APPLICATION NOTE

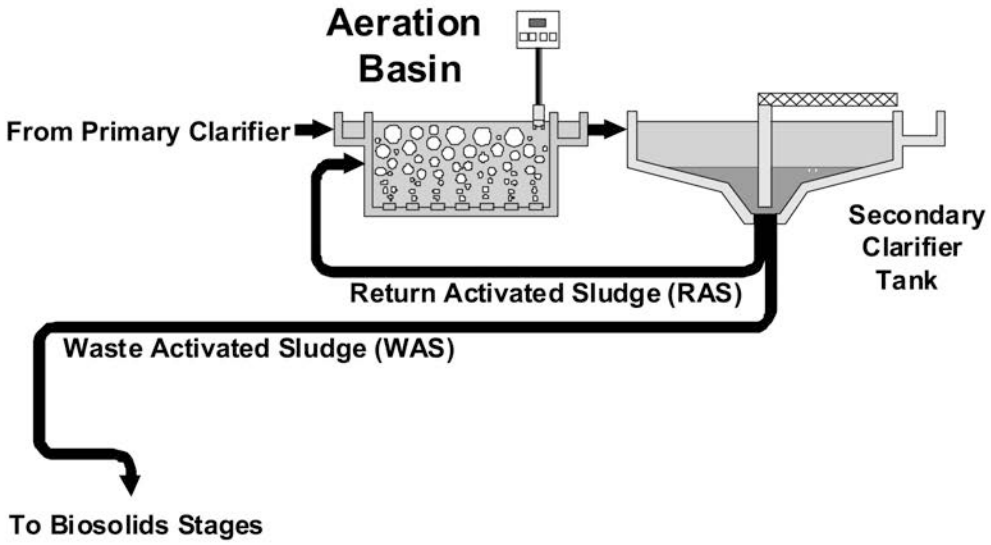
SAVE MONEY BY CONTROLLING DISSOLVED OXYGEN IN THE AERATION BASIN

Maintaining the proper concentration of dissolved oxygen in an aeration basin is necessary to keep microorganisms alive for breakdown of the organic waste. This can only be efficiently accomplished by using an accurate, continuously measuring system. When the measured dissolved oxygen decreases below a desired concentration, the plant control system automatically adds air to the aeration basin, providing life-sustaining oxygen for the microorganisms. This also helps to thoroughly mix the organic waste. Without enough dissolved oxygen concentration, the beneficial microorganisms will die while troublesome filamentous microbes proliferate, causing sludge settling problems. When the dissolved oxygen content becomes too high, costly energy is wasted, and expensive aeration equipment endures unneeded wear.

A small Mid-western city is a case in point, illustrating the benefits of continuous dissolved oxygen monitoring and control. The city decided to investigate ways to improve the efficiency of their waste treatment plant. The plant operator wanted to pursue further aeration system improvements after hearing from another plant operator of a nearby treatment facility. He learned that their experience in continuously measuring process dissolved oxygen helped them respond to rapid increases in plant load. The operator wanted to apply this strategy to achieve automatic control of blower speed and further reduce energy costs.

The city consulting engineer and plant operator completed a simple study, evaluating the cost effectiveness of continuous dissolved oxygen measurement and automatic aeration control.

Figure 1 Dissolved Oxygen Monitoring/Controlling in an Aeration Basin



During a five-month period, the following data was collected:

- Dissolved oxygen concentration in contact tank
- Dissolved oxygen concentration in reaeration tank
- Time of day dissolved oxygen measurement was taken
- Energy consumption (in kWh) for preceding day
- Percent speed at which variable frequency drive (VFD) had been operating during preceding day

A portable dissolved oxygen meter was used to obtain dissolved oxygen measurements in the process tanks. The variable frequency drive unit was manually controlled to operate the blower motor at 50%, 60%, 70%, 80%, and 90% of full speed (1750 rpm). A second blower motor was also operating at 1750 rpm. The operator collected 91 sets of data. Seventy-six percent of the data sets involved readings at about 8:00 a.m. when dissolved oxygen concentrations tended to be high due to the lower nighttime loading.

Twenty-four percent of the data sets involved afternoon dissolved oxygen readings taken during higher loading conditions. With higher blower speeds, early morning dissolved oxygen values were as high as 8 mg/l. Even with lower blower speeds, the afternoon dissolved oxygen values were never unacceptably low.

Analysis of the data disclosed that each 10% reduction of blower speed decreased the daily energy use by about 40 kWh. These results confirmed that using an automatic controller to regulate blower speed would significantly reduce energy use. Subsequently, the plant operator installed an automatic dissolved oxygen monitoring/control system for a six-month trial. A control set point of 2 mg/l dissolved oxygen concentration was established for the trial. During part of this trial a single blower was used. When two blowers were used, they were operated simultaneously under the control of the automatic system. Both variable frequency drives were set to operate at a minimum speed of 50%. Over the course of this trial period, total plant energy consumption was reduced by about 8%.

Summary

The U.S. Environmental Protection Agency Design Manual on Fine Pore Aeration Systems (EPA/625/1-89-023) states: "energy saving achievable by automatic aeration on dissolved oxygen control is 25% to 40%, but can be as high as 50%." Realistically, a waste treatment plant can expect energy savings of anywhere from 0% up to 50%. Many factors influence the magnitude of energy savings, including:

- Plant size
- Mixing limitations
- Type of aeration equipment used
- Plant loading

It is recommended to conduct a feasibility study to determine the potential cost savings.

References

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Oxygen in Liquids (Dissolved Oxygen), R.K. Kaminski, B.G. Liptak and G.J. Rorech
Simplified Wastewater Treatment Plant Operations, Edward J. Haller, 1995
Basic Activated Sludge Process Control; Water Environment Federation, 1994

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