Saving Energy in the Aeration Basin

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San José-Santa Clara
Regional Wastewater Facility

Introduction

The San Jose-Santa Clara Regional Wastewater Facility is comprised of four districts covering approximately 1.4 million residents and more than 17,000 businesses. The four sanitation districts treat approximately 110 million gallons per day (MGD) with a capacity up to 167 MGD.

The aeration basin system (in the secondary BNR II treatment process) includes five variable speed blowers that push air through a main header, which transfers the air via diffusers throughout each of the facility's 96 aeration zones (each basin is 225'L x 30'W x 17'D). The air provides the dissolved oxygen (DO) that supports the micro-organisms feeding on the biological content passing through each zone. The variable speed blowers used to maintain the DO levels increase or decrease air flow as the DO requirements in a zone change with fluctuating biological content.

Pitot tubes were previously installed for monitoring and controlling the DO in each zone. However, the pitot tubes were unable to adequately track fluctuating air flows and typically caused the variable speed blowers to oscillate with the changing load of biological content. The oscillation results in decreased machinery efficiency and increased energy consumption. Additionally, the pitot tubes required substantial maintenance as they are prone to plugging.

Working Smart

In preparing for the project, Facility staff toured other wastewater plants and investigated alternative flow measurement technologies. During these tours, we discovered many wastewater facilities were using thermal flow meters in the aeration basin. Our Instrumentation Group decided to perform a technology test by setting up 32 aeration zones (16 zones with pitot tubes and no valve on the second pass, and 16 zones with Kurz 454FTB thermal meters and a new valve on the second pass) for concurrent testing. The goal was to compare the abilities between the pitot tubes and thermal flow meters in their effectiveness at accurately monitoring and maintaining the DO levels.

All blowers are powered off during an emergency shutdown, which require a 40-minute delay in powering them back up to avoid electrical equipment damage. In addition, when forced air is turned off the life cycle of the micro-organisms in the aeration basin deteriorates as the amount of DO declines until the micro-organisms die.

After the blowers were off-line to the 32 basins, the following was noted:

- The 16 basins with the pitot tubes were able to maintain the DO level for only 7 minutes before having the DO level drop to zero.
- The 16 basins with the Kurz 454FTB meters provided such stable airflow that the basins were able to maintain the DO level for 30 minutes before having the DO level drop to zero, which was the result of those basins maintaining a much tighter and stable DO control.

The Kurz 454FTB performed well beyond the capabilities of the pitot tubes, with the Kurz meters and additional valves saving more than 15% of the electricity use. During the 6 months of testing, the performance of the Kurz flow meters did not degrade or drift.

Method of Calculation:

	Method 1			Method 2				
	Total Air Volume to Aerators	Total Influent Volume to Aerators	CF Air per Gallon of Influent to Aerators	Nitrogen Influent Average BOD (30 Days)	Nitrogen Influent	Nitrogen Influent	KW to Blowers	BTU per LB of Influent Load
	MCF	**MGD**	**CF/Gal**	**Mg/L**	**Mg/L**	**KLBS**	**KW**	**BTU/LB**
Pitot Tubes	91.16	73.84	1.23	197.49	38.86	224.5	63910	971
Kurz 454FTB	81.62	75.09	1.09	227.28	36.19	239.8	57537	819
							Percentage of reduction expressed in BTU/LB	15.65

Where: 4.1 Kw = 3412.14 BTU
Kw unit cost = $0.124

Blower Cost and Energy Savings: $407,646/year, $1,697,560/5 years, $3,735,791/10 years
KW Savings = 9007/day, 3287469/year
Therm Savings = 112173/year
Annual CO2 Savings = 1312425 lbs (11.7 lbs/therm), 586 tons (2240 lbs/ton)

Planning For Success

By recognizing the limitations of some flow technologies and confirming the capabilities of another, we were able to show that replacing inadequate flow instrumentation with advanced flow technology can pay off in both maintenance and energy costs. As one of the largest advanced wastewater treatment plants in the United States, our Facility will save over 15% in annual energy costs in our BNR II process, decrease our energy use, and save the cost associated with maintenance.

We are in the process of retrofitting our BNR I treatment process with the same system.

Efficiency Highlights

- Total investment **=** $340,670 (includes all new hardware such as flow instrumentation, valves, actuators, brackets, fittings, and labor for the complete installation)
- Total energy savings per year **=** $407,646
- ROI **=** 10.16 months
- Projected cost savings over first 10 years **=** $3,735,791

Additional Benefits

- Cost savings by eliminating expensive pitot tube maintenance
- Enhanced process control **=** Quick acting and repeatable control of each pass results in much better process control
- Better blower stability leads to better DO control
- Improved nitrogen control and removal
- Decreased greenhouse gas emission charges **=** 586 tons/year reduction