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# Time to change

**Compressed air is one of the most expensive forms of energy produced from electricity, so that due to the currently unimaginable extent of rising energy prices, many compressed air users are looking for short-term, simple and quickly implementable solutions for saving energy in the area of compressed air and compressed air purification.**

**When considering the energy optimization of existing compressed air stations, the focus is initially on optimizing the compressors, reducing the pressure, or searching for leakages due to the larger energy shares. The fact that compressed air adsorption dryers also contribute a not inconsiderable part to the total energy consumption of a compressed air station is often overlooked.**

The energy consumption of a compressed air adsorption dryer depends on the regeneration process, the desired pressure dew point and the desiccant used to achieve this dew point. The lower the pressure dew point, the higher the required energy input.

Direct energy consumption includes the electrical consumption required for regeneration of the dryer, depending on the system. Indirect energy consumption includes the dry compressed air required for stabilizing the regeneration and/ or the cooling. This purge air consumption, which is often forgotten in energy comparisons, can amount to up to **0.14 kWh/m$^3$** depending on the specific power of the compressor and has the same effect as a classic leakage in the compressed air network.

**Cold-regenerated adsorption dryers** (HEATLESS), which carry out regeneration with 15-20 % dried compressed air of the nominal throughput without any further external heat supply, are definitely the most expensive way of drying compressed air in terms of energy consumption.

Externally heated compressed air dryers (blower dryers) illustrate the classic design of **heat-regenerated adsorption dryers** with high enersave potential. Here, the heat required for desorption is transferred by an external electric heater to a blower air stream (ambient air), which takes over both the task of heat transfer and that of the subsequent transport of water vapour from the desiccant vessel. After desorption, the regenerated adsorber must be cooled to prevent a heat or dew point peak after the switchover.

With externally heat-regenerated dryers, a distinction is made between different cooling variants. In the so-called BLOWER PURGE process, a partial flow of dried compressed air is required for cooling the adsorber, whereas in a BLOWER NON-PURGE or ZERO PURGE system, cooling is carried out with blower air in direct flow to the adsorption, so that no dried compressed air is required for the process.

Based on the systems described, the greatest difference in energy consumption results from the different regeneration processes between cold and heat regenerated compressed air dryers.

A cold-regenerated dryer (HEATLESS) has **about 35 % higher energy consumption** than a heat regenerated BLOWER PURGE dryer. BLOWER NON-PURGE or ZERO PURGE processes, on the other hand, require **about 12 % less energy** than the heat-regenerated BLOWER PURGE dryer with purge air consumption.

However, with an existing compressed air dryer, this knowledge of the differences is not really helpful. Replacing such a dryer with a new compressed air dryer with a more efficient regeneration system or modifying an existing dryer and converting it, for example, to ZERO PURGE operation or a different heating medium such as saturated steam can, if it all, only be realized with considerable effort and associated high investment costs.

Of course, there are still numerous ways to optimize an existing compressed air dryer.

One of these possibilities is a loading-dependent dew point control, which is usually already available, and which carries out a switch-over delay of the adsorber via a dew point setpoint and thus modifies the operation to actual operating conditions and enables more efficient operation.

Another effective and timely solution to immediately save energy costs on an existing heat-regenerated dryer is to use or *refill it with a higher efficient desiccant.*

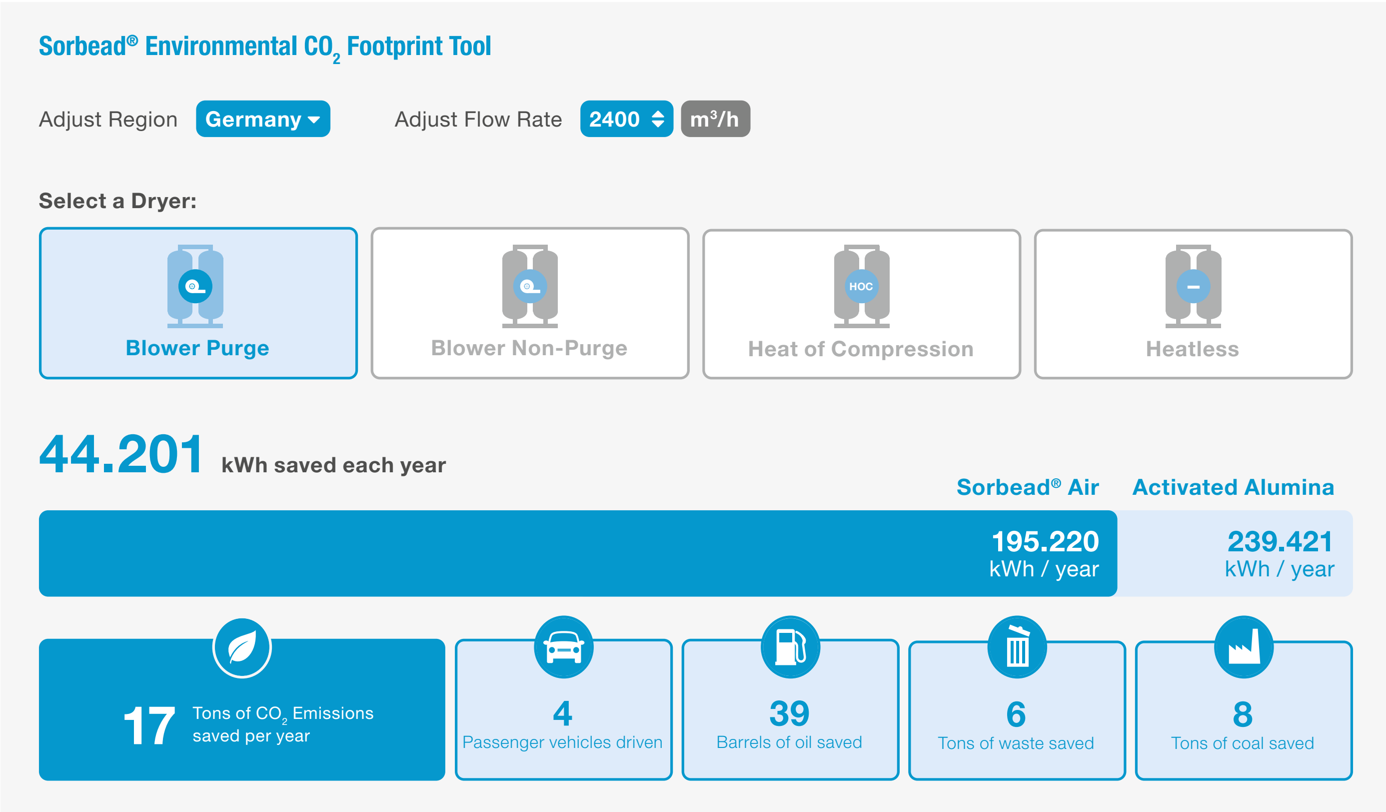
## Sorbead® Air, the low energy solution

The energy efficiency of a desiccant essentially depends on two factors. Firstly, the lowest possible desorption temperature and a high dynamic adsorption capacity for moisture adsorption.

BASF's low-energy **Sorbead® Air** precisely fulfils these properties in heat-regenerated compressed air dryers, in contrast to the low-cost but not particularly energy-efficient Activated Alumina desiccants. Desorption temperatures of 120-140 °C, depending on the desorption air humidity, are already sufficient to achieve low dew points of -40 °C. In addition, depending on the inlet conditions dynamic capacities of up to 20 wt.% (200 g $H_2O$ per kg desiccant) can be achieved, which results in an extension of the drying time per adsorber (cycle time) and thus also reduces more the average energy requirement.

The following diagram shows an example of the difference in the operation of the same BLOWER PURGE compressed air dryer filled with **Activated Alumina** and alternatively with Sorbead® Air. Only the standard desiccant was replaced by **Sorbead® Air** in this dryer.

In addition to the direct energy consumption for desorption (heater, blower), the indirect power consumption required for the necessary cooling with dried compressed air was also considered.




*Source: BASF Environmental $CO_2$ Footprint tool* *https://catalysts.basf.com/industries/oil-gas/compressed-air-drying*

Based on the calculation by the Sorbead® $CO_2$ footprint tool, it can be seen that even with an exemplary low flow rate of compressed air, the use of a low-energy **Sorbead® Air** desiccant **saves more than 44,000 kWh per year**, which corresponds to **approximately 18 % of the energy**.

In addition, **17 tons $CO_2$ Emissions per year** a less produced in operation with Sorbead® Air only with this dryer.

In this context, it is partly inexplicable that today, in times when every kWh of electrical energy should count, Activated Alumina is still used in newly supplied heat-regenerated compressed air dryers or in a scheduled desiccant refill of an existing dryer, partly also maybe only due to unawareness at the efficiency at different desiccants.

## Sorbead® New for Old!

However, not only the replacement of an Alumina desiccant with Sorbead® Air, but also compressed air dryers that have been operated for many years with a low-energy desiccant such as KC-Trockenperlen®, Sorbead® or Sorbead® Air, offer the opportunity to reduce energy consumption through timely desiccant replacement.

Even an aging low-energy desiccant such as Sorbead® is subject to natural hydro-thermal ageing due to the drying cycles caused by the continuous moisture loading during adsorption and the subsequent number of desorption's. Ageing here means a reduction in pore volume and specific surface area, which can be **much as 800 m² per gram** for an as-new desiccant such as Sorbead® Air.

This natural ageing can increase due to further influences such as oil- or hydrocarbons components that get into the adsorber bed or due to contaminations in the compressed air. However, mechanical loads due to increased flow velocities or moisture overload resulting in increased abrasion also led to an additional decrease in capacity.

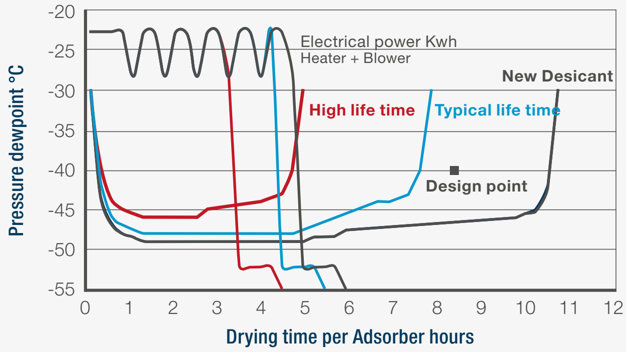
The remaining capacity of a desiccant filling can be determined by a desiccant sample based on the specific surface area and the pore volume in a laboratory or quality test. If complete plant data, current operating data, temperature and dewpoint curves of the compressed air dryer are available, a process simulation can alternatively provide results of the dryer on the current efficiency independently of a desiccant sample.

The following diagram shows an example of the additional energy consumption in relation to the lifetime of a desiccant filling in a BLOWER PURGE dryer already filled with Sorbead®. Already with a typical achievable service lifetime, a corresponding additional consumption is shown compared to a new desiccant filling. Beyond this assumed period, the power requirement of the compressed air dryer increases proportionally, which results in a not inconsiderable additional electrical consumption in further operation, even with a low-energy desiccant filling that is getting on in the years.

As can be seen in the diagram, the decrease in adsorption capacity does not necessarily lead to an immediate deterioration of the pressure dew points over the complete drying cycle but is particularly noticeable through a shortening of the drying time which is triggered by a premature breakthrough due to the no longer available loading capacity of the desiccant filling.

It is true that less moisture has to be adsorbed in a shorter cycle. However, since the required desorption heat of the water (heat of adsorption in kJ/ kg $H_2O$) increases with decreasing dynamic adsorption capacity during regeneration and the steel adsorber as well as the desiccant mass must be heated unchanged before the water is desorbed, this results in a higher energy requirement per cycle despite a lower adsorbed moisture quantity.

### Desiccant efficiency in relation to the life time




**+8,6 kWh/h** **+2,3 kWh/h**

**Average Power consumption kWh/h**
Power consumption Heater, Blower and purge air

Blower purge dryer flow rate 2400 m³/ha, pressure dewpoint -40 °C, switch over DP -30 °C at dewpoint control

*[1] The curves and energy consumptions in the diagram correspond to practical evaluations, whereby the degree of ageing determined for this dryer is exemplary and can deviate in practice depending on the type of dryer, the desiccant used, operating conditions or environmental influences.*

## Time to change!
## Now is the right time for a desiccant replacement

The article clearly shows, there are simple and quickly implementable solutions for saving energy consumption on heat-regenerated compressed air dryers.

Whether you are replacing a less efficient desiccant with a low energy desiccant such as Sorbead® Air, or replacing an ageing desiccant charge, now is the time to make a change to immediately reduce the energy costs of a compressed air dryer.

For more information on Sorbead® Air, please visit the BASF Compressed Air website.

**catalysts.basf.com/industries/oil-gas/compressed-air-drying**


## Any Questions?
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