budgeting for an additional circulation unit at its pre-treatment reservoir to handle raw water that enters the pond from the South Platte River through "The City Ditch," a historic open channel that

travels approximately 24 miles from the Chatfield Reservoir. "During the summer months the river is often very shallow, and so the water carries higher concentrates of elements such as manganese as well as a lot of organic material from the river and the trench. The new circulation unit will help handle those," Coatman says.

In a report "Improving Lake Water Quality by Solar Powered Circulation" published by Bo Labisi, P.E. of the Palmdale Water District, Labisi concluded that forced lake circulation using the solar-powered device was effective in controlling the incidence of seasonal algal bloom in Palmdale Lake during the summer of 2003. He said the greatly reduced amount of copper sulfate used to limit algal activities in 2003 amounted to a significant savings, while water quality parameters including dissolved oxygen, pH, secchi transparency depth, turbidity and chlorophyll-a concentration all improved noticeably during forced lake circulation. Irrespective of nutrient loading to the lake, algae proliferation was curtailed because circulation exposed available nutrient to all species, thereby stimulating much higher food demand and resulting in a more advanced food chain. **L&W**

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