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Water Supply

# Flygt Propeller Pump Key to Lake Oxygenation System

**A unique submerged oxygenation system of unparalleled scale is in use at Northern California's Camanche Reservoir. This system has proven it's effectiveness by both vastly improving reservoir water quality and by protecting fish populations from the effects of seasonal oxygen starvation. This innovative design, using submersible Flygt propeller pumps will aid others in solving similar water quality problems occurring at warm-climate reservoirs.**

The East Bay Municipal Utility District (EBMUD) supplies 1.2 million people in the greater Oakland, California metropolitan area with drinking water obtained from the 577 square mile (1.500 sq. km) Mokelumne River watershed located in the Sierra Nevada Mountains.

When poor water quality in the 1980's caused significant fish loss in a hatchery located downstream of this supply reservoir, EBMUD has cause for alarm. State and Federal agencies developed a plan to improve the river's water quality which involved a significant increase in the flow of stored water past the Camanche Reservoir Dam. This would severely threaten EBMUD's ability to meet its customer's water demands as the mandated bypass rate would reduce the quantity of water that EBMUD could draw upon, thus creating a water shortage situation.

View of the 150-foot long diffuser used to distribute oxygen-rich water in the hypolimnion layer of the lake.

A key cause of fish losses was the presence of hydrogen sulfide in Camanche Reservoir releases to the Mokelumne River. High levels of H2 S in the reservoir's hypolimnion layer (the coldest and deepest layer of water) occurred during the warmest months, the result of a natural process of oxygen depletion. Warm climate lakes and reservoirs become thermally stratified in late spring and summer, "turning-over" to mix uniformly in late fall. Dissolved oxygen in the hypolimnion gradually declines during the warm season as decaying plant material and sediments deplete the lower stratum's limited oxygen supply.

Scientists recommended the installation of a large-scale hyplimenetic oxygenation system on the reservoir bottom to inject oxygen into the cold, dense layer of water. The system creates an oxygenated plume near the lake's outlet that prevents the presence of hydrogen sulfide in reservoir discharges.

ITT Flygt helped design the oxygenation system. A 23-foot (7m) high, cone-shaped oxygenator is positioned on the reservoir bed about 600 feet (183m) from the Camanche Dam at maximum depth of 135 feet (41m). Oxygen is drawn from an onshore storage tank to the cone. Water, introduced into the cone by an ITT Flygt model PL-7061.735 propeller pump, then combines with the oxygen to produce water with an elevated level of oxygen. The integral submersible pump is powered by a 127kW/170Hp motor and is capable of producing 14,500 gpm at a head of 35 feet (9151/2 at 10.7m). The highly oxygenated water is discharged into the hypolimnion layer through a 150-foot (46m) long linear diffuser equipped with horizontal ports. The momentum of this oxygenated flow, in conjunction with the normal flow patters of the reservoir, distributes oxygen throughout the hypolmnion in a plume measuring up to 30 feet (9.1m) high, 2,000 feet wide (610m) and over 10,000

(3km) long. EBMUD has purchased two Flygt PL-7061 pumps for this project, one for unit operation and a second pump to act as a stand-by.

The Camanche project represents a ground-breaking achievement in the large scale employment of oxygenation system technology. This unique and innovative application of the hypolinetic oxygenation technology was not only the first deep-lake application of a Speece Cone oxygenator, it was also by far, the largest.

In it's final report to the District engineers stated that the "program met or exceeded all of its objectives". Additionally, the oxygenator system and the integral ITT Flygt PL-7061 submersible propeller pump "consistently and effectively diffused oxygen into the reservoir such that no hydrogen sulfide was present in discharges during 1993, 1994 and 1995".

According to Bob Domkowski, municipal market manager/engineering consultant for ITT Flygt, "The project's importance is in overcoming a problem that is inherent in nature and to provide a better and purer water source to the water supply companies."

The problem of hydrogen sulfide is greatest in areas where there are hot summers Domkowski notes that "It adds a tremendous burden on the water supply companies to get rid of the hydrogen sulfide. Adding aeration is less expensive than altering the course of their treatment facility."

Several interested parties have inquired about similar systems for stagnant reservoirs across the southern/southwestern U.S. and throughout the world.

**A Flygt propeller pump combines oxygen and water in this 23-foot tall, cone-shaped oxygenator.**