MESSER
Gases for Life

A Breath of Life – with Oxygen.

Aerobic wastewater engineering with BIOX™ water treatment installations.

Are you having diffulty meeting your BOD or DO discharge limits?

Oxygen is a fast, flexible and efficient way to support the natural purification of wastewater. It creates the optimal aerobic conditions for successful biological treatment and supports biological nutrient removal. Controlled oxygenation can thus help you to manage peak loads, control odors, meet stricter environmental legislation and reduce municipal fees for discharging contaminated wastewater.

Pure nature.

Oxygen solves wastewater problems in municipal and industrial wastewater treatment plants.

Problems in municipal and industrial wastewater treatment plants are usually the result of insufficient levels of dissolved oxygen (DO). The consequences are inadequate or even anaerobic decomposition processes, giving rise to highly offensive odors. Particularly in the event of breakdowns, peak loads or reconstruction work, an adequate supply of DO must be maintained to the biomass in a biological treatment plant. This can be achieved effectively and efficiently by systematically introducing pure oxygen at critical points within the wastewater cycle.

Corrosion in wastewater pipes

Effluent in pressurized mains or pipes is particularly prone to anaerobic decomposition. The corrosion damage and offensive odors caused by wastewater in pipes can be prevented by enrichment with pure oxygen.

Disposal and holding

Highly biodegradable wastewater is prone to biological activity during storage and preliminary treatment. This applies in particular to wastewater from the food industry. The unpleasant emissions from storage or balance tanks can be conveniently prevented by injecting oxygen to increase the DO level. This prevents the formation of anaerobic by-products.

Cost control

The discharge of highly contaminated, easily biodegradable industrial wastewater is also subject to fees and fines. The partial treatment of wastewater with pure oxygen in holding or balance tanks improves downstream process performance, thus minimizing these additional expenses.

Debottlenecking

Wastewater treatment plants are another example where the transfer of pure oxygen can solve various process problems without the need for complex and costly extension work. Additional oxygen transfer can cover peak loading, maintaining the biological balance, for example, in the event of increased wastewater inflow, increased contaminant concentration or seasonal fluctuations in pollution loads.

Costly: corrosion damage to a pressure pipe

Backup strategy

Emergency gas injection has also proven to be an effective backup strategy if aeration equipment breaks down, maintenance work needs to be performed or the plant needs to be upgraded. If the blower for diffused aeration or the drive mechanism for surface aeration equipment develops a fault, for instance, pure oxygen can provide the much-needed DO efficiently and economically.

Nitrification

Oxygen also enables the biological removal of nitrogen compounds from wastewater. First, oxygen is applied to support the biological conversion of ammonia to nitrate. This is followed by the conversion of nitrate to nitrogen in the denitrification zone, operated under anoxic conditions.

BIOX™: pure oxygen to the rescue

BIOX water treatment systems from Messer are designed for the fast, flexible and controlled delivery of dissolved oxygen over both the short and longer term. Keeping investment and maintenance costs low by utilizing existing assets, the BIOX system improves the performance of aeration and preliminary treatment plants, maintaining DO levels in the optimum range for aerobic biotreatment.

Advantages of pure oxygen and BIOX

- Low overall investment and maintenance costs
- Simple to install and operate
- Compatible with existing equipment
- Improved performance without major refurbishment work
- Optimum oxygen utilization with process-driven, flexible metering
- High oxygen concentration possible for increased treatment capacity
- Reduced foaming and aerosols
- Reduced stripping of volatile organic compounds (VOCs)
- Lower sludge yield and improved sludge settleability

Consistently hits the target.

BIOX water treatment processes for oxygen transfer.

Whether you need additional oxygen capacity to support your activated sludge process, contain odors or prevent septic conditions in your wastewater transfer pipes, we have the perfect BIOX solution for your individual wastewater treatment challenge.

BIOX hose/diffusion tubes

BIOX tubular diffuser hoses are especially suited to preliminary treatment plants and activated sludge processes. These oxygenation mats are placed on the base of the tank. As very little infrastructure is required, the mats can be deployed when the process is operational – in an emergency oxygenation situation for example.

The finely perforated hoses are made of chemical-resistant elastomers. When the hoses are inflated with oxygen, the pores open and emit microbubbles of oxygen gas. No additional energy source is required to inject the gas and existing monitoring and aeration equipment can be used to control DO levels in the basin.

BIOX Venturi

BIOX low pressure Venturi dissolver is a patented, versatile dissolving unit usually integrated into the pipe installation. BIOX low pressure Venturi dissolver is easy to install and combines high oxygen efficiency with low energy requirements.

BIOX injector

The BIOX injector process transfers oxygen into pressurized pipes by means of a spherical-head perforated nozzle. This prevents sulfurous corrosion caused by anaerobic processes, avoids septicity and helps to reduce the treatment load for downstream receiving plants.

BIOX reactor

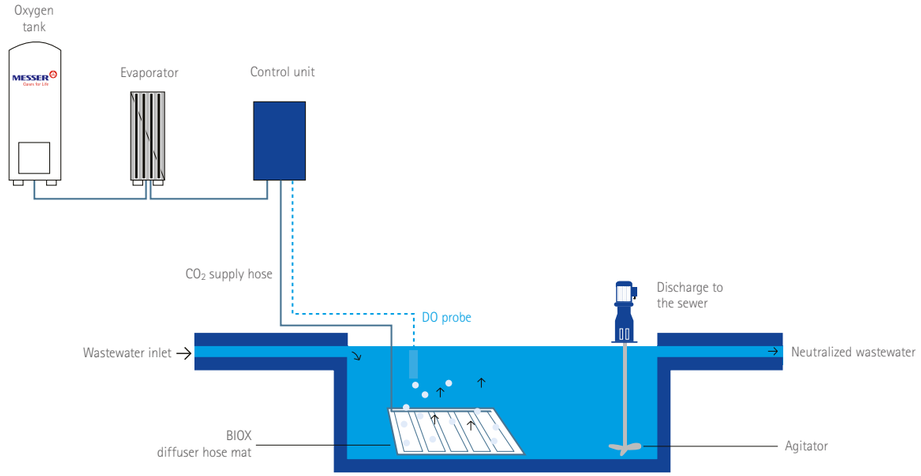
In the BIOX reactor process, oxygen dissolves into the wastewater by means of a pressurized reactor. This can be integrated into the main or bypass flow as needed. To suit individual needs, the reactors are available in eight different capacities ranging from 9 to 590 scfm.

BIOX mobile

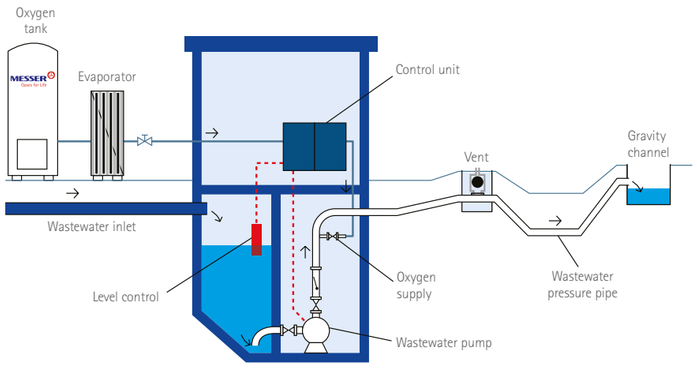
The BIOX mobile unit is a flexible solution suitable for all industrial wastewater treatment plants using aeration processes. Ideal for small and medium-sized plants, BIOX mobile can be used to bridge seasonal or production peaks or as a backup solution during maintenance. Its modular concept allows for flexible capacity management, and it can be easily stored and installed again when needed. The portable, lightweight, submerged jet dissolver can be installed without a crane. It can be installed floating or in a fixed position, horizontally or vertically, to fit any shape of basin.

BIOX water treatment applications

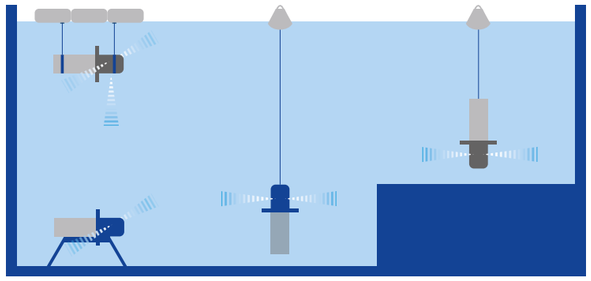
BIOX hose process



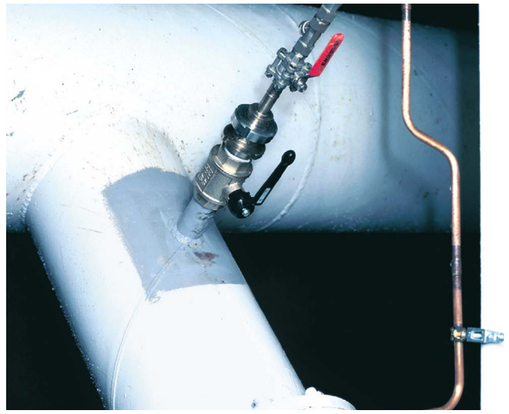
BIOX injector process



BIOX mobile installation



BIOX hose oxygenation mats ensure that oxygen is transferred as evenly as possible



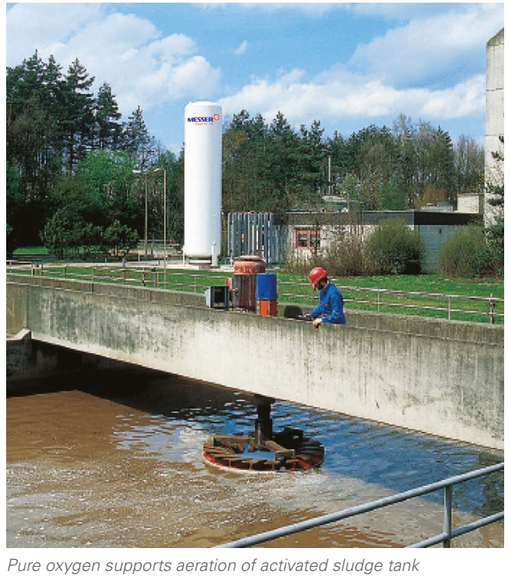
BIOX injector spherical-head nozzle

BIOX mobile

BIOX for versatility and process control.

BIOX process application equipment improves the performance of biological wastewater treatment plants effectively and economically without the need for costly plant extensions or restructuring work. This flexible, versatile solution supports nitrification, peak load management, emergency oxygenation and temporary increases in capacity.

BIOX processes create aerobic conditions in a wide variety of applications. In addition, they can be integrated into existing processes and plants without complex technical work. So what does a BIOX wastewater treatment installation do?



Pure oxygen supports aeration of activated sludge tank

The BIOX system carries out preliminary purification

Pure oxygen is beneficial not only for overworked activated sludge plants. It is also used to prevent highly biodegradable wastewater from undergoing anaerobic fermentation, for example during storage in balance and primary sedimentation tanks.

Such highly contaminated, easily biologically activated wastewaters are produced particularly by the food industry (dairy, breweries, poultry, yeast, fruit and vegetables) and by paper and pulp and pharmaceuticals manufacturers. Many of these companies operate primary and secondary treatment plants in order to reduce municipal wastewater fees levied for discharging highly contaminated wastewaters.

Here BIOX treatment processes can be used to improve on-site treatment so that the purified wastewater can be readily discharged into municipal wastewater treatment plants.

The BIOX system improves aeration

The treatment volume of overloaded activated sludge plants does not necessarily need to be increased in order to cope with higher pollutant loads and the need for more dissolved oxygen. Transferring pure oxygen with BIOX covers peak demands much more efficiently and economically. BIOX also avoids the complexity, investment and high operating costs involved in installing larger surface aerators, additional compressors and other aeration equipment.

The BIOX system purifies activated sludge

The use of pure oxygen combined with elements of existing aeration equipment can produce fast process enhancements in overloaded activated sludge plants. By removing the limitation of aeration oxygen transfer, more active biomass can be held and higher background DO can be maintained. Sludge settlement improves, thus enhancing the degradation performance of the entire plant. This effect is supported by the decreased F/M or sludge loading ratio. As a result, effluent from the wastewater treatment plant has lower concentrations of BOD5 (biological oxygen demand) and COD (chemical oxygen demand) in the final effluent. Higher DO and better BOD removal has the beneficial effect of reducing wastewater levies, allowing the wastewater to be treated without odor nuisance problems and avoiding the cost of covering tanks.

Brewery wastewater case study

The wastewater treatment plant of a brewery was looking to solve the problem of weakly structured bacterial flocs caused by inadequate levels of dissolved oxygen. After just 14 days of the BIOX system oxygen treatment, the brewery had well-developed sludge flocs. The solution was based on a BIOX hose diffuser oxygenation mat installed in the activated sludge tank. All BIOX system processes keep investment and installation costs low. No additional energy source is needed to transfer oxygen using the BIOX hose. A quick response from Messer and simple installation prevented action by regulators and possible plant closure.

Weakly structured flocs caused by inadequate oxygen supply in the wastewater treatment plant of a brewery

Well-developed sludge flocs after 14 days of oxygen treatment

The BIOX system protects pressurized wastewater transfer pipes

Wastewater in pressurized mains or transfer pipes has no contact with the atmosphere. This means that bacterial degradation processes quickly consume the available dissolved oxygen. The consequences are corrosion damage and offensive odors in gravity channels, pumping stations and the inlet structures of wastewater treatment plants.

Adding a little pure oxygen into pressurized wastewater transfer pipes safeguards aerobic conditions in all places at all times. This prevents the generation of hydrogen sulfide and organic polysulfides. Instead, natural aerobic purification processes are initiated in the pipes, similar to those carried out in the biological stage of the treatment plant.

The BIOX injector spherical-head nozzles transfer pure oxygen into wastewater at the inlet of the pressurized transfer pipe, just after the pump discharge. Timers automatically regulate the amount of oxygen transferred during the day and night. Additional time delay routines prevent oxygen transfer during heavy rainfall when wastewater concentrations are greatly diluted.

The low investment costs for BIOX transfer equipment and the measurement and control unit quickly pay off through reduced need for maintenance, repair and restoration work, and odor control programs: BIOX improves wastewater purification.

Nitrogen removal under control

There are various ways to remove nitrogen from wastewater. Some of these entail expensive reconstruction work. A BIOX system process conversion is an effective, easy-to-deploy alternative that offers cost efficiencies over the entire process cycle. Thanks to its flexible design, it supports a variety of process flow sheet options.

Option 1: Intermittent nitrification and denitrification

The objective of this process modification is to reach the optimum oxygen concentration shortly after starting the nitrification stage. To enable this, pure oxygen is transferred right at the beginning of this phase. Most of the oxygen is supplied by the existing aeration system. The additional oxygen required for this is supplied by the BIOX system.

Denitrification in the same tank

After the nitrification phase, the aeration and oxygen transfer processes are shut down. The consumption of oxygen by the activated sludge rapidly causes the entire activated sludge stage to become anoxic and denitrification to begin. Energy-saving agitators now prevent settlement of the activated sludge.

Rapid cycling, low effluent concentration

Supplementary aeration with pure oxygen allows up to 24 cycles a day. This yields extremely low concentrations of chemical oxygen demand (COD) and total nitrogen content (including ammonia, nitrate and nitrite) in the effluent.

Option 2: Simultaneous nitrification and denitrification

With this process, it is important to reach the optimum oxygen concentration within the first few meters of the nitrification zone of a single non-partitioned activated sludge basin or tank. A BIOX system can be deployed to transfer pure oxygen at the beginning of this zone and reach the desired concentration. Here too, the aeration equipment already present in the nitrification zone continues to supply most of the oxygen.

During denitrification, the nitrate produced during nitrification is converted to nitrogen. This is achieved in special anoxic zones where very low DO levels trigger the denitrification process. These so-called anoxic zones are created in the activated sludge tank by simply shutting off the aeration equipment for the respective zone.

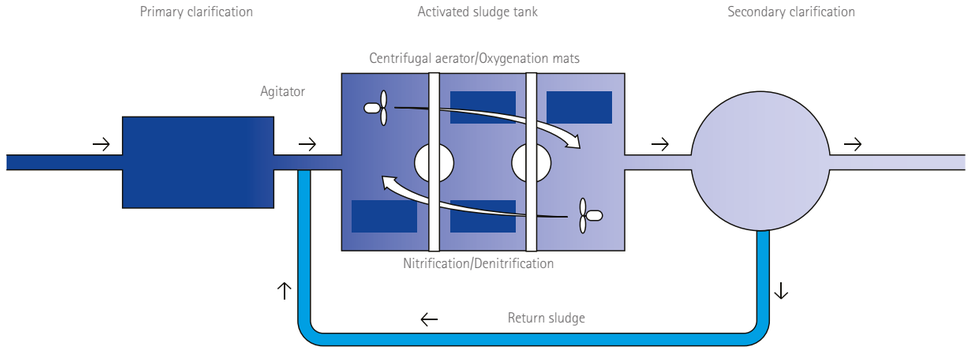
Option 3: Upstream denitrification

This process is particularly suited to activated sludge plants consisting of several separate tanks and also to long tanks which can be partitioned by a dividing wall. Separating off an area for denitrification cuts off part of the available aeration volume. However, there is usually not enough space to extend the aeration capacity system into the remaining nitrification zones. Simply increasing the amount of air fed through the remaining aeration system can cause a marked decrease in efficiency and generate excessive foaming. Pure oxygen supplied by BIOX is the more effective and reliable way to meet the need for additional oxygen in this case.

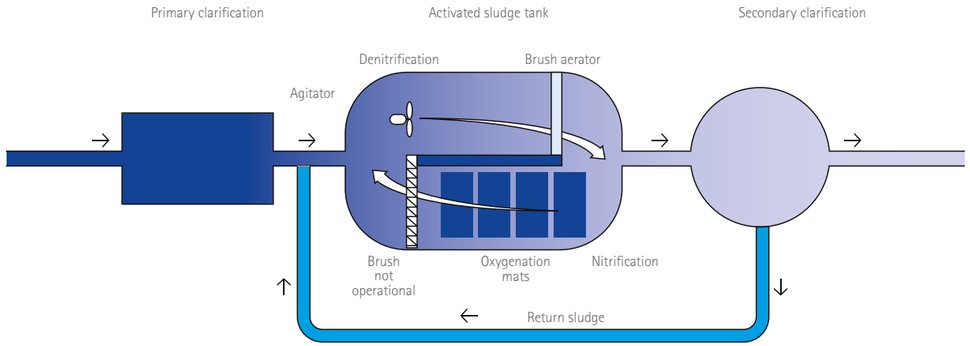
Advantages of BIOX for denitrification

- Significant increase in the plant's nitrogen removal efficiency
- No need for extensions or reconstruction
- All three solution options can be implemented quickly
- Low expenditure on measurement and control technology
- Improved sludge settling; little or no uncontrolled denitrification downstream
- Legal compliance and potential tariff reduction
- Reduced aeration intensity and power density

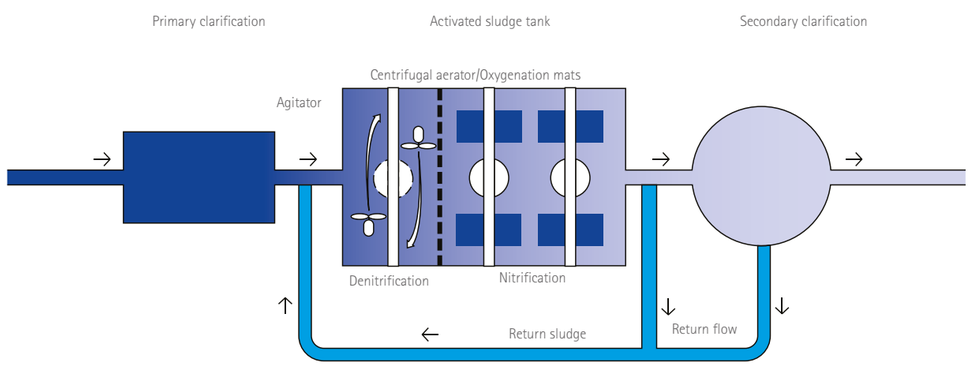
Intermittent denitrification



Simultaneous denitrification



Upstream denitrification



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