How to select the right air blower technology for water and wastewater treatment plants

GUIDE

Up to 70% of the energy consumption in a water or wastewater treatment plant is used by air blowers.

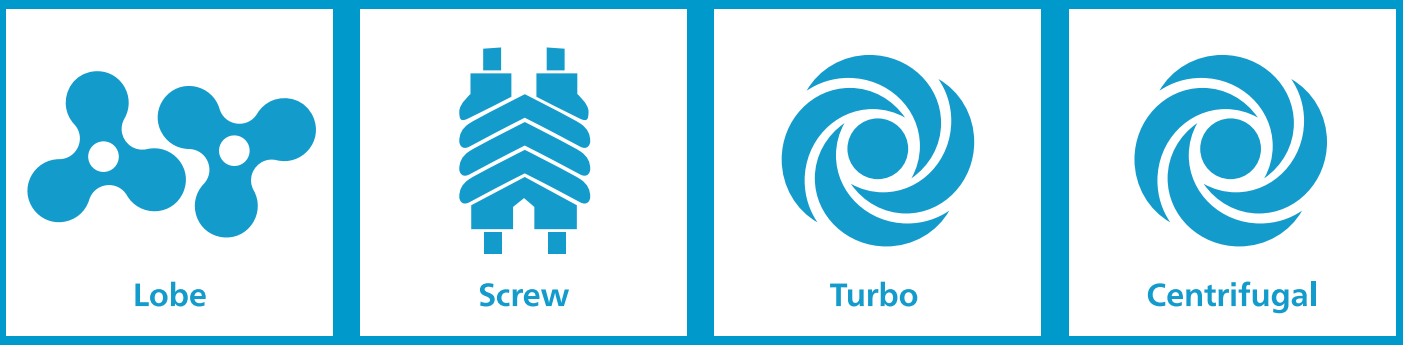
So, keeping electricity costs related to blowers down, especially in the face of rising energy costs, is key to keeping total operational costs low.

Furthermore, when counting on a compressed air supply to keep the bacteria alive during the treatment process, a continuous supply of compressed air which is free from oil-contamination and can handle a variable air flow demand during the day is imperative. This guide will cover the different low-pressure blower technologies available and explain how to select the right blower to deal with the particular requirements of your water or wastewater treatment plant.

Blower efficiency and operating characteristics are important factors in the performance of water and wastewater treatment applications, such as diffused aeration, filter backwashing or activated sludge systems. Not only are these processes required to conform to regulatory and environmental standards, but compliance with strict regulations concerning water and wastewater operations helps to reduce water pollution and encourage water conservation.

An introduction to the types of blower technologies

There are a number of different types of low-pressure blower technologies available to the plant operator, categorised as lobe, screw, centrifugal, and multistage blowers, so it pays to check the vital statistics of each type and compare their performances.



Positive displacement blowers

There are two basic types of compression: positive displacement and dynamic compression. Positive displacement blowers draw in a specific volume of air or gas at suction pressure via the inlet into an internal chamber. They transport that volume of air and force it out via the outlet at a higher discharge pressure. There are two types of positive displacement blower technologies which are widely used in aeration applications: screw blowers and lobe blowers.

Choosing between rotary screw blowers and lobe blowers

For plants which are focusing on operational expenses, oil-free screw blowers are the most suitable positive displacement technology. Oil-free screw blowers are up to 35% more energy-efficient than traditional lobe blowers. They lead the field for applications involving back pressures greater than 0.5 bar(g). An important advantage of direct-drive, oil-free, rotary screw blowers is wide turndown, especially on models with integrated inverter drives. This allows the units to match the airflows to the daily and seasonal variations in the wastewater inflow, resulting in additional energy savings. To cope with fluctuations in air demand, screw blower technology can operate from 100% capacity to 25% with very little change in specific power requirement. They demand less energy because the internal compression concept offers higher efficiency derived from the design of its rotor elements.

For plants which are focusing on the capital expense of their compressed air system, lobe blower solutions may be the right fit. With a lower initial investment cost and a simple design, a tri-lobe blower offers reliable operation. Manufacturers such as Atlas Copco offer the option of pure mechanical basic units employing dial gauges for pressure reading or high-end solutions with an integrated VSD inverter and intelligent control. As an example, the tri-lobe rotors incorporated into the latest generation of low-noise, low-vibration, low-pulsation blowers are capable of sweeping nearly six times the volume of air in a single revolution compared to their belt-driven, twin-lobe predecessors. On average, this older technology experiences 5% –7% more transmission losses.

Centrifugal blower technologies

High-speed turbo blowers, multistage blowers and multistage centrifugal blowers are primarily designed for low-pressure applications that require higher flow rates of over 5,000 m3/hr, and are well suited for specialised applications at large water and wastewater treatment plants. Oil-free, high speed turbo blowers with frictionless direct drive are an ideal fit for larger plants, as they are highly efficient, reliable and designed to ensure a low total cost of ownership, often resulting in a payback of the investment cost over a short period of time. They can be delivered as a plug and play package with all components necessary for operation included, reducing installation costs and making sure operation is possible upon arrival of the unit on site.

The need for quality, oil-free air

Clean air is needed for treating water and wastewater. Oil-free air blowers are a wise choice as they ensure that no oil from the blowers will be added to the treatment processes. For example, when counting on an air supply to keep the bacteria alive, oil contamination is not desirable. The air in conventional activated sludge systems must be oil-free to avoid contamination of the water, and oil-free air prevents filter media from becoming dirty and unusable in filter backwashing. If a blower is ISO 8573-1 (2010) Class 0 certified it is a guarantee that the air is not contaminated by oil during the compression process.

CLASS 0
ISO 8573-1

Choosing the right blower for the application

The starting point is a thorough analysis of an installation and recognition that application characteristics are key to selecting the right technology. In the decision process, there will undoubtedly be one or more aspects that might take precedence over others.

Apart from finding a blower technology that matches the airflow and pressure needs of a specific water or wastewater treatment process, other factors such as initial investment cost or return on investment will also affect the search for the right air blower technology.

Key factors that should be taken into consideration include:

Flow and Pressure

A correctly sized blower installation will help to achieve a more energy-efficient process. For instance, in a situation where compressor turndown is employed as the low-pressure source, replacing the compressor with an air blower to deliver 0.3 and 1.5 bar(g) air will result in savings. For every 1 bar(g) the air is compressed above the actual demand, 7% of energy is wasted.

Operational costs and TCO

The capital cost of a low-pressure aeration lobe blower may represent less than 5% of a total wastewater plant's investment. This may appear to be an attractive proposition, but blower running costs are a far more significant factor and are likely to constitute up to 70% of the electricity costs for an entire wastewater treatment plant. This is because the aeration blowers need energy to run 24 hours a day in supporting the biological processes. They supply the right amount of oxygen to micro-organisms, maintaining their constant, balanced performance within the plant. It follows that, when considering the total cost of ownership of a blower installation, the need to seek an energy-efficient solution should be at the top of the list.

Application conditions

Site characteristics have a bearing on blower choice. For example, limited space availability for a blower installation might dictate the choice of a technology offering a smaller footprint and lower noise level.

On the other hand, the application criterion of lower energy costs may be best met by a more energy-efficient technology that comes with a higher capital cost but a far lower lifecycle cost.

Operating noise levels

A feature of the latest generation of low-pressure blowers is intelligent baffle and canopy design that provides reduced sound levels down to 72dB(a) for an improved working environment. Consequently, installation costs are reduced as there is no need for the provision of noise-insulated rooms and doors. Outdoor variants are also available to give the flexibility of having an outdoor installation.

Service and lifetime support

When it comes to routine maintenance and service support, some older blower technologies may require units to be serviced, repaired or re-furbished offsite. Advanced design developments in the latest oil-free, low-pressure blowers now see the inclusion of low maintenance components, extended on-site service intervals, and the benefits of lifetime customer support plans, and the possibility to do maintenance and inspection from the front and back of the blower.

An example of blowers in action

Clean water and wastewater treatment plants stand to benefit from adopting the latest innovations in air blower technology.

A recent case study with Scottish Water shows how they achieved annual energy savings of 25% at the Nigg wastewater treatment works, as well as a continuous, uninterrupted operation and a reduced maintenance routine, after replacing 19 traditional roots-type lobe blowers with 17 modern Atlas Copco ZS VSD rotary screw blowers.

The reduction in number of blower units was enabled by the ability to use the extra capacity per blower and wide turndown function to match process demands. The Atlas Copco ZS machines can run at considerably reduced loads whilst delivering the same or larger volumes of air as the previous nineteen units did before.

The roots-type lobe blowers previously in operation at the Nigg plant were a constant area of concern and attention for the site maintenance team. They required intense levels of maintenance and were frequently unable to operate at the upper end of their performance range. There was also a high incidence of air and oil leakage to deal with, as well as an energy cost consideration to take into account. With the majority of the blowers running 24/7, the BAFF (Biological Air Flooded Filter) process represented a significant share of the plant's total energy consumption. Following an energy study, it was decided to switch from roots to rotary screw blowers, which has led to around 25% savings in energy costs for aeration, with potential further savings through DO (dissolved oxygen) control process optimisation. Before the change, regular blower failures meant they were experiencing unacceptable process and compliance risks. Now, they are able to operate reliably at the plant's design capacity while also using less energy. What's more, they have gone from having to spend an average of 14 hours a week maintaining the blowers to just carrying out daily checks within their service contract.

Conclusion

The full picture of blower technology is a catalogue of comparative technical features and benefits that merit earnest consideration at the point of equipment replacement or plant expansion decisions.

The best solution will be one that ticks all the boxes on questions of the type of blower technology, its physical size and capacity, its level of energy efficiency, and total cost of ownership. There should be positive feedback too on issues such as whether it is designed for oil-free operation, minimum maintenance, and extended service intervals. The ultimate aim is for a blower system that provides total reliability, guaranteed continuity of process operations, and combines optimum performance with protection of the process, the environment and operational energy costs.

Get in touch

To find out more about how to specify the correct air blower for your water or wastewater treatment plant, contact an Atlas Copco specialist today.

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Or visit our website:
https://www.atlascopco.com/en-uk/compressors/industry-solutions/wastewater-treatment

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