



# Sabroe Water, Dirt & Oil purifier (WDO)



Keep your plant clean and save money

# Purpose of the WDO

The WDO is a recommended add-on for your ammonia (R717) refrigeration plant in order to ensure continuous operation and efficiency of the plant.

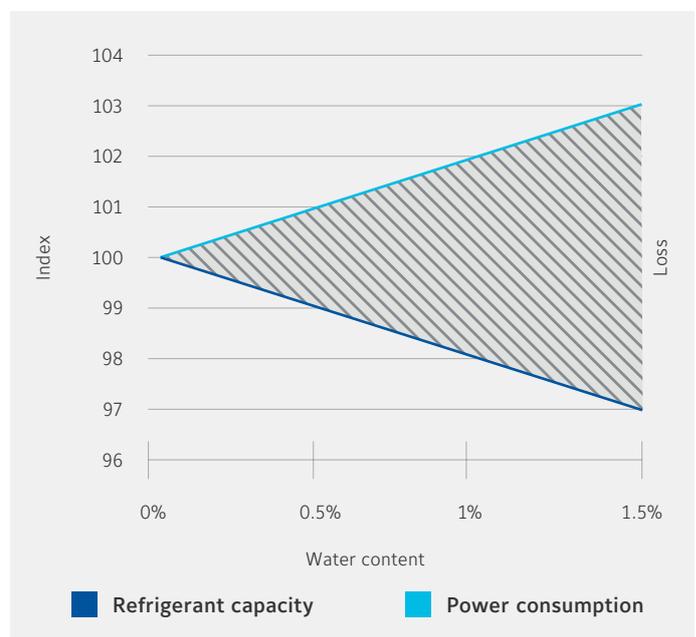
## Effects of water on ammonia plant

The WDO is specially designed to remove water contamination and bring down the content of oil and dirt particles in the refrigerant and thereby reducing both the operation costs of the customer's plant and the risk of unintended shut down.

Higher operating costs – There are three causes of higher operating costs as a result of water in ammonia refrigeration plants. These are:

- Increased power consumption – When water mixes with ammonia the compressor is required to keep a lower evaporation pressure to compensate, and to do this requires a higher level of power consumption. Generally speaking, power consumption increases by 2% for each percent of water in ammonia.
- Increased oil consumption – Oil is broken down by the formation of nitro-compounds when water and oxygen are present in the system, thus resulting in the need to change oil more often than if water was not present.
- Increased maintenance costs – Water mixing with ammonia results in the formation of ammonium hydroxide, which if present in a system causes the corrosion of valves and pipes (especially if oil is not present). Consequently, maintenance costs increase.

## Effects of water contamination



## Customer benefits

### Advantages

Removes oil and dirt from your refrigeration installation

Removes any water present in the ammonia refrigerant

Fewer oil changes needed

### Benefits

Avoids unnecessary operating costs and keeps system components operating at maximum efficiency

Less corrosion of mechanical parts, along with fewer breakdowns and unscheduled service interruptions

Prevents any water present in the refrigerant degrading the lubricating oil and reducing operating efficiency and service life

# Avoid unnecessary operating costs

The primary purpose of the WDO is to protect the equipment and the plant owner's investment. By removing water contamination in the ammonia you will lower power consumption. For a typical ammonia plant, removing water contamination can result in levels of power consumption being reduced by 5 to 10 %.

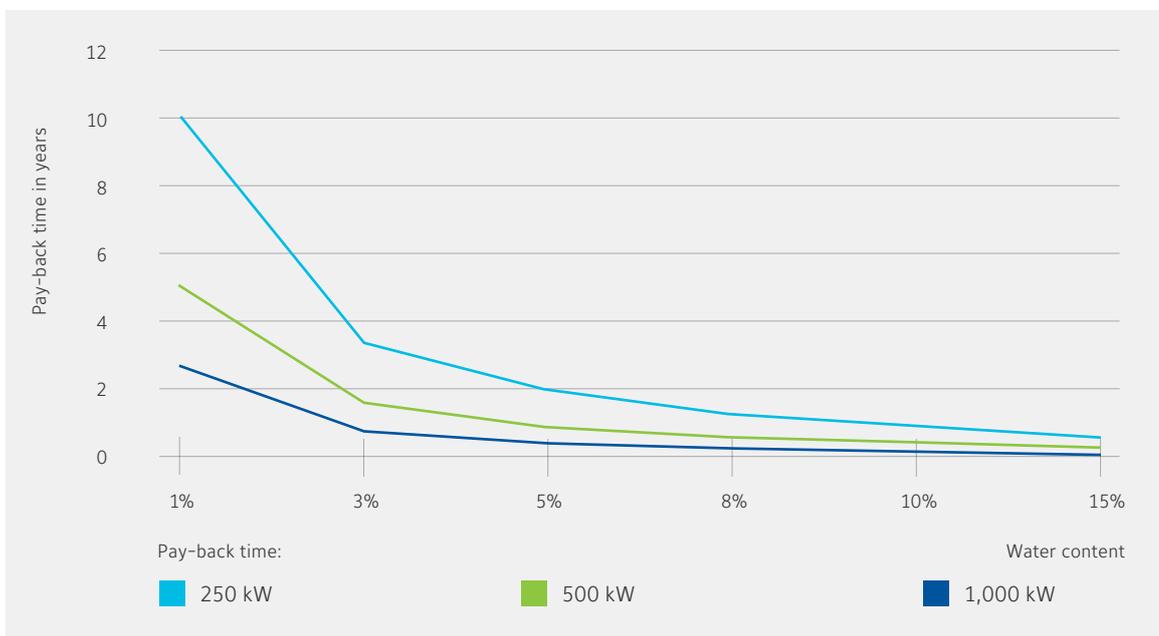
For a medium sized plant, the WDO Purifier will have a payback time of less than 12 months, with all future savings going straight to your bottom line.

Here is a representative table of the economical impact of having contaminated refrigerant in a plant and a chart detailing pay-back time for WDO installation.

Water Content	1%	3%	5%	8%	10%	15%
Additional power consumption [kWh]	25,000	75,000	125,000	200,000	250,000	375,000
Pay back time	10.0	3.3	2.0	1.3	1.0	0.7
Water Content	1%	3%	5%	8%	10%	15%
Additional power consumption [kWh]	50,000	150,000	250,000	400,000	500,000	750,000
Pay back time	5.0	1.7	1	0.6	0.5	0.3
Water Content	1%	3%	5%	8%	10%	15%
Additional power consumption [kWh]	100,000	300,000	500,000	800,000	1,000,000	1,500,00
Pay back time	2.5	0.8	0.5	0.3	0.3	0.2

Based on the following assumptions:  
 Operating hours 5000 Hours. Power expense pr kWh 0,1 EUR. Total cost of installation WDO-HG 25000 EUR. Energi consumption increases 2% pr 1% water contamination.

## Pay-back time for WDO Installation

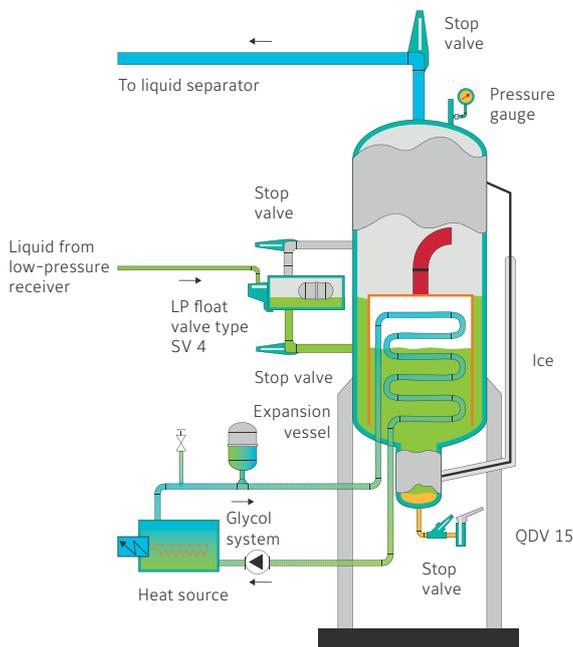


The graph shows how fast the investment of a WDO can be covered, and start generating savings directly on the EBIT.

# WDO is available in two different versions

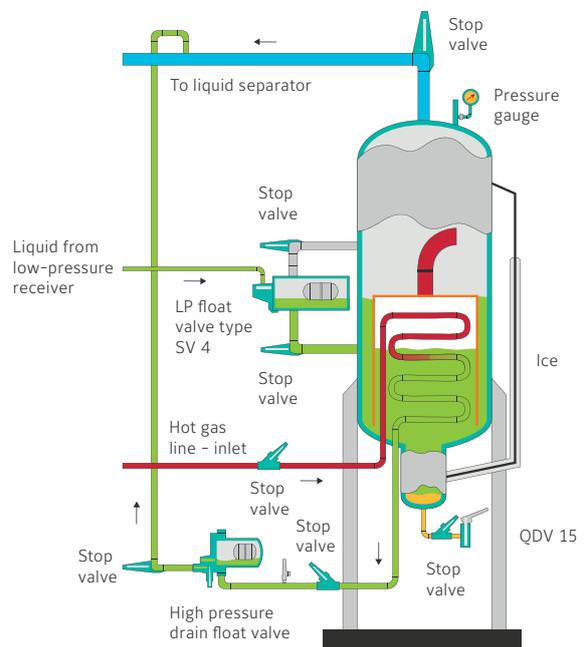
## WDO – electrical heating

The electric heated WDO is always delivered with frame and isolation



## WDO – hot gas

The hot gas WDO is always delivered without frame and isolation



# General about the WDO models

WDO can be used in all refrigeration plants operating with ammonia (R717), to separate oil and water from the refrigerant.

Analysis has shown that the typical water content in refrigerant in a R717 plant is about 3 - 8%; in worst cases up to 20%. The presence of water results in corrosion, increased condensing pressure, decreased heat transfer coefficients and decomposing of lubricating oil.

## Function

Basically, a batch of liquid refrigerant is taken from the high or low pressure side of the refrigeration plant through the liquid line. The refrigerant is heated and evaporates, while a mix of water, oil and refrigerant is left in the bottom of the vessel. This operation is repeated a number of times and results in a high concentration of water and oil remaining in the WDO.



To purge the WDO is a very simple maintenance task that only requires a few minutes.

## Typical indications on decomposing

- Clogging of oil filters
- Coke on piston crown/valves
- Sludge in oil separators
- Sludge in the compressor

## WDO is designed for:

- Highly efficient separation of water and oil
- COP-improvement



The picture above shows the outcome of a WDO purge after one week cycle in a medium / small plant.

# Check profitability

Use the table below to calculate whether it is profitable for you to purchase a WDO.

Experience has shown that COP and cooling capacity decrease by 2% every time the water pollution increases by 1%. This indicates that the total power consumption increases by 2% for every 1% water contamination.

Value	Description	Unit	Example	Your refrigeration plant
A	Plant power consumption	kW	500	
B	Annual operating hours	h	5,000	
C	Power expenses	Euro/kWh	0.1	
D	Water contamination	%	4	
$E = A \times B \times C$	Annual plant power expenses	Euro	250,000	
$F = E \times D \times 0.02$	Additional annual expenses on plant due to water contamination	Euro	20,000	
G	Investment including installation for a WDO	Euro	25,000	
$H = G / F$	Payback time	Years	1.25	

# Consider adding an air purger

You might also consider adding an air purger to your plant.

Any air present in the system will influence the effective surface of both condenser and evaporators, which will result in higher operating cost due to increased energy consumption and premature wear of compressor parts. Air in the system will impact the running conditions and the general rule of thumb is:

## Condensing temperature

1°C increase mean approximately

1% lower cooling capacity  
3% lower COP  
3% higher power consumption

This provides a quick overview of the consequences of increasing the condensing temperature, as caused by the presence of air in the refrigerant.

For more information please find our air purger brochure on [www.sabroe.com/en/aftermarket-solutions/downloads/](http://www.sabroe.com/en/aftermarket-solutions/downloads/).

## Evaporating temperature

1°C decrease mean approximately

At	Capacity	COP	Power
+10°C	-3.6%	-5.0%	+5.2%
0°C	-4.0%	-4.3%	+4.5%
-10°C	-4.4%	-3.8%	+4.0%
-20°C	-5.1%	-3.5%	+3.6%
-30°C	-5.5%	-3.9%	+4.1%
-40°C	-6.5%	-4.4%	+4.6%
-50°C	-7.3%	-5.0%	+5.2%

This table shows the effect of lowering the suction temperature by a single °C to compensate for the reduced effect caused by air in the system.

# Know-how makes a difference

AfterMarket Solutions (AMS) ambition is to be your preferred partner in re-manufacturing, overhaul and retrofit projects.



## Need a solution?

AfterMarket Solutions (AMS) ambition is to be your preferred partner in re-manufacturing, overhaul and retrofit projects. We welcome all types of compressors and our entire staff takes great pride in ensuring that your plant suffers minimal down time, by entirely exchanging your defective compressor, or overhauling it and returning it in a timely manner. To provide further service to you as our customer, we also offer Air purgers and system cleaners compatible with e.g ammonia plants.

The Johnson Controls compressor block exchange programme enables customers to avoid the downtime and inconvenience associated with on-site overhaul by sourcing a replacement block directly from Johnson Controls ready-for-sale stocks.

## Retrofit

We can now provide a retrofit programme that offers customers to buy a new compressor block to be mounted on an existing unit. This will drastically reduce the maintenance costs and shorten the lead times.

## On your terms

The Johnson Controls AMS exchange and overhaul programmes are planned and configured to make sure customers can keep their Sabroe, Stal, Gram and Frick compressor equipment operating at peak efficiency for an exceptionally long time. Any exchange or repair work can be carried on the customer's terms, planned to take place at the most convenient time and with the absolute minimum of operating disruption.

# Johnson Controls, Industrial Refrigeration

Leading the world forward to new opportunities

So many things in our lives rely on refrigeration, which is why we are dedicated to providing the world with the industrial refrigeration, energy recovery and gas compression technology required today and tomorrow.

Our industrial refrigeration products allow the food industry to deliver fresh food to consumers by providing essential equipment for processing and distribution. We also supply many of the unique products required to move gas through pipelines, recover and transfer energy and to manufacture chemicals, pharmaceuticals and other products that are needed for the everyday items we depend on.

Refrigeration processes are often required to operate 24 hours a day and, with operational lifetimes of 25 years or more, reliable service and support is an essential part of our commitment to our products.

Key to the provision of refrigeration services to our customers is the efficient supply of reliable and long-lasting Sabroe parts, thereby reducing downtime and the overall cost of machine maintenance. Making the most of our effective worldwide logistics infrastructure and rapid response inventory management, the Parts Centre dispatches any part-in-stock to wherever it is needed, worldwide, within just 24 hours.



We provide all kind of service related to the following brands:





## Customer benefits



### Global reach

Our global service and parts network ensures customers an organisation with a global reach that is also known and active at the local level.



### Customer satisfaction

Our 142,000 global colleagues strive to serve our customers in the best way, customer focus is our key to success.



### Improvements

To continually improve the value we provide to customers we strive to become more competitive and capture new opportunities.



### Sustainability

We believe that sustainability will play a significant role in any future development of our products, services and operations, where our focus will be on efficiency and environmental protection.



### Innovation

We believe that there is always a better way. This belief inspires us to develop new solutions, change and opportunities, which we pass on to our customers.



### Quality

We will distinguish ourselves with our customers through the exceptional quality of our products and services.

At Sabroe, we do not simply design and deliver spare parts for our customers. We test each part against competing products. This ensures that our goal, engineering in accordance with the highest standard, is maintained and exceeded.

## About Johnson Controls Building Technologies & Solutions

Johnson Controls Building Technologies & Solutions is making the world safer, smarter and more sustainable – one building at a time. Our technology portfolio integrates every aspect of a building – whether security systems, energy management, fire protection or HVACR – to ensure that we exceed customer expectations at all times. We operate in more than 150 countries through our unmatched network of branches and distribution channels, helping building owners, operators, engineers and contractors enhance the full life-cycle of any facility. Our arsenal of brands includes some of the most trusted names in the industry, such as Tyco®, YORK®, Metasys®, Ruskin®, Titus®, Frick®, PENN®, SABROE®, Simplex® and Grinnell®.

For additional information, please visit [www.johnsoncontrols.com](http://www.johnsoncontrols.com) or follow us [@johnsoncontrols](https://twitter.com/johnsoncontrols) on Twitter.

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