

# Air System Solutions for Wastewater Treatment Plants



# Systems for Wastewater Treatment Plants

## Reliable, energy efficient solutions

*Wastewater treatment plants provide a critical service to our communities. WWTP systems operate continuously and equipment must be completely reliable and sustainable. Kaeser delivers exceptional air system solutions for wastewater treatment operations that are engineered for long life and continuous energy savings.*

### Meeting Tough WWTP Requirements ... and More

We understand the important requirements WWTP designers and operators consider when evaluating and selecting blowers and compressed air equipment:

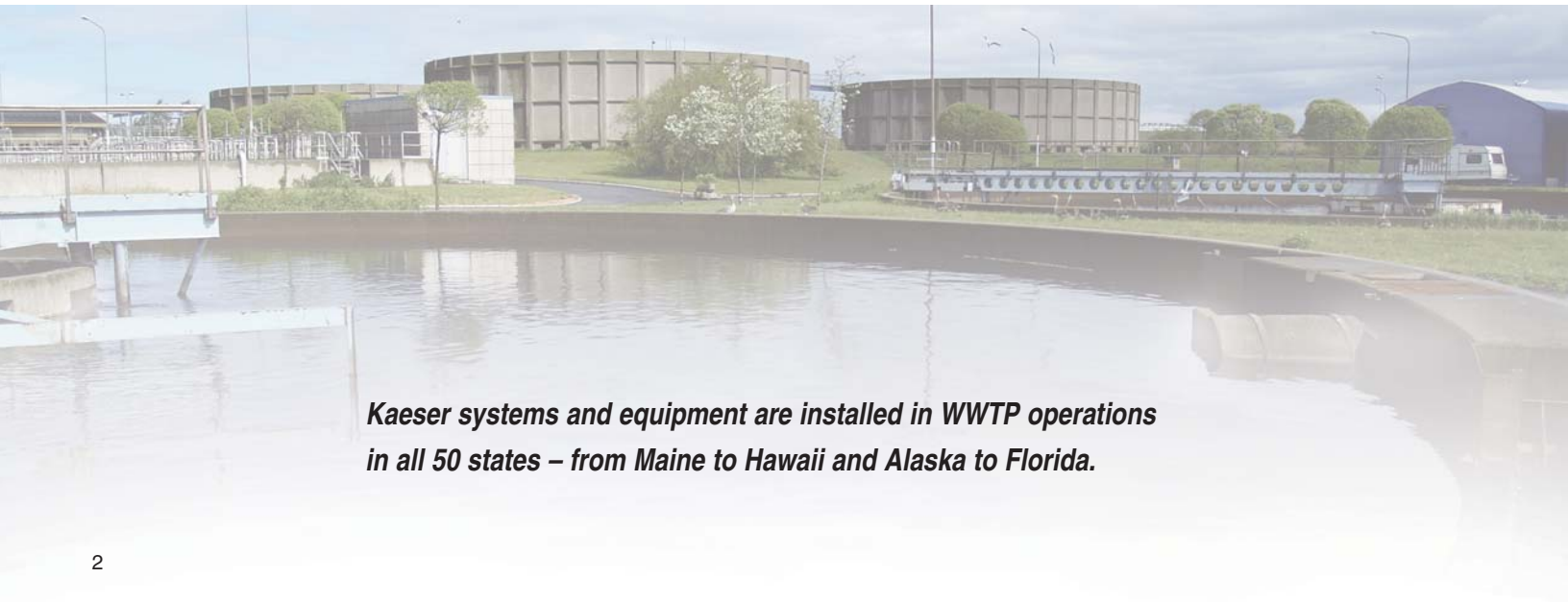
- Best possible equipment reliability
- Lowest life-cycle costs
- Simplicity and ease of maintenance
- Superior energy efficiency
- Small footprint and ease of installation
- Low-noise operation

To fulfill these needs and more, Kaeser offers fully packaged blower systems for applications including aeration, agitation, membrane scouring, filter backwashing, and bio-gas recovery. We also provide complete compressed air systems for controls, instrumentation, and shop air.

Beyond the excellent performance and quality of our equipment, Kaeser offers comprehensive design and installation support, a 24-hour emergency parts delivery pledge, maintenance and repair services, air system audits, and other system services. Strong support is always available whenever you need it.

### ***Kaeser is helping improve WWTP operations and efficiency by:***

- Replacing mechanical aerators with more efficient, reliable, and low-maintenance blower technology
- Replacing older blowers with modern energy-efficient ones
- Minimizing power costs with load splitting, sequencing, and superior multi-blower controls



***Kaeser systems and equipment are installed in WWTP operations in all 50 states – from Maine to Hawaii and Alaska to Florida.***

# Products engineered for WWTP

## The Complete Package Concept

Wastewater treatment plants across the country have discovered that factory-built blower and compressor packages provide distinct benefits to their operations.

Our Com-paK rotary blower packages are engineered to simplify installation while ensuring proper integration, component compatibility, and equipment protection for many years of trouble-free performance.

Kaeser leads the industry in designing packages that include a complete scope of supply with motors, drives, valves, enclosures, controls, and instrumentation.

- **Motors and drives** – TEFC premium efficiency motors are standard. Each motor is selected for superior efficiency and durability and sized conservatively for long life. Drives

and starters are engineered for maximum efficiency and reliability.

- **Enclosures** – Our standard enclosure designs feature heavy gauge powder coated steel frames and panels with thick sound insulation to ensure low noise levels. Panels are easily removed for full access to operating components for maintenance.
- **Vibration isolation** – Our chassis design eliminates vibrations to keep piping leak-free and all wiring secure.
- **Controls and instrumentation** – We design controls to provide easy and efficient operation, access to operating and maintenance information, and to protect equipment from electrical and mechanical problems.



- **Variable speed controls** – Omega Com-paK blower systems are available with integral variable frequency control to maximize your energy efficiency. A selection of control modes allow the user to select a method best suited for their application.

## Intelligent control and protection

To protect your investment and ensure the most efficient operation possible, we control these integrated blower packages with our Sigma Control 2™. This intelligent controller comes standard with multiple pre-programmed control profiles so you can select the one that best fits your application.

Sigma Control 2 monitors a wide range of operating parameters, shuts the unit down to prevent damage, and signals if immediate service is required. It also tracks preventive maintenance intervals and provides notice when PMs are due. An RFID sensor provides secure access and simplifies managing maintenance intervals. A SD card slot enables fast, easy software updates, storing key operational parameters, and offers long-term data storage for analyzing energy consumption and compressor operation.

Sigma Control 2 has superior communications capabilities. An Ethernet port and built-in web-server enable remote viewing. ModBus, Profinet, Profibus, Devicenet, and other industrial communications interfaces are also available as plug in options for seamless integration into plant control/monitoring systems. See our Sigma Control 2 brochure for details.





# Designing an Efficient System for Today That Will Meet Tomorrow's Needs

## System splitting for superior wire-to-air efficiency

Stephen Horne, Product Manager - Omega  
Kaeser Compressors, Inc.

Energy is the single highest operating cost in a wastewater treatment plant. More specifically, the energy to operate *blowers for aeration* is the single highest operating cost. Fortunately, blowers and blower systems are becoming more energy efficient as system engineers pay more attention to this critical cost factor. At Kaeser, this has been an important design criterion for decades.

### Nature of WWTP planning

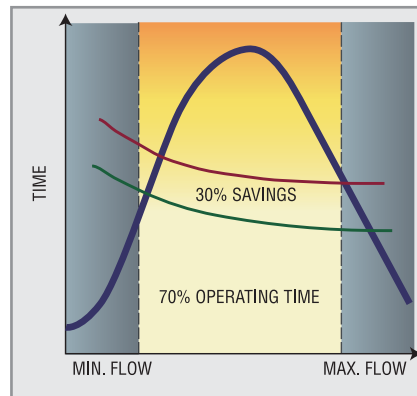
Unlike commercial systems, municipal wastewater treatment plants are often designed and built based on projected populations and demand 10, 20, and even 30 years in the future. Although the volume of air needed changes seasonally, day to day, even hour to hour, the plant's capacity is designed for worst case/maximum load. As a result, blowers are frequently oversized, do not operate at their most efficient design point, and spend as much as 90% of their operating time wasting costly energy.

### Wire-to-Air Efficiency

Increasing focus on energy efficiency has helped spawn a new generation of blower products. Blower manufacturers are taking advantage of the increasing interest in "wire-to-air efficiency" to promote these new technologies, which can produce more efficient blowers for certain performance points. The most important development, however, is in the controls for multiple blower systems.

Wire-to-air efficiency is simply the total energy used to provide the specified flow and pressure and is expressed as a ratio of the power to the flow. While this consideration is relatively new to the blower market, it is a metric widely used for industrial compressors and compressed air systems, usually expressed as *specific power* (kW/100 cfm). It is a very useful phrase if applied correctly.

The challenge is that wastewater air systems are typically sized for the absolute worst case scenario, but don't usually operate at those performance points. The best way to manage aeration is to vary the air flow according to changing need. Specifically, this means controlling air production based on dissolved oxygen levels or other performance targets. While the desired levels of DO, NH<sub>4</sub>, and NO<sub>3</sub> remain the same, the amount of air to maintain these levels varies based on a wide range of factors (e.g., ambient temperature and humidity).



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This highlights the need for adaptive controls in multi-

multiple blower systems that maintain optimal efficiency by selecting the combination of blowers that will always meet demand with the least energy consumption, tying plant air requirements to wire-to-air efficiency.

### Focus on the System

For a multiple blower system, the focus must be on system efficiency. It is not enough to simply use the most efficient blowers. Well-designed blowers are a great start but to operate as an efficient system, they must be applied correctly and controlled properly.

Conventional aeration system designs include two large blowers. In the name of efficiency they are often large variable speed blowers with an identically sized back up unit. Simple control systems are set to share the demand and the blowers operate at the same speed. This is very costly, since not only do variable frequency drive units cost more to purchase, their drive losses must be factored into the unit's efficiency. Additionally, as their name suggests,

variable frequency drive units are designed to handle varying demand. It is wasteful to run VFD units during periods of steady demand.

The preferred approach is splitting the maximum load among several cycling fixed speed machines to cover the large portion of the demand and using variable frequency drive (VFD) machines to provide the trim load. This method of system splitting allows much more efficient control.

## Adaptive Control

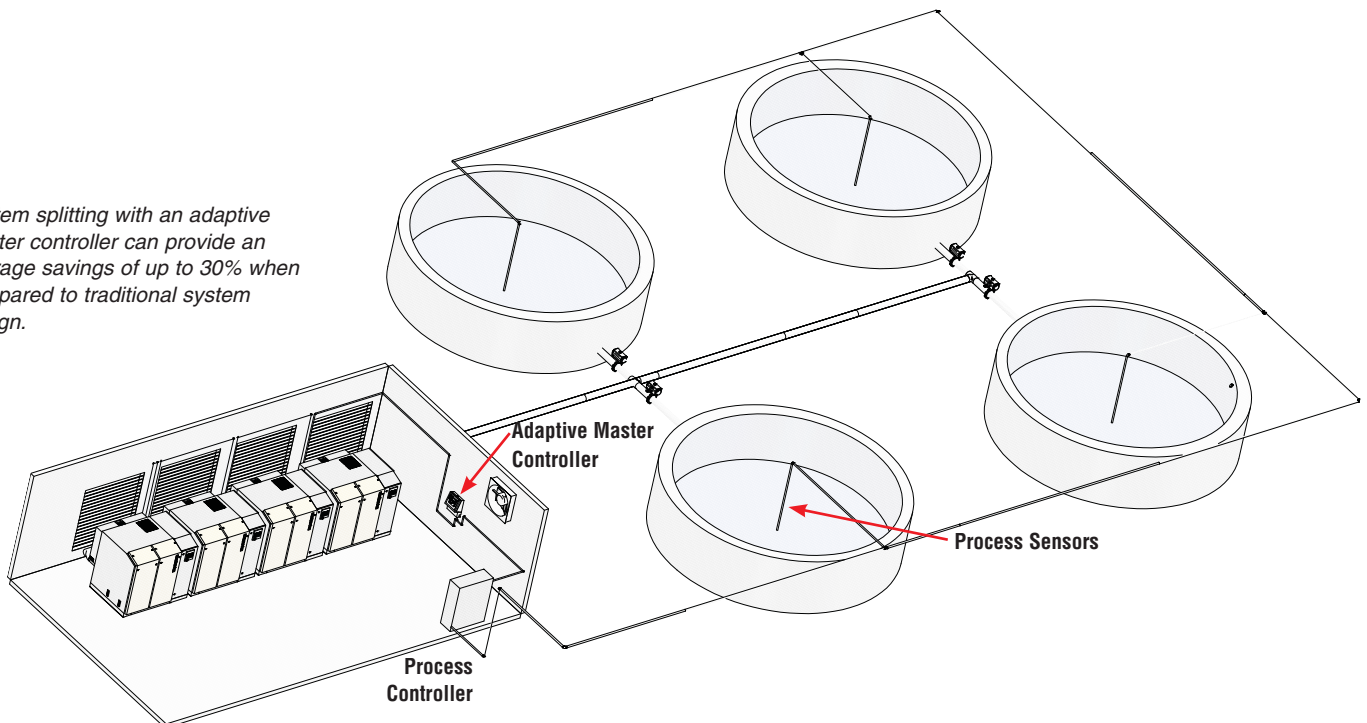
For system splitting, only one or two machines are VFD units. The remaining blowers are fixed speed units with reduced current starting. By limiting the number of VFD units in the system, initial investment costs are considerably reduced. Adding an adaptive master controller makes it possible to find the best combination of units to meet the current demand. Since the fixed speed units run on auto-dual control, the units can run idle for a defined period of time before shutting down. This gives the adaptive master controller enough time to observe the system's response and signal the units to reload if needed. The VFD is sized no larger than required, reducing the initial investment cost while covering the supply gaps that occur when the fixed speed machines are idle.

## Example

Consider a 2,000 cfm system at 7.0 psig at standard conditions. The conventional method of system design would use three like-sized VFD packages. Each unit is a 40 hp blower sized for at least 667 cfm. The true system specific power for these three units in operation is 4.5 kW/100 cfm over the entire operating range. A split system concept with an adaptive master controller would use one 25 hp VFD blower package, two 20 hp fixed speed machines, and one 40 hp fixed speed machine. The average specific performance of this system over the entire operating range is 3.6 kW/100 cfm. This averages out to a difference of 25%. Over a ten-year period, the split system concept with an adaptive master controller would save over \$180,000.

Clearly, wastewater is a critical utility and the system must be designed to reliably meet its highest expected load. But when it comes to the blower system, bigger is not necessarily better. The best air system design is a holistic one that takes into account the range of demand, future growth, the entire system's specific power, and optimized energy efficiency. System splitting and using an adaptive control scheme can provide reliable supply without unnecessarily burdening the community with higher energy costs. Spending a little more time today to understand the dynamics of your system can save initial costs as well as maintenance and power costs for many years to come.

*System splitting with an adaptive master controller can provide an average savings of up to 30% when compared to traditional system design.*



# Sigma Air Manager Series

## Why you need a system controller

*Controls are critical to a wastewater blower system. Without them, a system with multiple blowers operating on their individual controls will run more than necessary and result in wasted energy. Maintenance costs increase and worst of all: process performance suffers. Kaeser's Sigma Air Manager (SAM) controls up to 16 blowers and only turns them on when needed. This improves pressure stability, reduces energy use, and equalizes blower run time. Using the SAM in conjunction with a system splitting solution results in average savings up to 30% when compared to traditional system design.*

### Superior aeration control

SAM can monitor any 4-20 mA sensor/sensing device for system control. This makes it possible to set a single system control variable, e.g., header pressure or dissolved oxygen (DO) levels, and operate only the needed blowers to maintain a tight band around the set point, resulting in a stable flow output.

SAM can accept remote inputs for additional system monitoring capabilities. It can communicate via an OPC server to the plant SCADA system for monitoring and historic data. The system set point and other critical parameters can also be changed. Data from individual blowers can also be monitored/extracted.

### Advanced energy management

Energy costs are a vital concern for any WWTP. SAM constantly monitors the system demand and selects the most efficient combination of units to meet it.

Whether a fixed speed or variable speed blower, SAM knows the specific performance of each unit. SAM can select the appropriate machines to provide the best system performance and wire-to-air efficiency throughout a wide range of demands, especially when

VFDs are a part of the installation. SAM keeps the VFDs running in their optimal operating range to maximize energy efficiency while minimizing drive losses at lower operating speeds.

### Reduced maintenance

SAM rotates like-sized machines to equalize runtimes and spread out maintenance intervals. Sending maintenance alarms for specific units via text message is available as an option. SAM can also specify particular units as backup only, so that the unit will not turn on unless there is a failure in one of the other operating units. See our SAM brochure for more information.

### Sigma Air Control Plus

With the optional Sigma Air Control (SAC) *plus* software package, SAM provides continuous energy audit information to document energy savings. SAC *plus* also enables remote monitoring via standard web browser without developing a third party system.





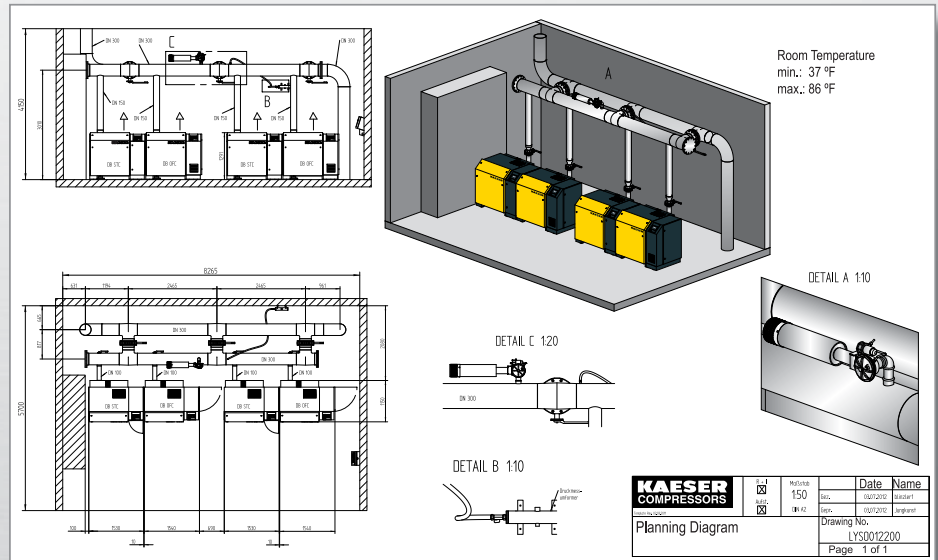
# Engineered Solutions

*Kaeser is always at your service to help design or optimize your wastewater treatment air system. From complex installations to challenging environments to limited space, Kaeser can design a system to meet your specific requirements for performance and reliability.*

## System design

Kaeser specializes in designing a complete air system that takes into account the numerous variables necessary to ensure optimal system performance. Based on your needs, our engineers can recommend the best layout, ventilation, and cooling fan capacity for your system.

To help make your project planning easier, Kaeser can also produce two-dimensional and three-dimensional drawings of the proposed system. Being able to visualize the new equipment and how it will fit into the building with the existing equipment is a huge asset in facilitating your installation planning.



*Kaeser can provide valuable system drawings to simplify your installation planning.*

## Containerized Solutions

Our turnkey, all-weather compressed air packages integrate our high quality blowers with rugged, weather-proof containers. These containerized systems are built to specification for any climate or location and are perfectly suited for even the most demanding wastewater treatment plants.

With remote connectivity supported by our Sigma Air Manager, air production is constantly monitored for optimum efficiency. Furthermore, the master controller's wide range of industrial communications interfaces allows seamless integration into the plant's SCADA system.



*Kaeser's containerized systems are tailored to meet any application demand.*

## The Air Systems Specialist

We strive to earn our customers' trust by supplying superior quality equipment and services. Our products are designed for reliable performance, easy maintenance, and energy efficiency. Prompt and dependable customer service, quality assurance, training, and engineering support contribute to the value our customers have come to expect from Kaeser. Our employees are committed to implementing and maintaining the highest standards of quality to merit customer satisfaction. We aim for excellence in everything we do.

Our engineers continue to refine manufacturing techniques and take full advantage of the newest machining innovations. Extensive commitment to research and development keeps our products on the leading edge of technology to benefit our customers. Our industry-leading controls continue to set the standard for efficient system operation. With over 90 years of experience, Kaeser is the air systems specialist.

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Certified Management Systems



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