

VACOMASS[®]

Technical Data

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THE SYSTEM VACOMASS®

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.

The VACOMASS® concept utilizing local air distribution and control system 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 load-dependently based on further process information (e.g. pH and others) for intermittently aerated basins.

VACOMASS® is a modular measuring and monitoring system, consisting of several optimized and coordinated system components for the measurement, control and distribution of aeration air in purification plants. The components can be supplied as an individual construction system. Depending upon plant size, process control strategy and specific requirements, the components of the VACOMASS® system can be used either separately or in combination with one another. The VACOMASS® system integration and the precise calibration of the air 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.

Conventional monitoring systems are usually based on the measurement and control of the oxygen concentration only, in larger purification plants 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 large size plants with several automatic control loops, in unfavorable cases it can lead to swinging in the automatic control loops and thus to an unstable air distribution.

The VACOMASS® system uses air flow with oxygen concentration as an additional control parameter. From the current situation, for actual and required O₂-concentration as well as actual air flow and opening position of the control valve (if beneficial including further parameters) 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.

In case of operating a plant under partial load conditions, the flow dependent counterpressures 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, however, results in less energy consumption for the air supply thus ensuring an economical plant operation.

In modern sewage treatment plants, frequency controlled rotary piston blowers and highly efficient turbo compressors are readily in use. However, the strive 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. An effective blower management system supervises not only the operation of the individual blowers, but transfers the automatic control of several blowers simultaneously to its system. The combination of differently large blowers with different operation modes (frequency-controlled, pole-changeable, without regulation), of different ages and possibly still, various manufacturers 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 compressor works 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
- improves process stability and reduces operation costs of the aeration system
- reduces operational disturbances und secures effluent quality
- independent of plant size and No. of tanks
- use of high-quality components made in Germany
- makes an efficient operation of the purification plant possible
- control strategy with many international user references at plants of different sizes

TECHNICAL DATA MODULES

VACOMASS® flow meter	Air flowmeter based on thermal dispersion technology, including pressure and temperature compensation
VACOMASS® control valve	Control valve with actuator for precise control of air flow
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 to get good repeatable information on air flow for insufficient straight inlet and outlet pipe runs
VACOMASS® basic	Electronic module for automatic correction of flow signal for irregular flow profile due to actual position of the 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 PLC
VACOMASS® master	Electronic module for permanent and automatic calculation of actual required air flow and new position of the control valve for local control of air supply, which 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 header pressure based on actual air flow and valve stroke (floating pressure control strategy)
VACOMASS® blower management	Electronic module for automatic and energy saving operation of blower stations
VACOMASS® biocontrol	Electronic module for load-depending control of aeration time if intermittent nitrification/denitrification process is applied

VACOMASS® calibration

compact systems (air flowmeter is positioned directly in front of the control valve) require a simultaneous correction of current flow profile to get a precise flow signal; calibration is done by simulation of the actual operating conditions (compressor pressure, operating temperature, flow conditions etc.) and special calibration with flow conditioner or simulation of the piping geometry improves the overall accuracy of the air flow metering and thus the precision in control

CONTROL STRATEGIES

Based on local situation related to No. 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 we develop together with the customer special control strategies.

IMPRINT

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