



Providing answers to the wastewater aeration market

Air compression solutions

Answers for energy.

SIEMENS





Providing customized products and integrated solutions from one single source

Environmental focus

By supplying the precise amount of clean air in a very efficient and optimized way, Siemens is contributing to obtain your environmental targets. We support you in achieving low sound emissions, increasing water quality output, and reducing your carbon footprint. Our team will accomplish this while keeping a focus on your required process conditions and demands.

Experience

In this specific application, Siemens has a 30-year successful history in over 60 countries worldwide. With more than 7,000 units installed globally, Siemens leads the aeration compression market in wastewater.

With our overall strategic focus on the development and manufacturing of equipment and solutions that provide efficient and high quality products, we define the industry standard.

Enabling solutions

We offer our customers standard and customized products and integrated solutions from a single source. Siemens not only supplies aeration blowers, but works with the customer to create the most optimized aeration process. Our team of engineering specialists, biological experts, and committed manufacturing technicians work closely together to create the best possible solution suited to your process needs.

Our ecological balance sheet with 7,000 installed references:

- We reduced the energy demand of the industry by 675 MW (equivalent to a 1 billion Euro power plant).
- This accounts for over 430 million Euros per year in energy savings for the wastewater treatment industry.
- Our installed products and solutions achieve emission savings of over 2.9 megatons of CO₂ per year (equivalent number of cars on the road: 750,000).



A plant's aeration process can typically consume 50% of its energy usage

Energy efficiency

The demand for sustainable energy usage is driving the search for the most optimized treatment processes. Siemens' energy-focused product portfolio is specially designed to meet this challenge. Our target is to enable our customers to increase energy efficiency, thereby decreasing the energy bill while contributing to environmental and climate protection.

Siemens provides you with:

- Customized or standard single-stage turbo compressor packages
- Auxiliary equipment needed to optimize operation of the primary components and systems
- The instrumentation, sensors, monitoring and control systems that are crucial in optimizing operation of the entire aeration installation
- Complete, fully integrated aeration solutions, along with cost-effective service contracts to ensure minimum life-cycle cost

Improving your operational efficiency

To better understand and manage the costs of investments, many organizations analyze the total cost of ownership over the equipment's entire life cycle. This creates a comprehensive overview of direct and indirect costs, and presents a true comparison between different offerings in the market.

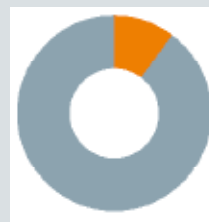
Focusing on the areas of greatest saving potential

In general, wastewater treatment plants and their respective aeration equipment have a minimum life span of 20 years. Less than 10% of the life-cycle costs or total cost of ownership during this period consists of capital cost, while upwards of 90% are costs relating to operating expenses.

For a typical wastewater treatment plant, the vast majority of the operating expenses are energy cost, the minority being maintenance costs. So a decrease in total life-cycle costs should be centered on reducing the operating expenses. Considering that the aeration process can typically consume 50% of its total energy consumption, aeration efficiency improvements are the most impactful step to reduce your electricity bill. Focusing on the areas with the greatest potential for improvement will yield the greatest savings.

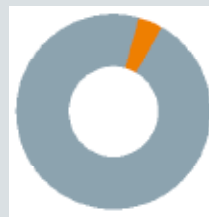


Life cycle costs



- 10% capital costs
- 90% total operating costs (20 years)

Operating costs



- 3-5% maintenance costs (20 years)
- 95-97% energy costs (20 years)

We study your aeration process

Siemens can help you focus on energy savings by carrying out case studies on the wastewater treatment plant. The case study compares the current set-up of the plant with an alternative configuration calculated by our experts. This comparison provides estimated figures on potential savings, optimized process conditions, and new solutions, which can be implemented at the plant. Furthermore, it gives you insights into the required financial needs and payback period.

Following are two case-study summaries of wastewater treatment plants, each of which gained significant savings by implementing high-efficiency single-stage centrifugal blowers and automated aeration system control.

Our ecological balance sheet with 7,000 installed references:

- Wastewater of over 600 million PE (population Equivalent) is treated with Siemens compressor equipment.
- Over 300 million people are benefiting from environmentally friendly wastewater aeration with Siemens equipment.
- Every year we supply or upgrade an additional 45 million population equivalent of wastewater plants.
- From development and manufacture to disposal, our products comply with all major environmental standards. Siemens has strong internal commitments to reduce its own carbon footprint. Our goal is to achieve a 20% increase in energy efficiency between 2006 and 2011.

Dillman Road WWTP, Bloomington, Indiana, US

- 57,000 m³/day two-stage activated sludge, built in 1982, aeration improvements in 2002
- Energy cost = \$ 0,0373 / kW – cost has increased since project completion in 2002
- Annual savings of \$ 119,000 (2002 energy price level) – 15 yr. Savings \$ 1,785,000
- Upgrade of new fine-bubble diffusers, and new single-stage turbo compressors with dual-point control.

Granollers WWTP, Catalonia, Spain

- Treatment plant capable of treating industrial and domestic wastewater
- A capacity of 30,000 m³/day, sufficient to meet requirements for 200,000 people
- Upgrade to Siemens compressors and Air Biological Control (ABC)
- After 12 months of continuous operation, overall performance exceeds expectations
- Compressors providing faultless operation and achieving energy savings of approximately 30%.

Making the right choice

Select the right aeration method

Control of the active sludge process is important in order to maintain a high treatment level under a wide range of operating conditions. One of the key factors for aeration process control is maintaining the defined dissolved oxygen levels in the aeration tanks.

Basically there are two methods for aeration of wastewater:

- **Surface aeration:** Mechanically agitating the water to promote solution of air from the atmosphere;
- **Bottom diffused aeration:** Oxygen transfer through submerged diffusers or other aerator devices

There are several criteria to consider when selecting the right aeration technology. Energy efficiency is one of the most important, followed by the system's mixing abilities, with significant differences between mechanical aerators compared to diffused aerators. Generally said, surface-aerated basins do not achieve the same performance level as bottom aeration.

Oxygen transfer efficiency depends on many factors, including diffuser type, air flow rate, and depth of submersion. Different diffuser types have been developed, with strong focus on reliability, energy efficiency, and easy maintenance.

Fine-bubble diffusers have high oxygen transfer and energy efficiency. Coarse-bubble diffusers are more economical, and require less maintenance, but have a lower oxygen transfer efficiency.

Select the right aeration source

The total energy efficiency of the aeration process is also strongly dependent on the selected blower type. There are several blower technologies available:

- Positive displacement compressors, PD blowers, (Efficiency is low.)
- Multi stage compressors (The efficiency is relatively low.)
- Single-stage turbo compressors (Highest possible efficiency)
 - » Direct-driven
 - » Integrally geared

The combination counts: highest energy efficiency can be achieved by using centrifugal turbo compressors and fine bubble diffusers.

References:

Environmental Dynamics Inc. Technical Bulletin 127. Energy consumption and typical performance of various types of aeration equipment. Aeration systems.

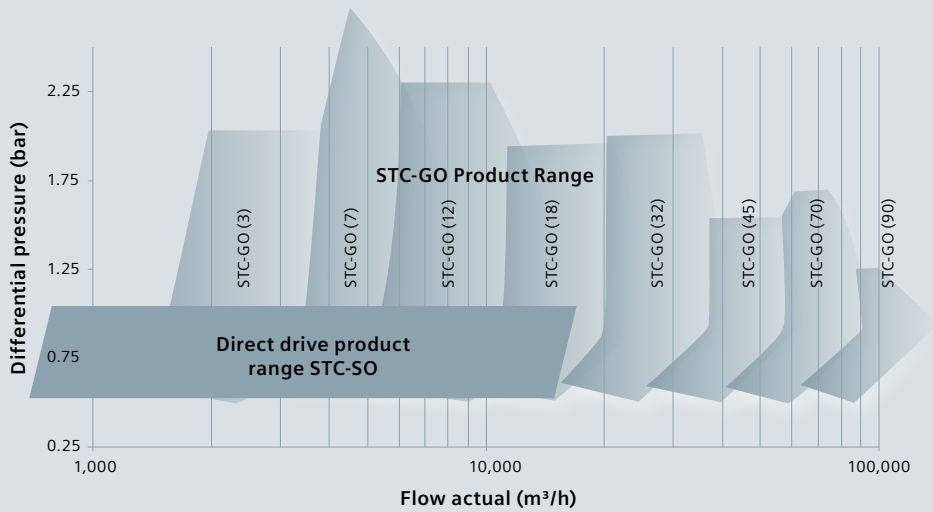
Mueller J.A., Boyle W.C., Pöpel H.J. (2002) Aeration: principles and practice. CRC press

Vesilind P.A. (2004) Wastewater treatment plant design. IWA publishing

Aeration method	Oxygen transfer efficiency (kg O ₂ /kWh)
Single-stage turbocompressors	
Fine bubble diffusers	2.8 – 4.0
Coarse bubble diffusers	1.9 – 3.2
PD blowers	
Fine bubble diffusers	2.5 – 3.1
Coarse bubble diffusers	1.5 – 2.1
Pure oxygen	1.0
Surface aeration	
Disk aerators	1.5 – 2.1
Brush aerators	0.9 – 2.0

Multi-stage oxygen transfer efficiency is generally in-between the low and High-end examples stated above.

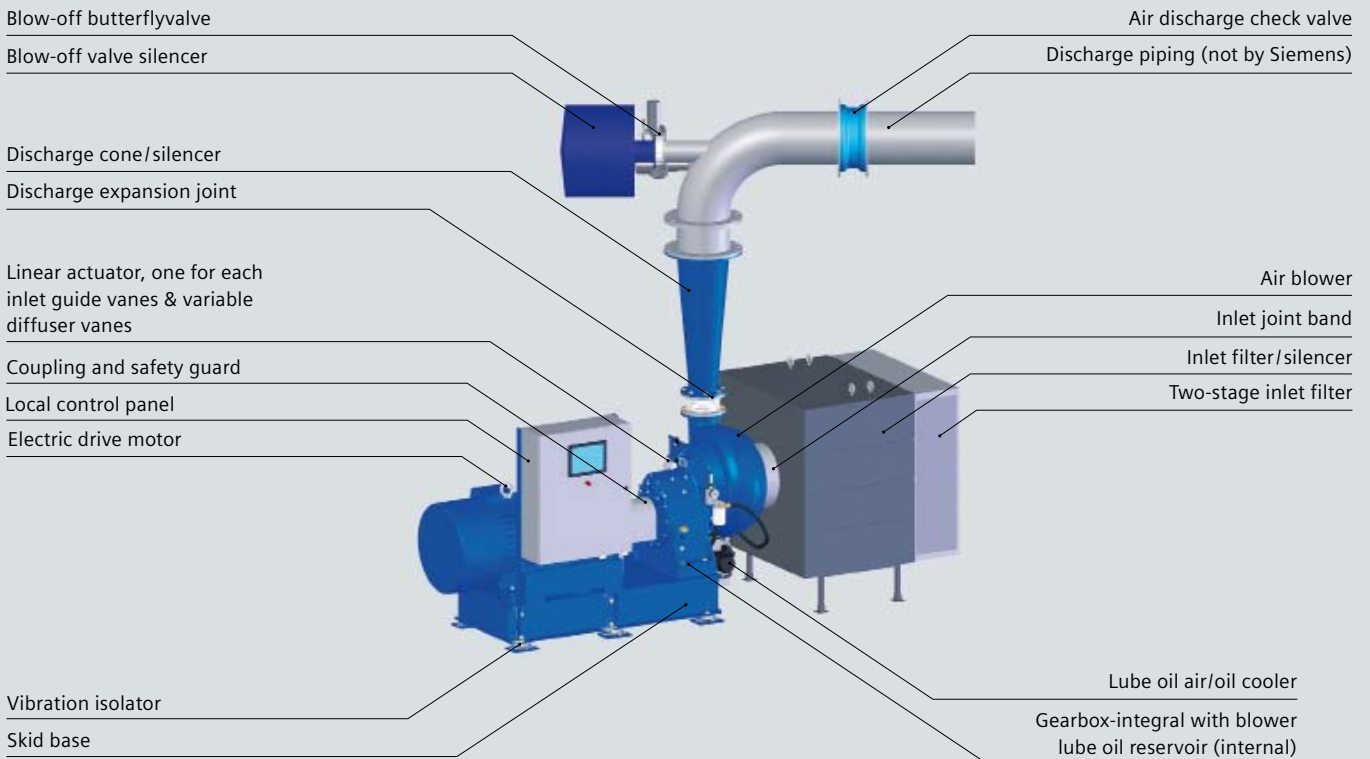
Comprehensive product range of air blowers



Main features:

- Variable flow with a turn down from 100 to 45 % at constant speed
- Electric motor drive
- Low operation costs due to state of the art efficiency in the total regulation range
- Long life time
- Minimum maintenance costs
- Compact design and easy installation
- Guaranteed oil free air delivery

Single-stage blower assembly



Choosing Siemens single-stage centrifugal compressors

Within the single-stage centrifugal compressor family, Siemens offers two mechanically different designs for wastewater treatment:

- **Integrally geared single-stage centrifugal compressor:** Design consists of a gearbox fully integrated in the compressor.
- **Direct-drive single-stage centrifugal compressor:** This blower design uses a high-speed motor, which eliminates the need for a gearbox, with the impeller mounted directly onto the motor shaft.

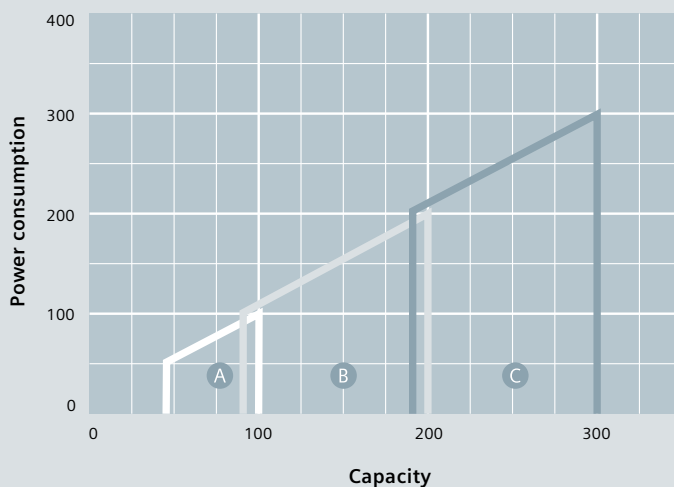
Optimized aerodynamic and mechanical design

The aerodynamic design is determined by three core elements:

- **Impeller,** which is machined from a solid forged piece of high-grade aluminum alloy.
- **Flow control by variable diffuser system** by adjusting the nozzle area of a number of diffuser vanes, arranged radially around the impeller.
- **Head control by variable inlet guide vanes or variable speed,** controlling the speed vector of the airflow to the impeller.

The **Dual Point Control**[®] flow and energy optimizing system combines the flow- and head control to meet the flow requirement at a constant high efficiency.

Overlapping of blowers A, B, C



Cascade control

The compressor regulation range from 45 to 100% enables regulation of two or more units.

With two compressors it is possible to regulate the flow stepless without gaps from 45 to 200%, with three from 45 to 300% etc.

Control systems

Siemens offers a wide range of specialized control systems for fully automatic and energy-saving operation of the compressor station. The systems consist of the following panels:

LCP Panel

The Local Control Panel is designed for fully automated monitoring and control of each compressor. The panel is equipped with the industry-standard Siemens PLC, working with an in-house developed dedicated program, adapted for each compressor. The Dual Point Control is realized by real-time data-sampling and calculation, whereby the highest possible compressor efficiency is achieved at all operational conditions.

MCP Panel

The Master Control Panel controls the oxidation-air supply to the aeration system, most commonly utilizing the cascade control. As an option, the MCP can be equipped with an ABC function, which fully integrates the plant air control system.

Air Bio Control System (ABC)

Main air header pressure transmitter

Main air header blow-off valve & silencer

Discharge check valve

Blow-off butterfly valve & silencer

Inlet filter/
silencer assembly

Single-stage blower assembly

Local control panel

Air flow control valve
to aeration basins

Manual air control valve

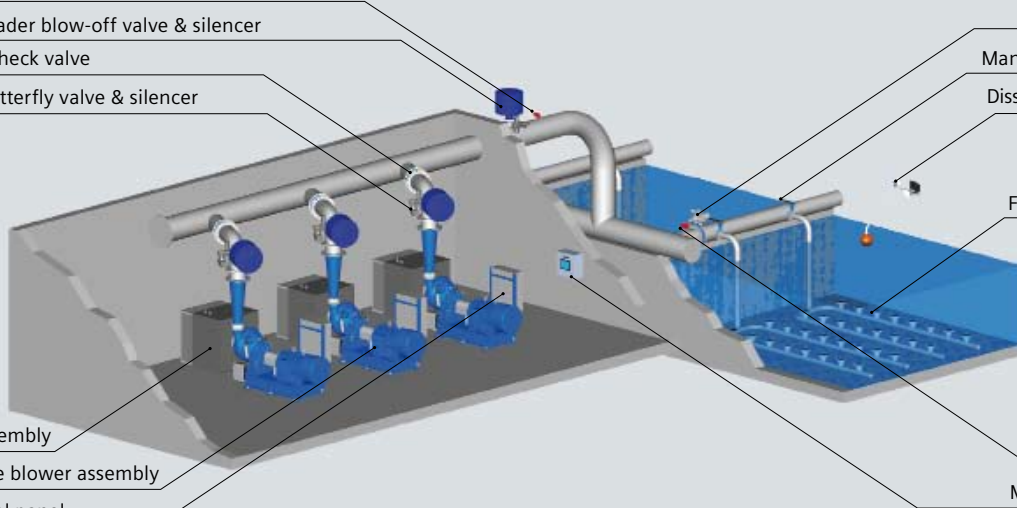
Dissolved oxygen probes

Fine bubble diffusers

Air flow meters

Air flow meters

Master control panel



Providing services and solutions

A global network of support

Our business unit can rely on a network of selected representatives in more than 30 different markets worldwide, combined with a vast organization of Siemens local entities in over 130 countries. This support structure is ready to meet your needs for exceptionally efficient aeration solutions, customized to meet your individual requirements, right down to the last detail. We provide the air power that gives you air control.

Our dedicated aftermarket service team consists of highly qualified experts, who offer the full service portfolio from:

- Installation & commissioning
- Spare parts
- On-site or classroom training of your staff
- Maintenance contracts
- Scheduled maintenance and troubleshooting
- Refurbishment and upgrades of your older machines
- Replacement of energy-inefficient equipment
- Footprint replacements

All parts for Siemens Turbomachinery Equipment compressors, from bearings and gaskets to impellers and casings, are available through the global Siemens Customer Service network. Delivery takes place either from stock or directly from our optimized production process, ensuring the best possible time of delivery.

Putting energy savings back into your production – our financial solution

Obtaining funding for wastewater projects is often one of the main hurdles to overcome when looking at implementing plant improvements or purchasing new equipment. However, as energy conservation grows more important, an increasing number of innovative funding opportunities are available. In cooperation with Siemens Financial Services (SFS), we can offer you a customized financial program to match your financial needs with the following advantages

- Avoiding upfront investments, hence not burdening your credit line
- Saving liquidity in turbulent times to stay financially flexible
- Enjoying cost savings and contributing to environmental sustainability

Optimized automation solutions

Siemens provides complete air-supply automation systems for wastewater treatment plants, thus ensuring effective integration of the aeration process with other downstream processes in the plant. This enables full end-to-end control, avoiding bottlenecks, and boosting efficiency at every stage.

Benefits and features:

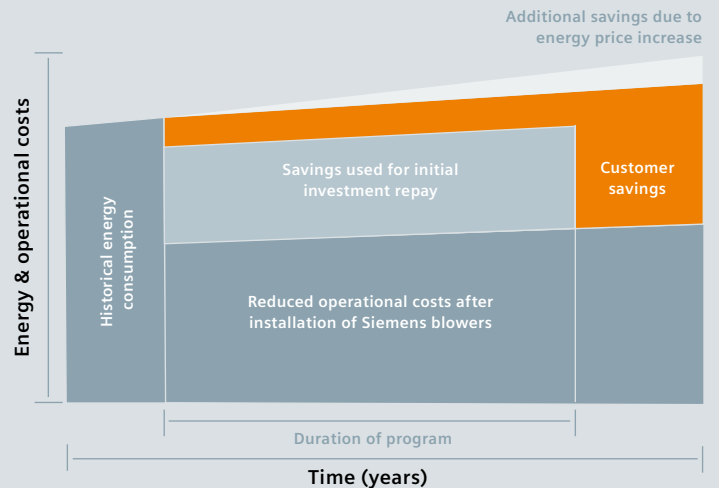
- An automated air supply assures the lowest system-operating pressure, keeping power consumption to a minimum.
- Continuous monitoring of process variables (dissolved oxygen, ammonium etc.) ensures the lowest airflow delivery, optimizing the aeration process, and minimizing power consumption.
- Precise, continuous airflow control enables maximization of the more complex nitrification / denitrification process, as required in the most modern aeration processes.
- Air-supply system-automation offers reduced operator intervention and ensures superior effluent quality.

Our heritage

With our headquarters based in historic Helsingør, Denmark, Siemens Turbo-machinery Equipment A/S (STE) is a specialized site, manufacturing and developing state-of-the-art single-stage turbocompressors and associated automated control equipment for aeration processes in activated-sludge biological treatment systems. Well known under the name HV-Turbo, and formerly part of Kühnle, Kopp & Kausch (KK&K) the organization was acquired by Siemens in 2006. With its production facilities in Europe, USA and Asia and regional offices in worldwide locations STE is a world-leader in blower technology for the wastewater industry.



Siemens financial services program



Enjoy saving costs and contribute to a clean environment.

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