This mini case study describes the conversion of the aeration system in an EQ tank from 3 submerged jet aerators to a totally external Venturi Aerator system. It describes the process change that resulted in operating cost savings of >$112,000/year and increases in total EQ tank performance to produce a clearer effluent, controlling odors, settling solids, cooling the water and hydrolyzing FOG causing them to float for better removal efficiency.

A national brands soup processor operates a food manufacturing and distribution facility in Vineland, NJ. This plant makes a wide variety of vegetable, chicken and beef-based soups. Its manufacturing plant generates ~600,000 gpd of wastewater from the various cleaning, washdown and sanitizing operations of the cooking kettles and packaging line in the manufacturing plant. As part of their discharge permit, the plant is required to “condition” the wastewater prior to being discharged to the local POTW (publicly owned treatment works) operated by the Landis Sewer Authority (LSA) in Vineland, NJ. Their permit has several requirements as well as some conditioning objectives of the plant:

1. Lower the temperature of the wastewater into the sewer,
2. Reduce the FOG to <100 mg/l,
3. Have a residual dissolved oxygen (DO) of >1.5 mg/L,
4. Have no odors.
5. Mix and equalize the contents of the tank.
6. Discharge with a BOD <400 mg/L.

To achieve these permit and conditioning objectives the plant was designed with an 800,000-gallon circular equalization (EQ) tank in which to achieve these reductions and condition the wastewater. The 800,000 EQ tank was originally fitted with three (3) submerged aerators and 20 hp submersible pumps (60 total hp connected).

**SITUATION:**

The intent of the system was to add dissolved oxygen to mix and equalize the contents in the EQ tank with submerged aerators. These submerged aerators were supposed to add dissolved oxygen (DO) which would cause fats, oils and grease (FOG) to float so they would not be discharged with the plant’s effluent into the POTW. Secondly, they were to provide cooling of the influent process washdown water (~105° F). These aerators had been in operation for several years and were not achieving the desired conditioning objectives. Further, whenever one of the submersible pumps plugged or failed, the facility had to rent a crane to remove the pump for repairs and then had to use the crane for removal, repair and to reinstall the
repaired pump at additional costs on each occurrence. A failure of one or more of the submerged pumps was occurring at least once if not twice a year adding to systems operating costs just for crane rental. The facility was looking for a more viable aeration, mixing and equalization solution to keep them in compliance.

Subject: Soup Facility Upgrades Aeration System

In 2001 the facilities environmental manager as part of his due diligence visited a bakery in Northern New Jersey that had installed a venturi aerator system in their 1,000,000 gallon EQ basin, and a second venturi aerator system in the sludge holding basin. He observed the ability of the venturi aerator system to 1. Float the

**SOLUTION:**

Gorman Rupp T-8 Centrifugal Pump
Horizontal V-belt

40 hp TEFC Premium Efficiency Motor

Gorman Rupp T-8 horizontal V-Belt, 40 hp premium efficiency motor, 1400 gpm

Venturi Aeration, Inc. 41 Tallant Road, Pelham, NH 03076-2236 Tel.: 603-635-8239
FOG, 2. Settle solids, 3. Control odors, and 4. Reduce the temperature of the influent wastewater into that plant from \(~110^\circ F\) to \(<85^\circ F\) in a short period of time, prior to those liquids being transferred into an SBR for additional treatment. He observed that since the Gorman-Rupp pumps for the venturi aerator units were all external to the tank he knew that with this configuration he could eliminate his crane rental charge if the system needed repairs. The bakery’s venturi aerator units were operated by highly reliable Gorman-Rupp T-10 and T-8 series pumps, which require little annual maintenance (oiling, belt inspection and adjustment, etc.), on a pump base driven by horizontal V-belts.

With the venturi aerator concept in mind he modeled his daily flow at 600,000 gallons and calculated that one venturi aerator unit operating at 1400 gpm would achieve several of his permit objectives. First, it would hydrolyze the FOG by adding large amounts of dissolved oxygen directly to the liquids pumped through the venturi aerator causing them to float in his 800,000 EQ tank. Secondly, by aspirating ambient air at a ratio or 2.2 volumes of air to one volume of process water the venturi aerator could effectively reduce the temperature to the targeted levels required for discharge. Third, because he was pulling liquids from the bottom of the tank—the most anoxic zone---and discharging into the top (headspace) of the tank the system would achieve a high level of dissolved oxygen transfer. Fourth, by keeping the contents of the tank aerobic he could non-chemically adjust pH using the stripping efficiency of the venturi aerator to remove CO\(_2\) generated by aerobic bacteria.

**Model VA-1400 Venturi Aerator with True-flow Air Check Valves Discharging into the 800,000 gallon tank**

**SYSTEM SELECTED:**

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After completing his due diligence, the facility environmental engineer decided on a single Model VA-1400 venturi aerator and a T-8 Gorman-Rupp pump. This pump was specified with a “totally enclosed fan cooled” (TEFC) 40 horsepower “premium efficiency motor” which would reduce the facility’s electrical costs ~$6,000 per year over the existing three submerged aerators that had 60 horsepower connected. The venturi aerator was designed to handle 1300 gpm, but the actual installed pump was delivering liquids to the venturi-aerator at 1400 gpm. This allows the contents of the EQ tank, at the 500,000-gallon level, to be recirculated four (4) times during a 24-hour period achieving greater oxygen transfer and better mixing and equalization. With better circulation and cooling in the EQ tank the FOG is floated for separation and treatment and is not being discharged with the effluent to the POTW reducing surcharges and solids are settled reducing TSS in the effluent.

**SYSTEM PERFORMANCE:**

After several weeks of operation, the manager observed a significant reduction in caustic usage for pH adjustment. He had been using ~ 400 gpd of caustic to maintain a pH range between 5.8 to 6.2. An on-line, in-tank, pH meter automatically controls the addition of caustic, which it doses into the EQ tank when the pH levels drops to 5.2 or lower. Since the conversion to the venturi aerator system caustic usage has dropped from the 400-gpd levels to daily doses ranging from 78 to 150 gpd depending on product mix in the plant’s kitchens. Caustic was costing the facility $14,000 to $15,000 per month. With the reduced monthly caustic usage there will be a net annualized savings in chemical costs of at least $89,000, if not more. And when added to the utility savings of $6,000+ per year the total savings for these two items only in the first year will be $95,000. The savings associated with bringing BOD into compliance is another ~$12,000+/year.
Gorman-Rupp T-8 pump with piping to the venturi unit mounted on the catwalk leading into the tank

The effluent for the reconfigured EQ tank is now “clear” instead of a murky white color. This is due to better separation of the FOG and enhanced settling of the solids, which also has reduced TSS in the effluent. Influent BOD$_5$ currently ranges between 800 to 1,000 mg/L. Prior to the installation of the venturi aerator system the plant was surcharged for BOD$_5$ >400 mg/L. With the venturi aeration system and a “live” biological culture system the effluent to the sewer is consistently <400 mg/L, which is the discharge permit requirement for BOD$_5$. This reduction in BOD$_5$ from ~1,000 to <400 mg/L contributes approximately another $1,000/month in savings as a reduction in surcharges ($12,000+ on an annualized basis).

When the operator used to opens the cover of the EQ tank, odors were so strong they would cause the operator to jump back, now there are “no odors” coming from the tank as the odors are “oxidized” into a soluble from of sulfur-compounded molecules that are non-odorous.

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The facility environmental manager now has a system that allows him to achieve his discharge permit parameters and he has less concern over maintenance issues and costs. Having a reliable Gorman-Rupp pump/Venturi Aerator system with an on-site spare parts kit on hand means the pump can be maintained with minimal downtime by changing the impeller, seals, or gaskets in a matter of minutes. Historically, the submersible pump would have to be sent out to a pump repair shop for bench repairs. This might take days to have it repaired and then reinstalled plus the added indirect expense of the crane rental cost and system under-performance with only 2/3rds the air supply. There were several OSHA safety related issues associated with pulling the submersible pump out of the tank with the crane, which are not necessary now with the combined Venturi Aerator/Gorman-Rupp pump being so accessible for servicing with all components completely external to the tank.