

Lagoon Aeration
Pure Oxygen
Hydrogen Sulfide

Paper Mill Enhances Lagoon Operations with Supplemental Pure Oxygen Gas Feed Aspirated Through Venturi Aerators

A paper mill was experiencing problems with insufficient dissolved oxygen in their wastewater treatment lagoon due to an upset as a result of dredging. The lagoon is equipped with 52 75-hp surface aerators [3900 hp connected]. To solve this temporary seasonal problem they contacted BOC Gases for a pure oxygen solution. BOC needed an efficient method to disperse their pure oxygen feed into the lagoon. To aspirate the pure oxygen into the wastewater they are using two model VA-1100 Venturi Aerators with two pure-Ox feed lines, one to each aerator from a BOC LOX tanker. The plant effluent liquids are being drawn from a large wet well [32' x 32' x 11'] by two six-inch Gorman Rupp pumps connected to the two venturi aerator units. The pure oxygen feed is used to augment dissolved oxygen levels in the 47-acre treatment lagoon.

All the plant effluent, approximately 42,000,000 gpd, passes through this wet well enroute to the lagoon. The effluent temperatures are 35-40°C [95-105°F]. At these elevated temperatures DO levels previously were at 0 mg/L but with the pure oxygen feed they are 12 mg/l in the wet well before dispersion and mixing. With the pure oxygen feed residual DO levels in the 27-acre lagoon [1500' x 780'] [~87,00,000 gallons] are up to 2.0 mg/L where previously there were 0 to 0.15 mg/L even **with all** 52 surface aerators operating. Hydrogen sulfide levels in the wet well headspace were very high [>100 ppm] prior to the addition of supplemental pure oxygen. H₂S is now 0 ppm with the pure oxygen assist and there are “no odors” in the wet well headspace and the air is at 21% on a multiple combustible gas monitor. This indicates that the pure oxygen is not migrating into the headspace but is being completely mixed into the plant effluent and is above standard saturation for 40°C.

Using the venturi aerators to aspirate the pure oxygen accomplishes mixing of the gas feed under pressure into a liquid that has been broken apart into macro droplets. These droplets are surrounded by the pure oxygen gas feed and a portion of aspirated ambient air resulting in a high degree of oxygen transfer estimated at >95%. This utilization is achieved because of the high internal Reynolds turbulence within the venturi aerator as well increased contact time in the discharge piping. The oxygenated liquids are discharged at depth at two different elevations [8 and 5 feet below the surface] in the wet well to further enhance oxygen uptake into the effluent water, using the principle of **cross flow dispersion**. The wet well contains 86,000 gallons, which is being changed every two minutes with the high velocity of the plant effluent sweeping the oxygenated liquids out into the lagoon. This also enhances mixing and equalization when they are introduced back into the high velocity flow from the paper mill.



The two venturi units with the LOX feed are directly treating only ~3.2 million gallons of the 42 million gallon effluent but the kinetic energy of the subsurface discharge is allowing for additional mixing and equalization prior to the liquids entering the middle of the lagoon through a 300 ft long pipe. This ensures maximize utilization of the pure oxygen feed to ensure good economic return.

Residual DO levels after two days of treatment are at 1.5 mg/L. This is sufficient to shut down odors from the lagoon and allows the other 52 surface aerators to transfer oxygen into the lagoon water to satisfy required BOD reductions.

