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How To Avoid The Biggest Wastewater Aeration Mistake

It's common for wastewater treatment plant operators and design engineers to get comfortable with one type of blower for aeration, so they hesitate to explore options when it comes to new plant projects or upgrades. The problem is that each aeration system has unique requirements, such as space, performance, and budget. By sticking to one blower technology without considering others, operators and engineers often purchase equipment that isn't the best for a project's unique requirements.

Multiple blower technologies are available to consider when designing a new system. Understanding the difference between them, as well as the pros and cons of each based on the specific application, is critical to the decision-making process.

There are two major blower types: displacement and dynamic.

Displacement Blowers

Displacement-style machines consume a fixed volume of air through the inlet port and are not dramatically impacted by ambient conditions. Density changes impact the amount of oxygen content in the air, but blowers always ingest the same amount. There are two varieties:

Rotary lobe – An older technology that's considered reliable and versatile, it is sometimes packaged and offered as highly-customized machines. Offers a predictable performance and turndown ratio as well as a 3:1 control range. Based on external compression, these blowers are adaptive, so they always meet system pressure needs regardless of conditions. They can be used anywhere air is needed within a wastewater plant. The downside is that rotary lobe blowers are less efficient as they speed up and slow down. These could be a better choice in digesters with varying fluid depth or a process with intermittent duty.

Screw – Internal compression, so the wide 4:1 control range in speed doesn't impact efficiency. Can offer as much as 30 percent efficiency gain compared to rotary lobe technology. The downside is that if internal compression is more than overall system pressure, energy is wasted making pressure that isn't used. Ideal for aeration ponds with a constant fluid depth greater than 6 psig with running hours more than 4,000 hours per year. When applied to varying fluid depths, the payback for the cost difference compared to rotary lobe blowers may not be realized quickly enough to warrant the higher cost.

Dynamic Blowers

Dynamic machines are based on mass flow principle, so they are impacted by ambient conditions such as air density. These machines speed up air molecules with an impeller, using velocity to accelerate air into the discharge pipe. Their efficiency overflow is parabolic shaped. The downfall is that their control ranges are typically narrow, with strong fluctuations with flow and pressure, so they work better in static conditions, and slowdowns can cause surges resulting in wasted air through venting. Often the choice for large flow applications.

There are three varieties:

Geared – Impeller is coupled to the motor with a gear, which is used to increase speed. While the increased speed increases efficiency, the addition of guide vanes and gearboxes increases their complexity and maintenance. These machines take up a significant amount of space and tend to be extremely loud and reject a lot of heat from the gearbox oil radiator.

Gearless – Impeller is coupled directly to the motor. Flow and pressure are increased by adding stages of impellers. Because of its simplicity, it can handle system surges better than geared turbo, but it lacks the overall efficiency.

High-speed turbo – Smaller impeller directly coupled to a permanent magnet electric motor constructed of rare earth materials, which is driven by a variable frequency drive. Operates at a much higher rate of speed than geared or gearless. Higher performance with similar efficiency to screw blowers in a smaller footprint. Can be magnetic bearing (3:1 control range) or air foil bearing (2:1 control range) technology. Regardless of bearing style, these require provisions for surge venting. Only the magnetic bearing type is able to handle routine starts and stops and environments with dust pollution. Best applied in constant depth high-flow applications.

Avoid The Common Problems

Wastewater plant operators and consulting engineers who select blowers based on personal preference, or simply by the lowest capital costs, face major issues. Common problems include installing blowers that are too large, so they run hot and produce excess air that requires venting, as well as failures from excessive starts and stops, and higher than necessary energy costs.

Properly completed blower technology evaluations should account for the specific processes, ambient conditions, objectives, challenges, space, and budget at each facility. Even with tight municipal budgets, it's critical for plant operators to examine the operational costs and performance over time to understand the total business case. In many situations, savings in power and repairs can more than offset the price difference of a lower-cost, but less-than-ideal blower technology.

Taking all these variables into consideration increases the odds that the blowers selected for a new plant or upgrade will be the best fit. ■

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