

→ AXENIS™ wastewater treatment system

# AXENIS™

Sustainable solution for the reuse of wastewater.



THE LINDE GROUP

*Linde*

# How AXENIS™ helps your business. Cost-efficient wastewater treatment.

Based on the Oxygen Membrane Bioreactor (Oxy-MBR) from Linde, the AXENIS™ process treats wastewater to an exceptional standard which is suitable for reuse or discharge to a watercourse.



External view of the 10-metre-long AXENIS™ pilot plant

## The process in brief

The AXENIS™ system treats wastewater to an exceptional standard which is suitable for reuse or discharge to a watercourse. The process supports the high level of biomass required to biologically oxidise the Chemical Oxidation Demand (COD) without converting it to surplus biological sludge.

The biomass generates heat, raising the temperature, which accelerates the reaction rate. This leads to an increased demand for oxygen, resulting in oxidation of more COD, and dramatically reduces the amount of surplus sludge produced.

## Confidence in the process through an on-site trial

Linde's containerised pilot plant, incorporating a small laboratory, allows for detailed trials at customer sites to determine the performance and the most appropriate membrane material. We work closely with our customers to ensure that we deliver an optimal solution to meet their needs.

Linde's wastewater technologists developed the AXENIS™ wastewater treatment system to significantly reduce the cost of wastewater treatment.

AXENIS™ is a patented process that combines innovative oxygenation equipment with best-in-class cross-flow membrane technology. The compact, reliable and robust design treats water to a high quality suitable for reuse, thereby saving money and helping your business achieve its sustainability goals.

The usual odour and foam-free processing seen in pure oxygen plants has now been combined with the cleanliness of the easily maintained external cross-flow MBR. The process produces less surplus sludge than comparable systems, reducing costs and helping reduce overall environmental impacts.

The treated water is suitable for reuse as well as river and coastal discharges, helping you meet national environmental requirements.

### Benefits

- Produces high-quality, reusable water
- Reduces the cost of wastewater treatment
- Low energy requirements
- Sustainable process reducing your environmental impact
- Fast, clean and trouble-free
- Assists in meeting your legal obligations

### AXENIS™: The full turnkey solution

Linde has partnered with Aquabio, who has unrivalled expertise in designing and building MBRs and water reuse schemes. A full turnkey service is available from trial work to building, training, remote monitoring and operational assistance.

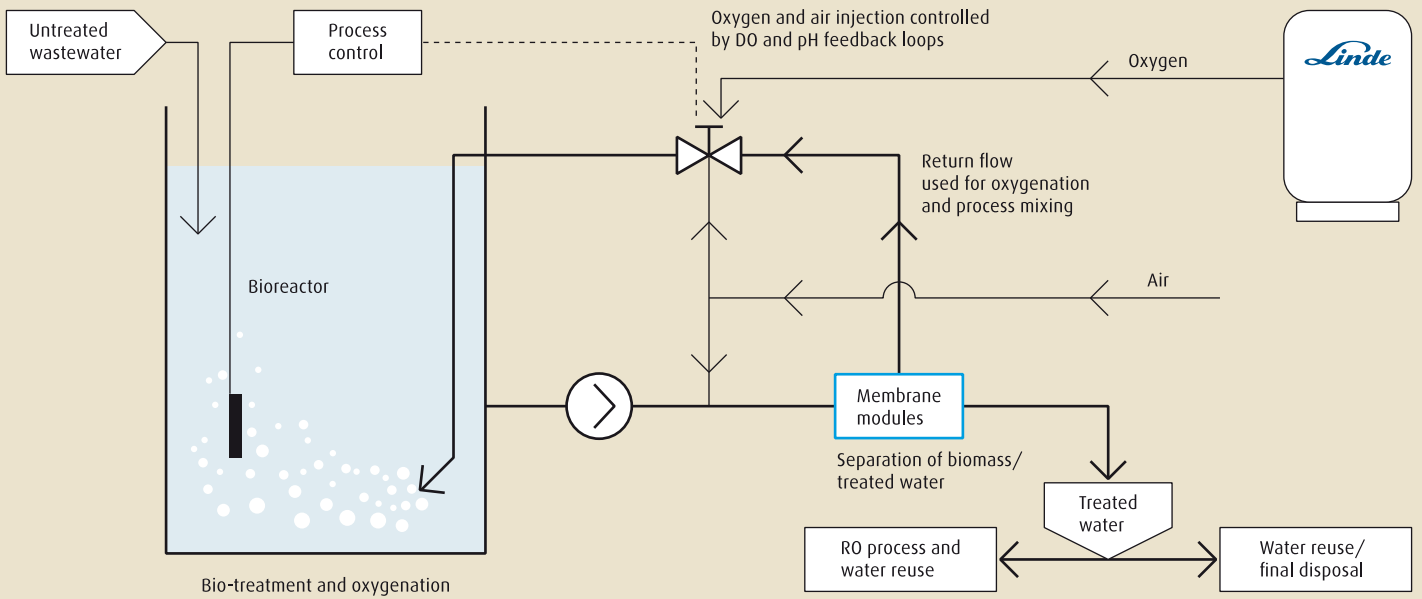
The full system design is based on specific requirements, considering effluent strength and final water purity required. Linde also offers system commissioning and maintenance packages as well as oxygen supply and storage.



The AXENIS™ wastewater treatment system: easily monitored and controlled

### Which types of effluent are treatable using AXENIS™?

The AXENIS™ system can treat industrial wastewater from many industries such as food, beverage, pharmaceutical or chemical. A final water quality with Biological Oxygen Demand (BOD) and suspended solids figures of < 5 mg/l is readily achieved. By including a reverse osmosis stage, river discharge and water recycling to potable water quality are easily attained.



Typical layout of an AXENIS™ wastewater treatment system



Internal view of the AXENIS™ pilot plant

## How AXENIS™ measures up

The AXENIS™ wastewater treatment system was developed from Linde's VAIROX patent which allows the injection of oxygen and air into a pumped sidestream to control both DO levels and pH. A cross-flow membrane is incorporated into the VAIROX system, enabling biomass separation to be achieved at the same time as oxygenation, aeration and mixing without additional energy.

Wastewater treatment occurs in bioreactor tanks using pure oxygen, enabling the process to operate at higher biomass and DO concentrations than air-based MBRs or conventional activated sludge plants. Faster COD oxidation takes place, resulting in less COD conversion to surplus biomass, which would otherwise require costly tankering off site. This means that the bioreactors can typically be half the size of an air-based MBR, thereby reducing the unit's footprint.



Bioreactor and membrane sidestream pump

Less undissolved gas leaves the surface of AXENIS™ reactors (about 1% of the volume of normal aeration systems), which results in minimal foaming and less heat loss to the atmosphere, leading to more active biomass.

Mixed Liquor Suspended Solids (MLSS) concentrations can be up to 30,000 mg/l without adversely affecting flux rates. Externally located membrane banks, through which the MLSS are pumped, ensure the biomass is retained within the bioreactor and provide easy access for maintenance. This eliminates the need to pump down the bioreactor to access the membranes, which saves valuable time and energy.

Biomass returned to the bioreactor is used for the dissolution of oxygen and controlled by DO probes. The pH is continuously measured and a feedback system controls the addition of air to strip out dissolved carbon dioxide to maintain a neutral operating pH regime.

Precise and independent control of both DO levels and pH enables the biological process to be operated at performance levels far above those of conventional air-based systems. The final effluent water quality that is produced from the Ultra Filtration (UF) membranes is of an exceptional standard.



# Getting ahead through innovation.

With its innovative concepts, Linde is playing a pioneering role in the global market. As a technology leader, it is our task to constantly raise the bar. Traditionally driven by entrepreneurship, we are working steadily on new high-quality products and innovative processes.

Linde offers more. We create added value, clearly discernible competitive advantages, and greater profitability. Each concept is tailored specifically to meet our customers' requirements – offering standardised as well as customised solutions. This applies to all industries and all companies regardless of their size.

If you want to keep pace with tomorrow's competition, you need a partner by your side for whom top quality, process optimisation, and enhanced productivity are part of daily business. However, we define partnership not merely as being there for you but being with you. After all, joint activities form the core of commercial success.

**Linde – ideas become solutions.**

## Legal Entity

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