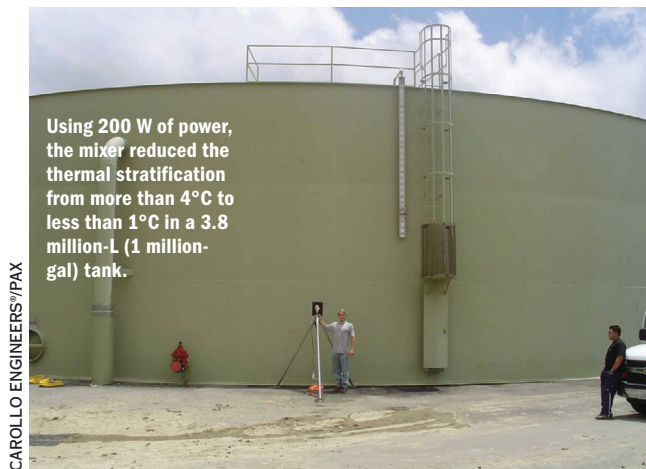


Small Mixer, Big Results

Scientist and engineers turn to nature for inspiration for water mixer

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CAROLLO ENGINEERS®/PAX

Using 200 W of power, the mixer reduced the thermal stratification from more than 4°C to less than 1°C in a 3.8 million-L (1 million-gal) tank.

Problem: Stagnant water reservoirs.
Solution: Small mixer uses blueprint from nature to reduce thermal stratification and minimize microbial contamination and nitrification.

“Natural capitalism,” the brainchild of environmentalists Paul Hawkin and business visionaries Amory and Hunter Lovins, is a set of guidelines to transform societal systems toward sustainability. Biomimicry — one of the four principles of the natural capitalism framework — is an idea Carollo Engineers® (Phoenix) has been investigating for use in the water and wastewater field for several years (see *WE&T*, December 2002).

Carollo’s investigations led the firm to PAX Scientific Inc. (San Rafael, Calif.), a fluid-sciences research and development company. PAX Chief Executive Officer Jayden Harman identified a basic principle that nature applies universally to reduce friction and drag in flow structures, plants, and animals. In nature, everything spins or moves in spirals, rather than in straight lines. Harman adapted this core principle into the PAX Streamlining Principle, which is employed to optimize fluid movement, manage turbulence, and reduce friction, drag, energy use, wear, noise,

and heat. PAX created an impeller based on nature’s flow geometry that can be used in pumps, fans, propellers, and mixers.

Working together, Carollo and PAX identified several applications for this technology in the water treatment field, including

mixing, aeration, and pumping, and selected one — mixing — that was low risk, but relevant, to validate the technology. Carollo designed and conducted a series of field tests to validate the technology for reservoir mixing to prove that it worked, develop some basic parameters for its operation and application, and confirm its applicability to the problem of mixing water.

The Problem

Many municipal water utilities have large potable water reservoirs in their distribution systems. Stratification due to solar heating causes a stagnant layer of water to form at the top of the reservoir that can lead to increased water age, low disinfectant residuals, and growth of bacteria, which can expose consumers to health risks. Compounding this issue is the fact that cooler water from the distribution system usually enters and leaves the bottom of the tank through a single inlet–outlet pipe. To combat this issue, many systems are modifying their reservoirs to mix the water within them. Some of these systems include separating the inlets and outlets, installing check valves, and adding mechanical mixers. Costs, benefits,

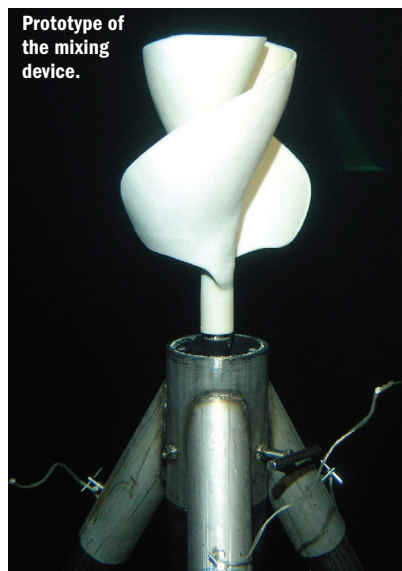
implementation issues, and effectiveness vary from system to system.

Demonstration Test Results

A small PAX mixing device was tested in several municipal potable water storage tanks ranging in size from 3.8 million to 15.1 million L (1 to 4 million gal). The PAX-designed mixer provided reliable mixing with low-energy use and material requirements. In the 15.1 million-L (4 million-gal) reservoir, for example, a temperature stratification of more than 2°C was reduced to <0.7°C using 225 W of power. Before mixing, the 3.8 million-L (1 million-gal) reservoir was thermally stratified with an approximately 5°C temperature difference between the surface and 0.6 m (2 ft) above the tank bottom. The thermal gradient was reduced to less than 0.5°C within 12 hours of mixing, using less than 200 W of power.

The company is preparing to beta-test the product with several large municipal utilities in anticipation of commercial release late this year.

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Prototype of the mixing device.

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