

Oxygen – the breath of life. Aerobic  
wastewater engineering with SOLVOX®.

Linde Gas

*Linde*

Declining efficiency in wastewater treatment plants? Corrosion in wastewater pressure pipes? Stinking lagoons? The systematic input of oxygen helps to avoid the fees levied for discharging highly contaminated wastewaters. Moreover, oxygen offers fast, flexible and efficient solutions for the ecological purification of wastewater. This is because only oxygen creates the aerobic conditions necessary for successful preliminary treatment, peak load treatment, nitrification, emergency gas injection and sealing.



# Pure nature. Oxygen solves wastewater problems in municipal and industrial wastewater treatment plants.

**Many of the problems of wastewater treatment – in both municipal and industrial wastewater treatment plants – are the result of insufficient oxygen. The consequences are inadequate purification or even anaerobic decomposition processes, giving rise to highly offensive odors. The systematic input of pure oxygen at critical points along the wastewater chain solves these problems quickly, flexibly and efficiently.**

## **Corrosion in wastewater pipes**

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

## **Disposal and holding**

The discharge of highly contaminated, easily biodegradable industrial wastewaters is subject to fees. The preliminary purification of wastewater with pure oxygen in so-called holding tanks minimizes these additional expenses.

Before preliminary treatment, such wastewaters are sometimes – particularly in the foodstuffs industry – temporarily stored in lagoons. The unpleasant emissions from these lagoons can also be conveniently prevented: by aerobically sealing the lagoons with pure oxygen.

## **Declining efficiency in wastewater treatment plants**

Wastewater treatment plants are another instance where the transfer of pure oxygen can solve various problems without the need for complex reconstruction work. Additional oxygen transfer covers peak needs, for example in the case of increased wastewater inflow, intensified contaminant concentration or major fluctuations in pollution loads. Even if the legal authorities were to tighten up the regulations governing purification, pure oxygen would help to fulfill these requirements.

Emergency gas injection has also proved to be effective in the event of breakdowns in the aeration system. If the compressor for diffuser aeration or the drive for surface aeration is faulty, pure oxygen can compensate for these deficits efficiently and economically.

And should the tank volume not allow for sufficient nitrogen elimination, it is by no means necessary to carry out expensive reconstruction work. The systematic transfer of pure oxygen enables the entire process to be converted quickly and economically to upstream, intermittent or simultaneous denitrification.

## **SOLVOX®: pure oxygen helps**

SOLVOX® processes from Linde Gas carry out this oxygen transfer quickly, efficiently, precisely and flexibly. While keeping investment and maintenance costs low, SOLVOX® improves the performance of aeration and preliminary treatment plants, for example, while eliminating the need for extensive construction work. A high oxygen concentration can be reached with SOLVOX®.



Costly: corrosion damage to a pressure pipe.

# Hits the spot five times over. The SOLVOX® processes for oxygen transfer.

**For wastewater treatment plants, in lagoons or pressure pipes, for pre-treating or aerating wastewater – with SOLVOX®, Linde Gas provides several widely varying processes for optimal oxygen transfer into wastewater.**

## **SOLVOX®-B**

The SOLVOX®-B process is especially suited to preliminary treatment plants and activated sludge tanks. The oxygenation mats are affixed firmly to the floor of the tank or, when temporary emergency oxygenation is required, simply immersed in the full tank. Oxygenation mats are metal grids on which oxygenation hoses are

mounted – this structure ensures that the oxygen is distributed over the widest possible area. The finely perforated hoses are made of chemical-resistant elastomers. When filled with oxygen, the pores open and emit the gas in micro-bubbles. Injection is carried out without additional energy sources and is controlled by oxygen measurement.

## **SOLVOX®-V**

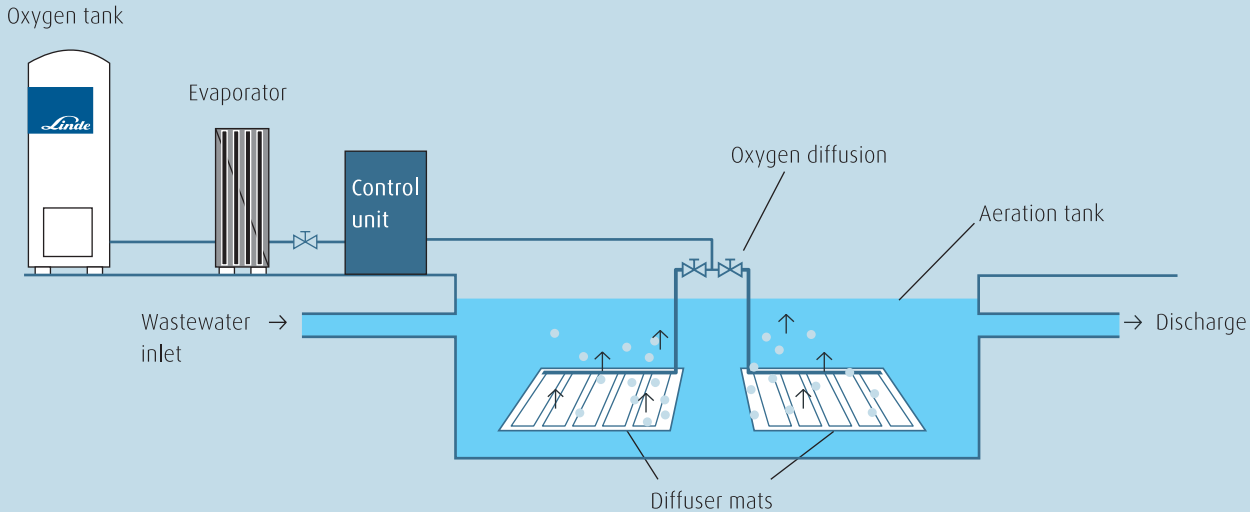
The SOLVOX®-V process for pre-treating and oxygenation wastewaters is very easy to install. The transfer system can also be installed in full tanks.

SOLVOX®-B oxygenation mats ensure that oxygen is transferred as evenly as possible.

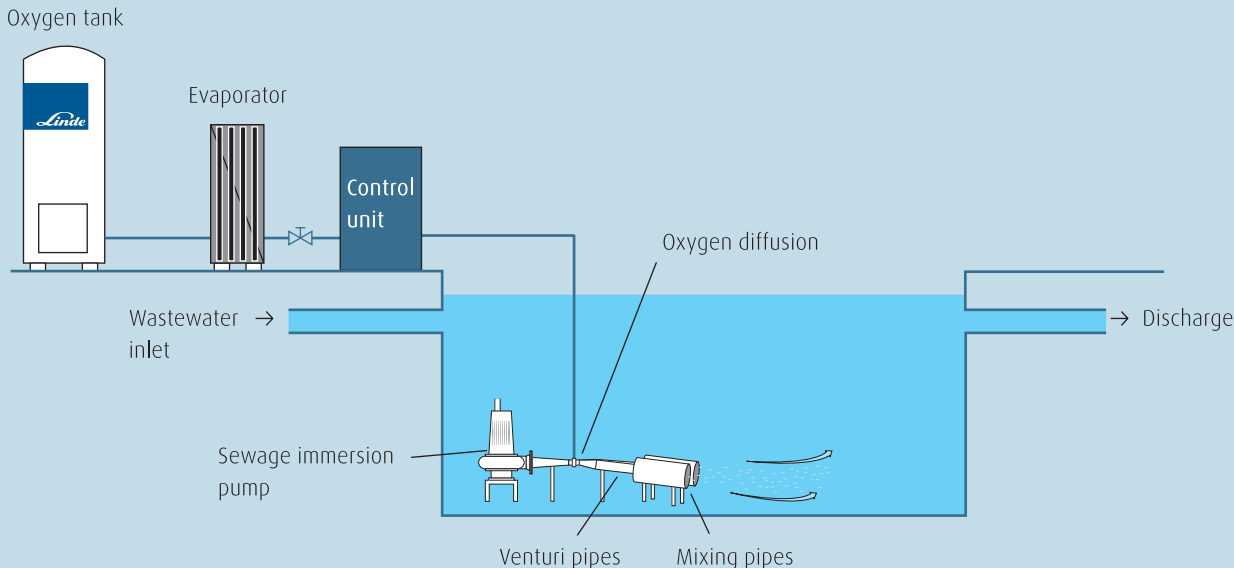


SOLVOX®-V oxygenation unit.





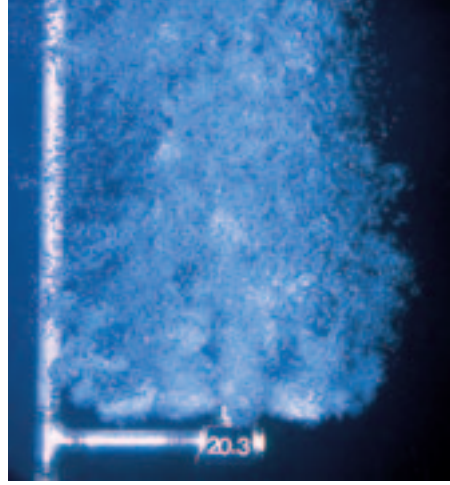
SOLVOX®-B process.



SOLVOX®-V process.



SOLVOX®-D spherical-head nozzle.



SOLVOX®-N conical-head nozzle.

**SOLVOX®-D**

The SOLVOX®-D process transfers oxygen into pressure pipes by means of a spherical-head nozzle. This prevents sulfurous corrosion caused by anaerobic processes.

**SOLVOX®-R**

In the SOLVOX®-R process, oxygen dissolves into the wastewater by means of a reactor. This can be integrated into the main or bypass flow as needed. The reactors are available in eight different capacities ranging from 15 to 1,000 m<sup>3</sup>/h.

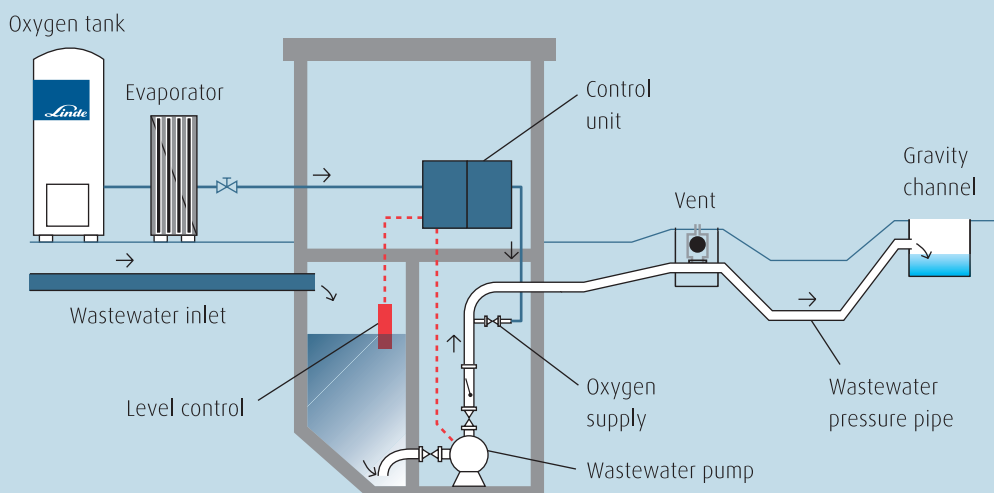
**SOLVOX®-N**

Paper and card manufacture gives rise to particularly aggressive wastewater with a high lime content. A case for the SOLVOX®-N process, which transfers oxygen via robust stainless steel nozzles. In the short term, it is also suitable for immediate emergency oxygenation.

When reconstruction measures are being carried out, the SOLVOX®-N process also takes care of oxygenation until the permanent installation of a SOLVOX®-B or SOLVOX®-V system is complete.

**SOLVOX® preserves biological processes**

The mixed liquor in a biological wastewater treatment plant must be kept supplied with adequate quantities of oxygen. Should faults or reconstruction work cause this supply to fail, oxygen must be "provisionally" transferred by another means. Otherwise the efficiency of the plant may decrease so far that in the worst-case scenario, its entire biology may be disrupted. For such contingencies, Linde offers the oxygenation systems SOLVOX®-B, SOLVOX®-V and SOLVOX®-N depending on the circumstances: for immediate emergency oxygenation, even over longer periods.



SOLVOX®-D process.



#### Advantages of pure oxygen and SOLVOX®

- Low investment costs
- Rapid, economical problem-solving
- Systematic oxygen input
- Improved performance without construction work
- Low maintenance costs
- Optimum oxygen utilization
- Flexible oxygen input
- High oxygen concentration possible

# Oxygenation XXL. SOLVOX® peps up wastewater purification.

**Denitrification, peak load coverage, emergency oxygenation – SOLVOX® processes improve the performance of biological wastewater treatment plants effectively and economically without the need for costly construction or restructuring work. This efficiency is due to the flexibility and versatility of SOLVOX®.**

## **SOLVOX® eliminates nitrogen**

Particularly as regards nitrogen elimination, alternative methods of operating the existing wastewater treatment plant should be considered before carrying out expensive reconstruction work. A simple process conversion involving the systematic use of SOLVOX® supplementary oxygenation with pure oxygen is usually the more reasonably priced solution.

## **Alternative 1: Intermittent denitrification**

The objective of this process conversion is to reach the optimum oxygen concentration within a few minutes of beginning the nitrification phase. To this end, pure oxygen is transferred right at the beginning of this phase – here the existing aeration system takes over the main supply. The additional oxygen input is carried out by special oxygenation equipment supplied with the SOLVOX® process developed by Linde.

## **Denitrification in the same tank**

After the nitrification phase, the aeration and oxygen input processes are shut down. The consumption of oxygen by the activated sludge rapidly causes the entire activated sludge tank 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  $N_{\text{total}}$  and COD in the effluent.

## **Alternative 2: Simultaneous denitrification**

In this process, it is important to reach the optimum oxygen concentration within the first few meters of the nitrification zone. Therefore, one of the Linde SOLVOX® processes is applied to transfer pure oxygen at the beginning of this zone. Here too, the aeration equipment already present in the nitrification zone continues to supply most of the oxygen.

## **Denitrification in special zones**

To trigger the denitrification process, anoxic zones are systematically created in the activated sludge tank – by simply shutting off the aeration equipment for the respective area.

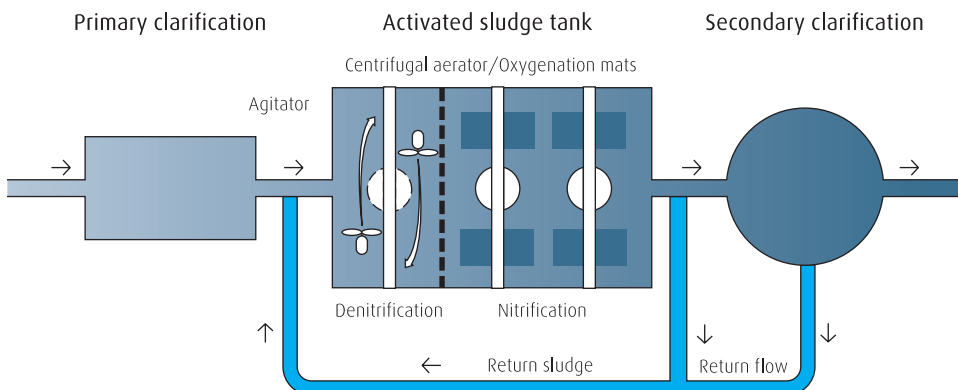
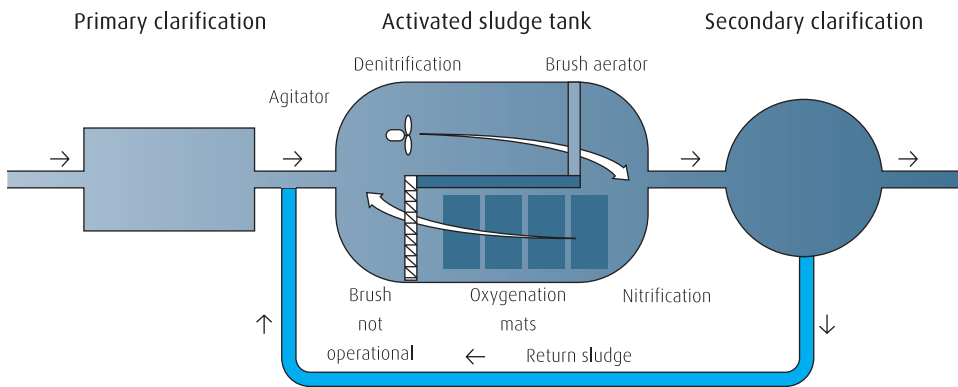
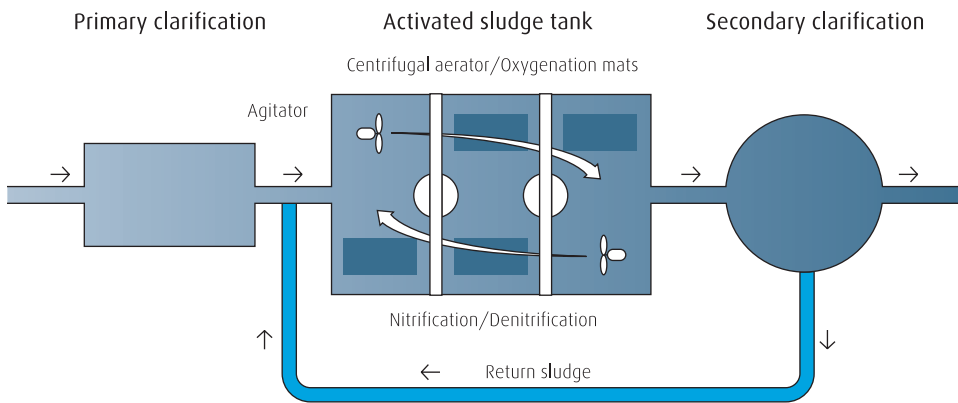
## **Alternative 3: Upstream denitrification**

The process is particularly suited to activated sludge plants consisting of several separate tanks and to long tanks which can be partitioned by a dividing wall. Separating off an area for denitrification cuts off part of the available aeration. However, there is usually not enough space to extend the air input system in the nitrification area. Simply increasing the amount of air fed through the remaining aeration system causes a marked decrease in efficiency. Pure oxygen therefore covers the need for additional oxygen more economically and above all more reliably.

## **Advantages**

- Significant increase in the plant's nitrogen elimination efficiency
- Minimum legal requirements are complied with; significant reduction in wastewater charges
- No need for extensions or reconstruction
- All three solutions can be implemented quickly
- Low expenditure on measurement and control technology
- Improved sludge settling: no uncontrolled denitrification downstream





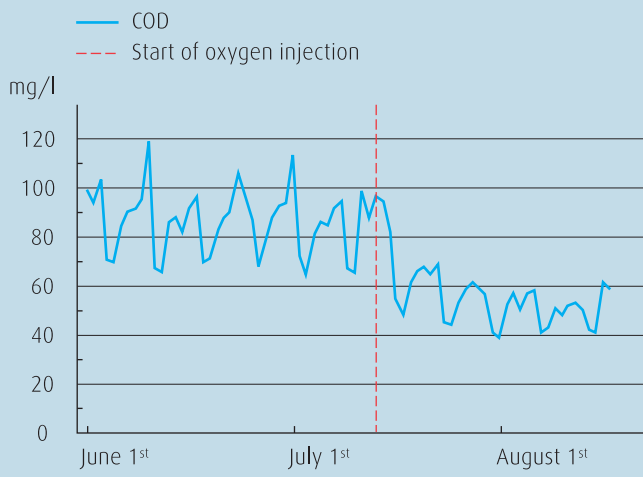
Intermittent denitrification.

Simultaneous denitrification.

Upstream denitrification.

Measurable success: low, consistent COD concentrations in effluent through supplementary aeration with pure oxygen.

Pure oxygen supports aeration of activated sludge tank.





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



Well-developed sludge flocks after 14 days of oxygen treatment.

### **SOLVOX® supports aeration**

It is not inevitably necessary to expand overloaded activated sludge plants in order to cope with increased pollutant loads and the rise in oxygen needed by the microorganisms. Transferring pure oxygen with the SOLVOX® processes covers peak demands much more efficiently and economically.

Main advantage: using SOLVOX® makes the expansion of existing aeration systems unnecessary. It also eliminates the high investment costs for larger surface aerators, additional compressors and other equipment. Especially in small activated sludge tanks, SOLVOX® helps to avoid the ineffective introduction of oxygen due to excessive amounts of air and power density.

All SOLVOX® processes keep investment and installation costs low. No additional energy source is needed to transfer oxygen using SOLVOX®-B. SOLVOX®-R reactors transfer the gas with virtually no loss. And SOLVOX®-V injectors can be installed in the full tank. All processes systematically transfer oxygen to specific areas of the tank.

This results in marked improvements in overloaded activated sludge tanks: first of all, they can hold more activated sludge. This settles better, thus improving the degradation performance of the entire plant. This effect is supported by the decreased sludge load. As a result, effluent from the wastewater treatment plant has lower, consistent BOD<sub>5</sub> and COD concentrations. In this way, wastewater levies can be reduced and wastewater can be purified without odors.



## All-round talent. SOLVOX® offers versatility.

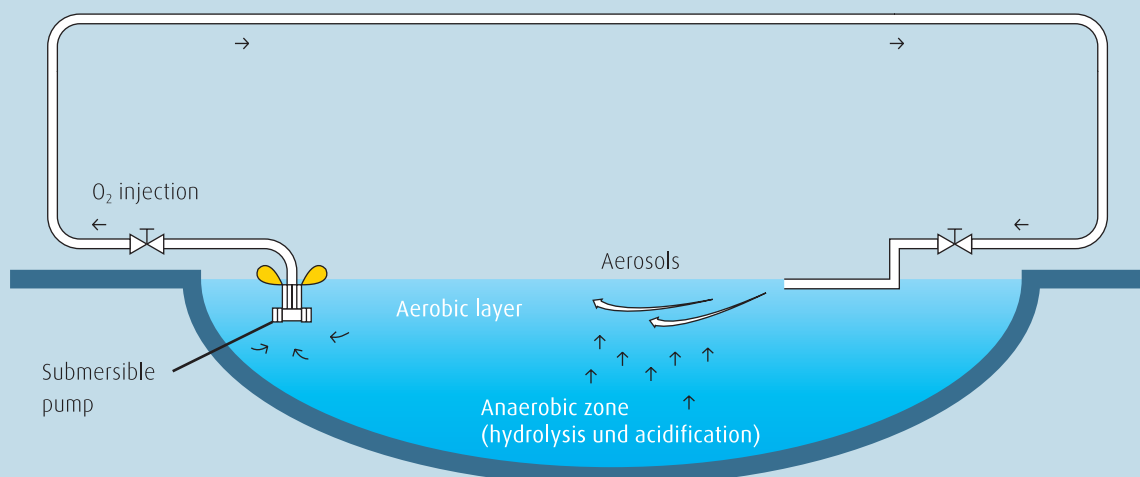
**SOLVOX® processes create aerobic conditions in a wide variety of applications. Moreover, they can be integrated into existing processes and plants without complex technical work. So what does SOLVOX® do?**

### **SOLVOX® carries out preliminary purification**

Pure oxygen not only comes to the rescue of overworked activated sludge plants. It is also used to pre-purify irregular inflows of highly contaminated wastewater from industrial production in buffer and holding tanks, for example. Moreover, it prevents offensive odors arising from mixing and equalizing tanks.

Such highly contaminated, easily biologically purified wastewaters are produced particularly in the foodstuffs industry – dairies, breweries, yeast producers, fruit and vegetable processors – and by pharmaceuticals manufacturers. Many of these companies operate biological pre-purification plants in order to avoid the fees levied for discharging highly contaminated wastewaters.

Here SOLVOX®-B, SOLVOX®-V and SOLVOX®-R processes transfer pure oxygen into the wastewater in order to degrade pollutants so far that the pre-purified wastewater can easily be discharged into municipal wastewater treatment plants.



Aerobic sealing of wastewater lagoons.



SOLVOX®-D for aerobic sealing.

#### SOLVOX® seals lagoons

During weeks of working at higher capacities, some food-stuff companies (sugar factories, potato processors etc.) discharge highly contaminated wastewaters from production which contain easily degradable pollutants. A large part of this wastewater is temporarily stored in lagoons to await further purification.

Long standing times and insufficient aeration lead to rapid exhaustion of the dissolved oxygen. Anaerobic acidification of the pollutants sets in after just a short time. This leads to intensive, malodorous emissions.

In the patented “aerobic sealing” process, wastewater is removed from the lagoon by pumping, enriched with pure oxygen using the SOLVOX®-D process and distributed over the surface of the lagoon.

Here the contents of the lagoon are not vertically mixed. An oxygen-rich layer of water forms on the surface and oxidizes the foul-smelling, volatile decomposition products such as sulfides, volatile fatty acids etc.

**SOLVOX® protects pressure pipes**

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

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

SOLVOX®-D spherical-head nozzles transfer pure oxygen into the wastewater at the start of the pressure pipe. Timers automatically regulate the amount of oxygen transferred during the day and night. Additional time-delay relays stop oxygen transfer during heavy rainfalls.

The low investment costs for the SOLVOX® transfer equipment and the measurement and control unit quickly pay off:

- No offensive odors from hydrogen sulfide and volatile organic sulfides
- No concrete or metal corrosion through hydrogen sulfide or sulfuric acid
- Improved settling of primary sludge during preliminary clarification
- Reduced loads in the biological stage due to preliminary degradation of pollutant load in the pressure pipe
- No energy source needed
- No chemical additives
- Low investment costs
- Low operating costs



### **Linde Gas – innovative environmental engineering**

Besides oxygen, environmental technology also makes use of carbon dioxide and hydrogen. Apart from wastewater purification, Linde Gas is also active in the areas of drinking water treatment, process water treatment and rehabilitating bodies of water. Are you interested? No problem. Just request additional information, e.g.:

#### **Brochures**

- Neutralizing alkaline waters
- Supplying liquefied gases

#### **Data sheets**

- SOLVOX®-B input process with oxygenation hoses
- SOLVOX®-V input process following the injector principle
- SOLVOCARB® input process for neutralizing alkaline waters with carbon dioxide
- SOLVOGEN® process for deoxygenating water
- Oxygen
- Carbon dioxide
- Hydrogen

# Getting ahead through innovation.

With its innovative concepts, Linde Gas 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 Gas offers more. We create added value, clearly discernible competitive advantages, and greater profitability. Each concept is tailored specifically to meet our customers' requirements – offering standardized as well as customized 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 optimization, 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 Gas – ideas become solutions.**

