HYDAC INTERNATIONAL

Vacuum-packed:
The cutting-edge, patented solution for hydraulic systems
OXiStop OXS

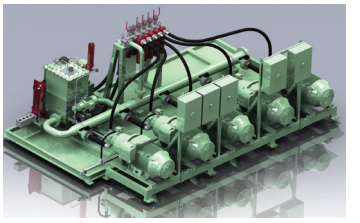
E 7.660.1/10.15

A real-world example

Before: conventional solution

A press with a pump flow of 250 l/min has a tank that contains approximately 1,500 litres of oil, although the volume difference in the cylinder is no more than 12.5 litres.

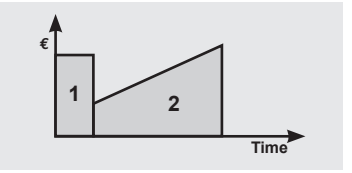
After: OXiStop

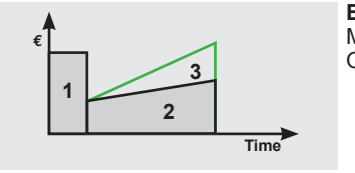


After installing the OxiStop tank, it was possible to create a system with an oil volume of only 185 litres.

Cost-benefit analysis

1 Procurement costs
2 Operating costs
3 Potential savings





Based on:
Mineral oil (new): €2/l,
Oil disposal costs €1.50/l

	Conventional solution			OXiStop		
INVESTMENT COSTS						
Tank	7,560 € (costs of tank and painting)			15,181 € (costs of tank, paintwork, level/temperature monitoring, bypass filtration include motor-pump assembly and degassing unit)		
Oil filling	3,000 €			370 €		
Bypass filtration including piping	4,716 €			-		
Oil pan	1,687 €			720 €		
Total initial costs	**16,963 €**			**16,271 €**		
OPERATING COSTS						
Replacement interval		*In years*	*Costs per year*		*In years*	*Costs per year*
Oil disposal	2,250 €	3	750 €	278 €	3	93 €
Oil filling	3,000 €	3	1,000 €	370 €	3	123 €
Membrane	-			960 €	6	160 €
MiniOX	-			3,600 €	10	360 €
Filter elements	641 €	1	641 €	124 €	1	124 €
Total costs per year			**2,391 €**			**860 €**

Monitoring fluid cleanliness is essential

70 to 80% of all breakdowns in hydraulic and lubrication systems are due to increased contamination of the fluids and components used. In practice, however this direct correlation is often not recognised because fluids and components are insufficiently analysed and monitored.

Fluid sensors have the following advantages for plant operators:

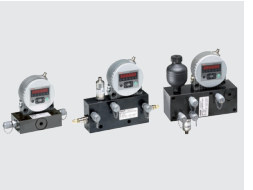
- Plannable availability of plants and components
- Prevention of sudden downtimes
- Reduction of operating costs
- Prevention of catastrophic consequential damages to systems and associated delivery bottlenecks
- Preventive and condition-based maintenance

HYDAC offers a comprehensive range of easy-to-use fluid sensors, measurement, display and analysis equipment.

ContaminationSensor CS1000 and AquaSensor AS1000 / AS 3000

Fluid sensors for measuring solid particle contamination, water saturation and temperature in oil

FluidMonitoring Module FMM



Ready-to-connect modules for measuring solid particle contamination, water saturation and temperature in oil

FluidControl Unit FCU 1000

Portable service instrument for measuring solid particle contamination, water saturation and temperature in hydraulic systems

OXiStop OXS, the optimised tank system

The innovative vacuum-packed solution

PATENTED

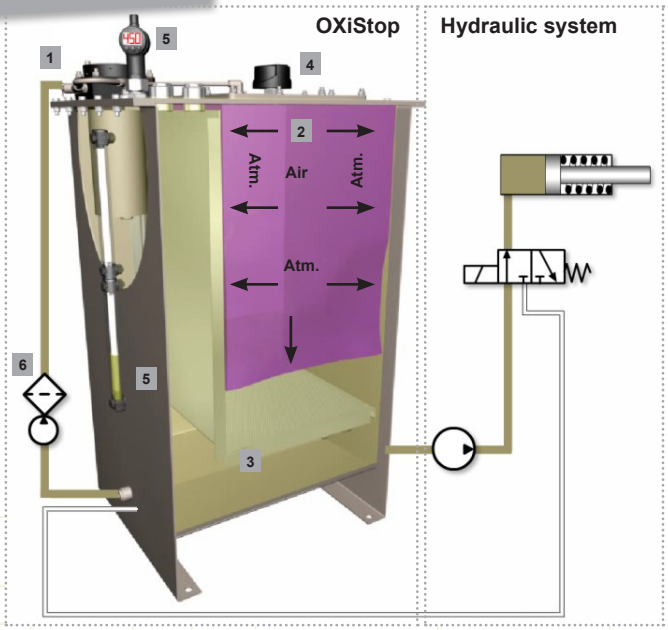
OXiStop OXS is HYDAC's "vacuum-packed" tank solution for hydraulic systems. The OXS features its own tank, filters and coolers and a continuously operating degassing and dewatering unit. In this way, the tank capacity of stationary hydraulic systems can be drastically reduced.

The oil in the OXiStop tank is sealed using an air-tight membrane which lies on the oil surface like a protective skin.

At the same time, the built-in MiniOX ensures that the oil is continuously degassed and dewatered. This minimises gas in the oil and ensures that any air entering the system is quickly dissolved. About 8–9 litres of air can be dissolved in 100 litres of oil. A compact bypass filter removes undesirable solid particle contamination from the system.

This means that the tank size can be calculated for the **differential operating volume actually needed**. The pump flow rate is no longer crucial for the tank design. As a result, **tank capacity can be reduced** in stationary hydraulic systems **by a factor of 10**.

Fluid conditioning is enhanced by fluid sensors for monitoring solid particle contamination as well as the air and water content of the oil. This combination of fluid monitoring and conditioning increases oil service life and ensures better protection of components and the system. For plant operators, it means fewer machine failures and lower life cycle costs (LCC) for the system.



1 = dewatering and degassing unit MiniOX , 2 = tank membrane
3 = oil, 4 = air filter, 5 = level monitoring, 6 = offline filtration unit

Cavitation – in addition to contamination in the hydraulic oil – is one of the main causes of short service life in components and oil.
In this context, cavitation refers to sudden or explosive decomposition of air in oil that is released when solubility limits are exceeded. Compression and temperature increase of the gas bubbles can also cause air and oil to react explosively (diesel effect, figure 4).

Cavitation and diesel effect affect the hydraulic system in the following ways:
- Loud noise emissions
- Erosion of surfaces
- Strong vibrations
- Severe darkening of the oil/formation of deposits on surfaces in contact with oil (varnish).

Hydraulic oil is a mixture of base oil, additives, air and gases. The solubility of air in oil depends primarily on the oil pressure [1]. In a complete vacuum, no air can dissolve in oil, whereas at atmospheric pressure the oil can absorb approx. 10% air (figure 1).
This corresponds to the conditions in the tank.
As long as there is no free/visible air in the oil, there is no measurable change in volume of the fluid as a result of degassing.

Figure 2 shows oil flow through a pipe constriction. There is a local pressure drop as a result of the increase in flow velocity. If the pressure falls below the solubility threshold for air in oil, gas bubbles appear that implode when they are next compressed.

This process has the following consequences:
- Surface erosion, e.g. in the valve cross-section, and
- Thermal oxidative stress acting on the fluid.

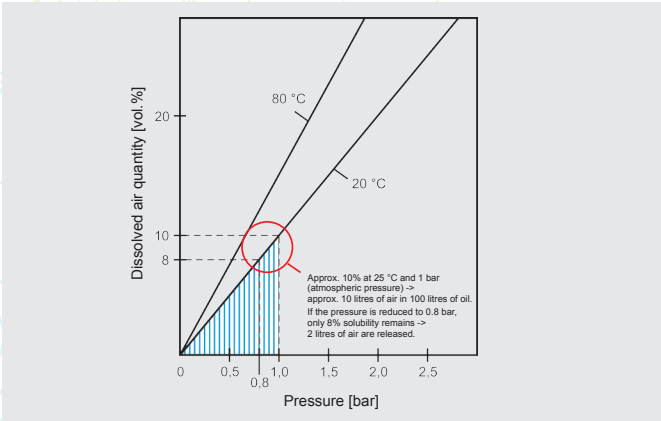


Figure 1: Solubility of air in mineral oil

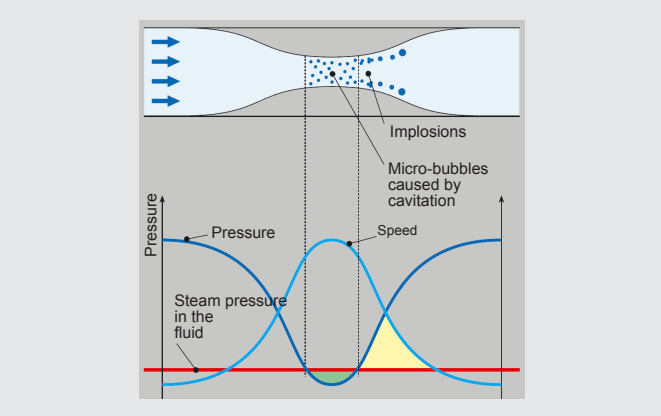


Figure 2: Release of air due to drop in pressure

[1] G. Schuster: Verringerung der Kavitationsneigung bei hydraulischen Ventilschiebern (Reducing cavitation tendency in hydraulic valve spools), O+P 9/2004, pp. 575 to 579

Similar phenomena were observed in highly dynamic processes.

Accelerating oil columns and rapid release of pressure lead to areas of negative pressure where the solubility thresholds for air and gas in oil are exceeded and free gas is produced. This means that degassed fluids also contribute to the acceleration of processes and reduce the risk of component wear.

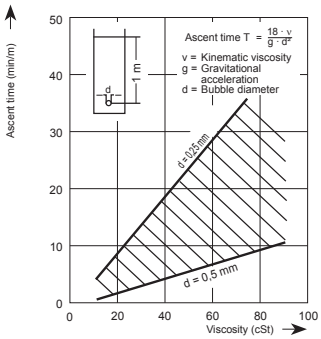
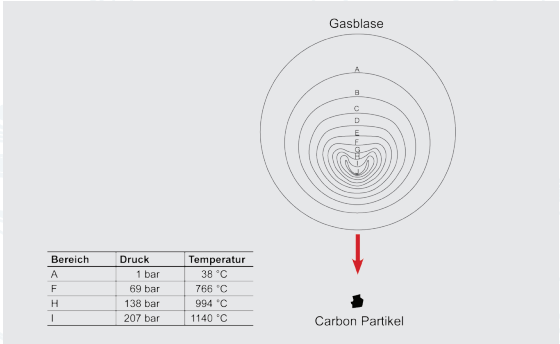


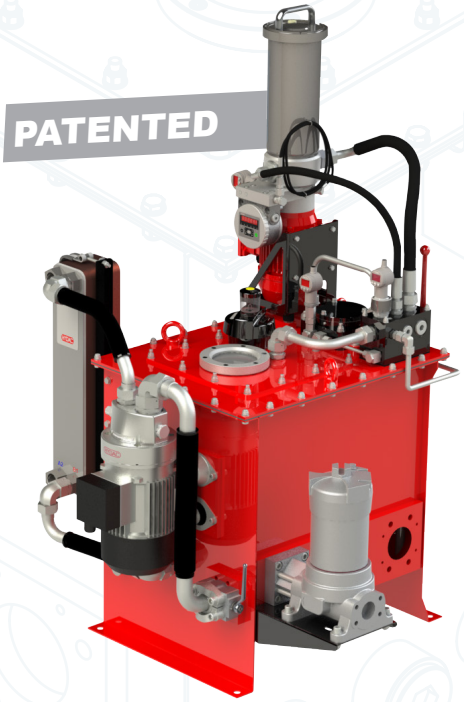
Figure 3: Ascent time for air bubbles in mineral oil (according to Hayward)



Bereich	Druck	Temperatur
A	1 bar	38 °C
F	69 bar	766 °C
H	138 bar	994 °C
I	207 bar	1140 °C

Fig. 4: Temperature rise in gas bubbles during compression (diesel effect)

The complete package: OXiStop OXS



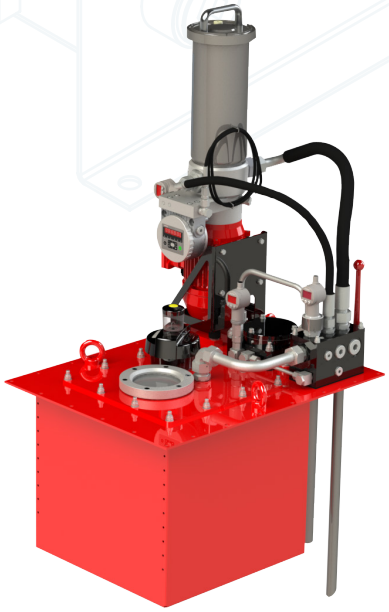
The complete OXiStop OXS package includes

- **Tank**
- **Membrane holder with defined differential operating volume and built-in tank membrane**
- **Degassing and dewatering unit MiniOX**
- **Monitoring of degassing function and filling level**
- **Filling and drainage port**
- **Offline filtration unit**

The OXiStop can be equipped with an optional **return line filter, oil cooler** as well as the **contamination sensors** AquaSensor AS and ContaminationSensor CS.

This HYDAC product range comes in **three standard sizes** for operating volumes of 30, 45 and 70 litres

The integrated version: OXiStop OXS LID



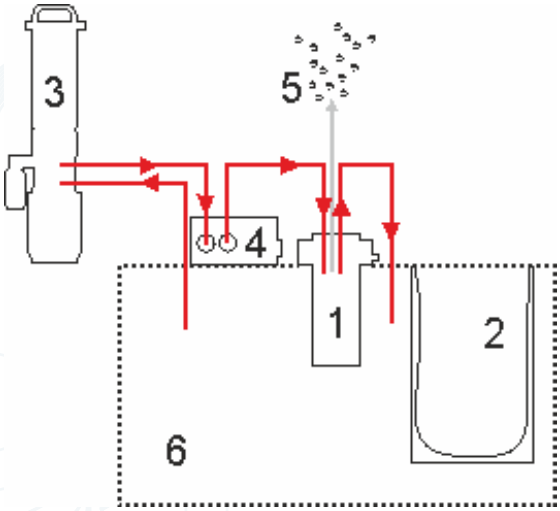
The OXiStop LID version is designed for the installation in a customer-specific tank and includes

- **Membrane holder with defined differential operating volume and built-in tank membrane**
- **Degassing and dewatering unit MiniOX**
- **Monitoring of degassing function and filling level**
- **Filling and drainage port**
- **Offline filtration unit**

The OXiStop can be equipped with an optional feature for monitoring the degassing function, a **return line filter**, **oil cooler** as well as the **contamination sensors** AquaSensor AS and ContaminationSensor CS.

This HYDAC product range comes in **seven standard sizes** for operating volumes of 30, 45, 70, 150, 250, 325, 500 litres

Schematic representation of OXiStop working principle



Item	Component
1	Degassing and dewatering unit MiniOX (MOX)
2	Membrane holder with built-in membrane
3	Filtration unit OLF5
4	Control block
5	Air removal
6	Tank (depending on version)

Degassing and dewatering unit MiniOX

MiniOX working principle:

The degassing and dewatering unit is hydraulically driven by the filtration unit and uses a hydraulic piston (oil surface) to generate vacuum for removing gas and moisture.

During the filling process, oil is pumped into the degassing unit through the prefill valve. The rising oil level displaces the air and forces it out of the degassing unit.

During the emptying process, the oil in the degassing unit is sucked out by an ejector pump. Vacuum is generated by the falling surface level of the oil. As a result of this negative pressure, gases and moisture are removed from the oil. The gases and moisture then accumulate above the surface of the oil and are expelled when the tank is filled again.

Thanks this continuous degassing, 100 % of the free air and up to 80 % of the dissolved air and gases are removed, and the total gas content in the oil is reduced to 1-2 %.

The advantages of OXiStop

- Oil volume is typically reduced by a factor of 10
- Service life of the oil is extended due to a reduction in air content up to 80% and water and contaminants are prevented from entering the tank
- The hydraulic system can be installed closer to loads, which results in considerable savings in the piping
- Improved filling of the pumps (higher efficiency, lower heat loss) and option of operating the pumps at a higher speed without the risk of cavitation
- Higher process velocity for example for cylinders with pre-fill valves
- Reduced noise due to reduced cavitation
- Reduces the risk of diesel effect in the oil
- Lower water content
- Significantly smaller oil volumes have positive impact on environment
- Longer service life of the pumps, for example
- Reduced occurrence of oxidation products, leading to cleaner systems
- Since the system has no direct contact with the environment, it is possible to have extremely clean systems, even in very dusty/dirty/humid environments

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