Efficient Aeration System Boosts Energy Savings

Oregon WWTP cuts energy usage by 55%, will save $235K in five years

By Cheri D. Cohen

A new efficient aeration system saves the Ontario, Ore., wastewater treatment facility $47,000 annually in energy costs. Besides giving this community a financial boost, the new system netted additional equipment cost savings by cutting aeration horsepower by more than half at the plant. The environmentally conscious city, located in the Oregon/Idaho border area, is meeting all of its effluent discharge permits.

The city of Ontario wastewater treatment facility operates a five-cell lagoon system with a total volume of approximately 305 million gal. The influent flow to the treatment plant is 2.174 mgd. A 600-acre land application site is certified for effluent irrigation during the crop-growing season.

Wastewater treatment facilities must meet strict effluent discharge permit standards to stay in compliance with governmental regulations. Dependable aeration equipment is a critical component of an efficient facility.

The aerated lagoons at the Ontario facility previously were equipped with float-mounted aspirator aerators, and the plant's discharge always met permit compliance standards. Facility staff had been satisfied with the aeration system's treatment performance and maintenance record over the years, and had even recommended the equipment to others.

Upgrades considered

In 2002, the city decided to look at upgrading to a new energy-saving aerator/mixer introduced by the same aerator manufacturer.

The project upgrade was approved after a preliminary sizing and energy analysis showed the new process aerator/mixer system would result in significant cost benefits and energy savings, due to the system's oxygen dispersion and mixing capabilities.

In 2004, the new system was installed. Aeration Industries International, Inc. manufactured all the aerators in use at the Ontario wastewater treatment facility.

The previous aspirator aeration system used a total of 435 hp, which consisted of a combination of 15- and 25-hp aspirator aerators. The equipment ran constantly, 24 hours a day, 365 days a year, using approximately 2,842,700 kW/hr per year.

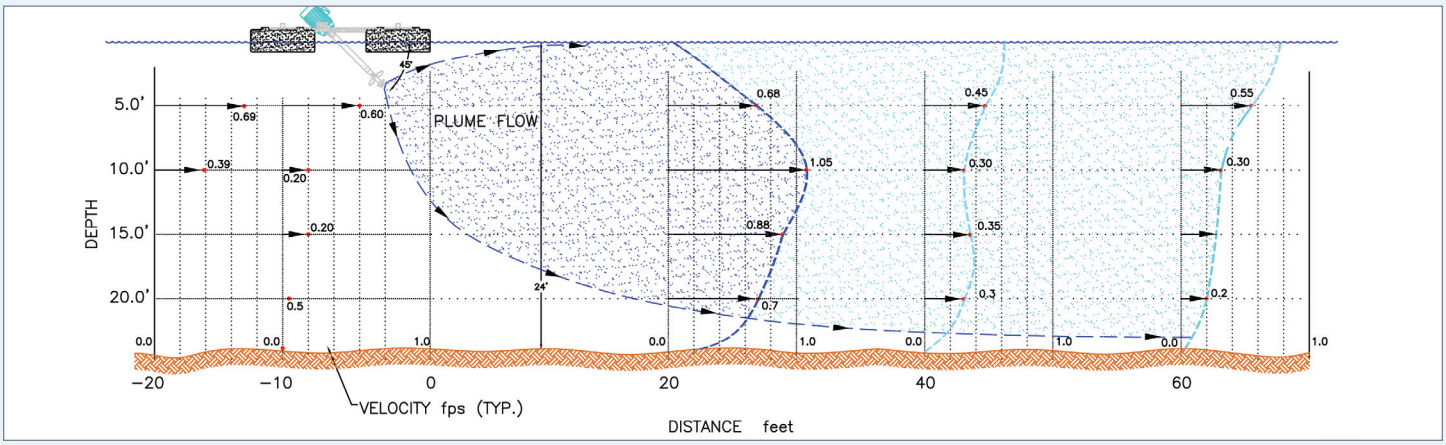
The new system uses 13, 15-hp Aire-O_2 Triton process aerators/mixers for a total of 195 hp and also runs 24 hours a day. This system, however, uses less than half the electrical power, consuming a total of 1,274,317 kW/hr per year.

"We cut our horsepower in half at the plant," said Ken Rossen, Oregon wastewater treatment superintendent.

Electrical savings calculation

With the new system's more effective treatment removal rates and energy-efficient air compressed motors, fewer units are required to meet a facility's permit, resulting in large electrical savings. These electrical savings for operational costs can be calculated by a formula where:

75-hp Aire-O_2 Triton - Mixing Velocities



Kw x $/Kw/hr x hr of operation = Operating Costs

For example, the city of Ontario wastewater treatment facility cut its horsepower from 435 to 195 hp. For an average wastewater treatment facility, a 240-hp savings in operational equipment means:

(.746) {Hp to Kw} x (0.07) {average cost of electricity in Oregon} x 24 {hours in a day} x 365 {for one year}.

The result is a staggering $109,787 savings in one year with the aerator/mixer system or $548,935 savings over five years.

Rossen reported a power rate of $0.03 that still translates into a significant savings of $47,050 per year or $235,260 in five years. The national average cost of electricity is $0.10.

The new system is providing the necessary oxygen and mixing to provide the biological performance efficiencies to meet permit requirements. The plant's current influent BOD is 158 mg/L, TSS 139 mg/L and NH_3-N 12. The effluent treatment levels are BOD 17 mg/L, TSS 18 mg/L and NH_3-N 1.24 mg/L.

The process aerator/mixer system's unique features and performance capabilities more than suited the plant's design requirements, whereby all the city's effluent requirements were met and yet, the horsepower requirements were significantly reduced.

The Aire-O_2 Triton process aerator/mixer is an electric motor-driven, propeller-type floating aerator equipped with a regenerative blower. The aerator induces the flow of air below the surface of the water and provides flow-linkage mixing in multiple unit arrangements. The Triton may be operated in mixing and/or aeration mode controlled independently for complete BNR. The Triton is a combination of optimal hydraulic and aeration efficiency.

Factors that affect aeration oxygen transfer and wastewater treatment performance efficiency include bubble size, hang time and complete mixing of a basin to prevent dead spots and short circuiting. The process aerator/mixer's ability to disperse oxygen throughout an entire wastewater treatment basin is the key to its oxygen transfer rates and performance efficiency.

Mixing efficiency put to the test

Mixing tests performed on a 75-hp Triton aerator/mixer under field conditions showed significant velocities were achieved down to the lagoon's depth of 24 ft and out to its maximum allowable distance of approximately 60 ft. The test was conducted by Redmon Engineering Co. consulting engineers.

A series of velocity measurements were made around the aerator/mixer using a Marsh-McBirney electronic velocity meter. One person held the pontoon boat in place while two others made the measurements. The velocity sensor was mounted on a long metal conduit. The sensor was pointed into the flow, and velocity was recorded at different depths.

"The observed gas-phase oxygen transfer efficiency values, which were observed to average around 34%, are some of the highest values measured by this writer," reported David Redmon of Redmon Engineering. "These very high gas-phase transfer efficiency values are due to the very fine bubbles generated by the Triton unit and the high pumping intensity of the unit, which results in the gas being kept in the liquid for substantial distances from the aerator. The pumping capability of the Triton unit is indeed impressive as observed by the high liquid velocities and the large area of the influence of the unit."

This type of aerator system is an efficient mixer because it has an induced flow rate that is much greater than the prop pumping rates, which can be mathematically calculated. Propeller manufacturers estimate that the induced flow rate can be 10 to 20 times that of the calculated flow rate.

Another cost-saving measure is the use of DO probes. These allow for direct control of the air by controlling the regenerative blower, which adds more energy conservation. When desired oxygen levels are reached, the aerator's blowers can be turned off independent of mixing or timed to run at various intervals during the day.

With the average national electrical rate running about $0.83 per Kw/hr, many cities are scrambling to find savings while dealing with cutbacks. There are no sleepless nights in Ontario with the savings they enjoy. WWD

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