VACOMASS®

Technical Data VACOMASS®

Measurement and Control System

BINDER
BINDERGROUP

THE SYSTEM VACOMASS®

COMPONENTS:
The modular design of the VACOMASS® measuring and control system operates on the building block principle. It can be used as a single component or a complete system in sewage treatment plants. In the simplest case, there is only an air flow meter or a control valve being used. The system can be one single local control loop for oxygen control only or alternatively a complex system of several control loops including control of blower pressure set-point of the air header pipe. The **VACOMASS® system integration** and the precise calibration of the air control and distribution system in our **CAMASS® Calibration Lab** ensure always an optimum interaction of the system components and thus the highest precision for the control of the air supply.

USE IN THE BIOLOGICAL STAGE:
The undersupply of oxygen in the biological process leads to process problems and the consequences that the legal limits of the effluent quality of the purification plant will be exceeded. However, if too much compressed air is fed into the wastewater, this can lead to process disadvantages and an uneconomical operation of the purification plant with a distinct waste of energy. Only an intelligent and load-dependent distribution and control of aeration air guarantees an equally economical operation of the purification plant.

Moving towards the aeration basins, air must overcome several static and dynamic counter-pressures against each other to balance in equilibrium. These pressures vary with the flow rate or vary in dependence of the external interference factors, which can be controlled only with much difficulty. Examples of these are changes of the loading, the wastewater level in the basins or the differential pressure drops across aerators (due to ageing). With minimum changes to these pressure ratios, it can have a significant influence on the air distribution.

CONTROL CONCEPTS:
The **VACOMASS® concept** - utilizing local air distribution and control - can solve this problem. Every VACOMASS® air distribution system supervises continuously the air supply and distribution and recognizes immediately the smallest shifts in the pressure ratios. The local controller intervenes immediately and eliminates the influence of external disturbances on the air distribution. VACOMASS® provides - depending upon actual load and oxygen demand - for this air supply meeting its demand in the various basins, zones and/or cascades of the purification plant. Furthermore the required and optimum aeration time can be determined based on further process information for intermittently aerated basins.

Conventional monitoring systems are usually based on the measurement and control of the dissolved oxygen concentration only. In larger purification plants, it is usually overlapped from further process parameters like the ammonium and/or nitrate concentration. Using only an oxygen control strategy, due to basin size, system inertia and in addition, unfavorable sizing of blowers and control valves as well as the use of butterfly valves as a control valve can lead to deviations in the actual concentration compared to the desired setpoint from up to 1.5 mg/l and more.

In the negative case, this deviation can lead to the undersupply of oxygen to the activated sludge with negative effects to the sludge characteristics, and the expiration values regarding ammonium can emerge.

In the positive case, this leads to over-aeration in the biological tanks, increasing energy

consumption unnecessarily. Subsequently, this can also lead to substantial negative process effects such as increased oxygen concentration in the denitrification zones (reduction of the denitrification capacity, increase of the nitrate concentration in the effluent) or mineralizing effects of the activated sludge. These negative effects arise particularly fast in under-loaded purification plants.

Furthermore, in unfavorable cases in large size plants with several automatic control loops, it can lead to swinging in the automatic control loops and thus to an unstable air distribution.

QUALITY OF CONTROL:

The **VACOMASS® system** uses air flow with oxygen concentration as an additional control parameter. From the current situation, for actual and required O_2-concentration as well as actual air flow and opening position of the control valve (including further parameters if beneficial) the necessary air flow is computed and adjusted directly by the control valve. An immediate response to load changes is possible, so there is no need to wait until response of the control valve in the current oxygen concentration become apparent. Deviations between actual and desired oxygen concentration are reduced. An overshoot and undershoot fluctuation of the oxygen concentration is avoided as far as possible. A very low DO control set-point can be defined without risk and this reduces the energy consumption.

PIPE SECTION FOR MEASUREMENT AND CONTROL OF AIR FLOW:

The design of the pipe section for measurement and control depends on type of the control valve (square diaphragm or jet control valve) and available space. There are two general versions available.

Using a square diaphragm control valve, pipe size is usually reduced in front of the valve and expanded after. The **VACOMASS® jet control valve** is usually mounted directly into the original pipe with reduction/ expansion.

Standard pipe section: If straight pipe section is sufficiently long, then the air flow meter is placed far away in front of the control valve, so that the changing stroke of the valve does not influence the flow signal.

Integrated version: The air flow meter is placed 350 m in front of the **VACOMASS® square diaphragm control valve** or 0.5*D in front of the **VACOMASS® jet control valve** respectively. If the square diaphragm control valve is used, the changing stroke of the valve is used for simultaneous flow profile correction. Depending on piping section in front of the flow meter and/or on the requirements on accuracy of flow measurement, simultaneous flow profile correction is not used for the **VACOMASS® jet control valve**.

SAVINGS IN ENERGY:

In case of operating a plant under partial load conditions, the flow dependent counter pressures will decrease. At constant blower pressure, this is compensated by closing the control valve which results in an increased differential pressure. Instead of throttling the air supply via the valve, however, it makes more sense to provide a variable adjustment of the blower pressure according to the actual air demand. For this, **VACOMASS® econtrol** monitors the operating state of all VACOMASS® systems in order to determine the pressure necessary just to maintain sufficient air supply for the whole installation. A lower pressure level results in less energy consumption for the air supply thus ensuring an economical plant operation.

BLOWER MANAGEMENT:
In modern sewage treatment plants, frequency controlled rotary piston blowers and highly efficient turbo compressors are readily in use. However, the push for greater efficiency and lower energy consumption with accurate control even under fluctuating conditions is still on-going. The effectiveness of the compressed air supply depends substantially on the blower management (MCP). An effective blower management system supervises not only the operation of the individual blowers, but takes over the automatic control of several blowers simultaneously in its system. The combination of different capacity blowers with different operation modes (frequency-controlled, pole-changeable, without regulation), of different ages and possibly from various manufacturers as well as adaptation to the fluctuating air demand are amongst others, some of the challenges faced. VACOMASS® blower management controls the supply of aeration air at a required pressure level, so that each of the compressors runs as far as possible at the optimum operating point. Thus a high efficiency and low energy costs can be realized.

MAIN ADVANTAGES

- modular system for improvement of biological process and effluent quality
- High-quality components for single use or use in a system made in Germany
- Precise air flow measurement in the different aeration tanks becomes possible
- independent of plant size and No. of tanks
- aeration air will be distributed into the different zones/ tanks load-depending
- improves process stability and reduces operation costs of the aeration system
- reduces operational disturbances and secures effluent quality
- makes an efficient operation of the purification plant possible
- control strategy with many international user references of plants in different sizes

TECHNICAL INFORMATION ABOUT COMPONENTS

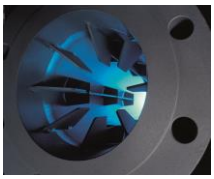
VACOMASS® flow meter

Air flow meter measuring system

- based on thermal dispersion technology, including automatic pressure and temperature compensation
- using several single sensors, precise results can be achieved even if there are flow profile distortions or big pipe sizes
- robust stainless steel/ ceramic sensors made from one single bar stock. Enclosure is made of corrosion proof aluminum or stainless steel, protection class IP68, mounted with a hot tapping unit (option only)
- repeatability better than 0.15%
- accuracy up to 1.0 % of reading + 0.1% of full scale

Reference for calibration: custody-transfer sensors or pipe sections in the **CAMASS® Calibration Lab** or in a DAkkS-certified Lab

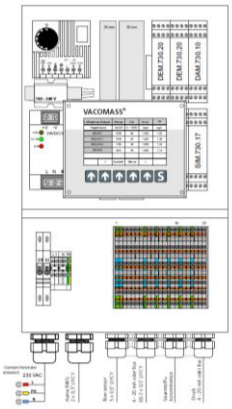
VACOMASS® hot tapping unit	Hot tapping unit for the air flow meter in different versions: ▪ Standard version OEIN-S with flexible insertion depth ▪ Version OEIN-F for repeatable mounting position
VACOMASS® square diaphragm control valve	Control valve with actuator for precise control of air flow with falling flow axis implemented with square diaphragm or special types adapted to the requirements of the project (construction, design and manufacturing according to VDI/VDE 2173, EN 60534 und VDMA 24422), with the mounted electrical **VACOMASS® actuator** Valve in two versions available: premium (higher grade materials, mechanical indication of position/ stroke and self-lubricating stem guide, RAL 5010) as well as eco (without mechanical indication of position/ stroke, manual or Perma-lubrication, RAL 7001).
VACOMASS® jet control valve	Gas-tight shut-off, aerodynamically optimized control valve, mainly made in stainless steel, with a linear operational characteristic in more or less full operation range, for precise control of air at very low pressure drop ▪ With a central control axis and actuator for sensitive control of air supply ▪ Changes in stroke are made in/ against flow direction (flow is routed to the outside wall in order to avoid vortices, supports rapid and high pressure recovery a very low pressure drop of the valve) ▪ Moving body has a very low drag coefficient (only a small driving torque is required, so a smaller size actuator with low torques can be used) ▪ Resistance coefficient Zeta remains unchanged over the entire stroke-range to avoid significantly higher energy losses related to changing resistance coefficient ▪ All materials are of high-grade stainless steel type A4, ambient and gas temperatures can range from – 40°C up to +150°C (corrosion-resistant & minimum maintenance) ▪ Closes gas-tight, can be used in flexible zones. For further process improvements, the costs for an additional butterfly valve can be saved ▪ Excellent repeatability (better than 0.2%) ▪ A nearly linear operational curve is best means for good resolution and stable control in combination with an ideal amplification factor of 1

VACOMASS® actuator	Sensitive electrical/ pneumatic actuator for control purpose, directly connected with the valve using flanges ▪ With a low torque ▪ Standard: AUMA SAR with high corrosion protection ▪ Option: all other actuators can be used too, if they fit from a technical point of view	 
VACOMASS® tune valve	Hand-operated membrane valve for fine adjustment of air distribution (for small pipe diameters)	
VACOMASS® blow-off valve	Safety blow-off valve to prevent blower trip-out	
VACOMASS® damper	Used in systems where tanks have permanent different water levels or to reduce noise of flow	
VACOMASS® flow conditioner	Flow-conditioner of different types. It reduces straight inlet pipe run to a few D only if piping has insufficient straight length. The baffles in the inlet pipe section equalize flow and pressure distortions.	
VACOMASS® control cabinet/ electronic	Control cabinet with required No. of electronic modules **VACOMASS® basic, slave, master, econtrol, multi** as well as graphic displays	

VACOMASS® flexcontrol

Modular SPC-based universal control cabinet with graphic display and customized software for local control of air supply and distribution

- System electronics in a stainless steel cabinet
- With separated 230 VAC electrical connection compartment, up to IP 65
- For indoor (standard)/ outdoor installation
- Visualization via graphic display (customized menus, error message screen, diagnosis, etc.)
- Data transfer: digital and analog signals to the main PLC as well as various Bus systems
- Simultaneous flow profile correction for integrated version (option)
- With external access for fine-tuning of the control parameter and service work (option)
- Automatic calculation of required air flow is done as well as automatic adjustment of the control valve for local control of air input and distribution, incl. plausibility check and alarm transfer to the PLC
- Redundant control of further process parameter, only signals of well working flow meter are used, in case of disturbances the valve is positioned in a safety position
- PID-control system can be implemented



VACOMASS® basic

Electronic module for automatic correction of flow signal for irregular flow profile due to actual position of the VACOMASS square diaphragm control valve

VACOMASS® slave

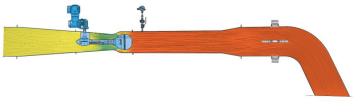
Electronic module for local control of air supply based on known setpoint for air flow, given by a **VACOMASS® master** or the main PLC/ operator

VACOMASS® master

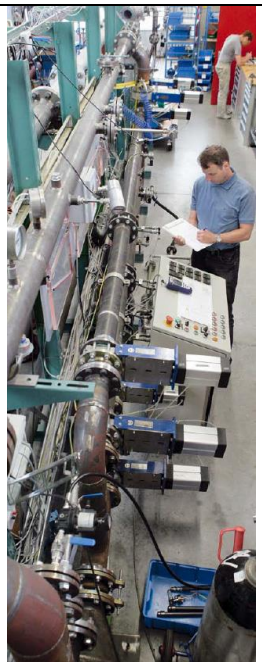
Electronic module for permanent and automatic

- calculation of actual required air flow
- new position of the control valve for local control of air supply is calculated and will be realized in one step only

Switching frequency and increased wear of the gear will be reduced. Permanent control of plausibility of air flow vs. position of the control valve. Transfer of alarms to the PLC if necessary. Redundant control of further process parameters possible. Only signals from well working probes are considered for control. In case of substantial disturbances a safety position of the control valve will be adjusted automatically

VACOMASS® econtrol	Super-coordinated electronic module for calculation and transfer of required minimum header pressure based on actual air flow and valve stroke (automatic adjustment of header pressure setpoint strategy)	
VACOMASS® multi	Super-coordinated electronic module for calculation and transfer of average and weighted flow signal for multi-point measuring systems. It is DIN-rail mounted or in a cabinet/ field housing.	
VACOMASS® biocontrol	Modular SPC-based universal control electronics in a field housing with a graphic display and flexible customized configuration For calculation and control of load-depending time sequences of nitrification/ denitrification process, as well as load-depending O_2-setpoint, time sequences of nitrification/ denitrification process internal recirculation rate, actually required aerated volume and dosing of C-chemicals	
VACOMASS® blower management	Electronic module/ cabinet for automatic and energy saving operation of several blowers/ compressors in a system	
VACOMASS® simulation	CFD-simulation of flow in the piping section with control valve and flowmeter, considering detailed installation situation, piping geometry, further installations in the inlet and outlet pipe run	
VACOMASS® calibration	VACOMASS® calibration considers individual components and their interactions including simulation of field installation situation in the CAMASS® Calibration Lab: <u>Level 1:</u> Calibration of the **VACOMASS® flow meter** under actual operating conditions in our **CAMASS® Calibration Lab**. This standard calibration will be done under the assumption that sufficient straight inlet and outlet pipe runs are available for installation of the single-point **VACOMASS® flow meter**. Process parameters like temperature, pressure, installation details of piping and gas composition will be considered to achieve a high accuracy on flow metering. <u>Level 2:</u> If straight pipe section is not sufficiently long, calibration of the **VACOMASS® flow meter** is done together with the **VACOMASS® square diaphragm control valve**. In addition, this calibration includes the simulta-neous flow profile correction depending on the actual	

VACOMASS® calibration	stroke of the control valve. Correction can be done in a **VACOMASS® master, slave** or **basic** module. In most cases, when a **VACOMASS® jet control valve** is used, the flow profile correction is not necessary. Level 3: If straight inlet pipe section is very short or if there are flow pulsations, a **VACOMASS® flow conditioner** must be placed in front of the flow meter and control valve. All three components are calibrated together in a scale 1:1. Level 4: If there is more or less no straight inlet piping section available or if there are butterfly valves or other devices upstream and close to the **VACOMASS® flow meter**, the measuring and control pipe section installation must be included into the calibration loop as a complete unit with some further pipe sections in a scale 1:1. Level 5: **VACOMASS® calibration** is customized and compared with master calibration devices and according to contractual requirements on DAkkS (German accredited Institute) Calibration Lab using measuring equipment which is regularly recalibrated and traceable to PTB (Physikalisch Technische Bundesanstalt).
VACOMASS® start-up/ fine tuning	Technical support during start-up phase, fine-tuning of control parameters in the control system based on local conditions by Binder specialists at site or via remote



CONTROL STRATEGIES

We develop together with the customer, special control strategies based on local situation related to the number of aeration tanks and their geometry, scope of supply (integration of existing equipment if possible from technical point of view) and requirements on the **VACOMASS® system**.

IMPRINT

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