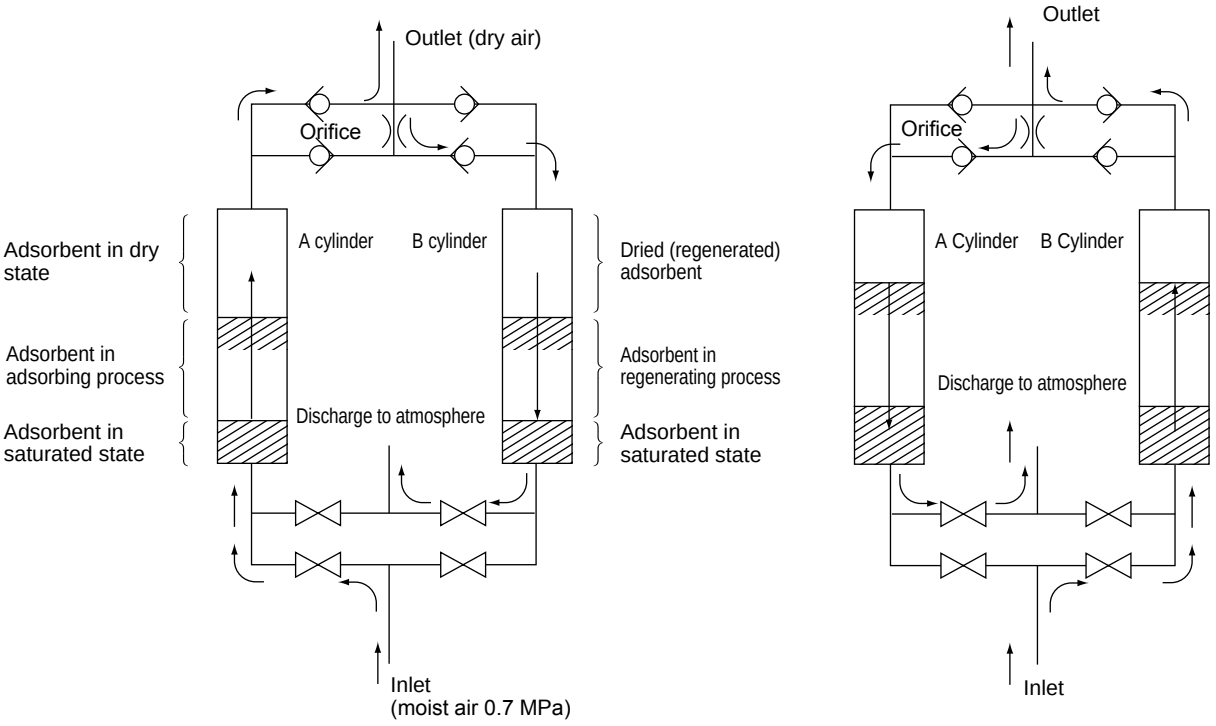
Suction principles and circuit diagram

The heatless dryer is a system that utilizes the characteristics of an adsorbent (desiccant) which constantly tries to create a state of equilibrium with the vapor concentration of the ambient air. The unit has 2 cylinders, repeatedly switching between the one for the process of absorbing the water vapor from the air, and the other for the regeneration process of releasing the adsorbed moisture with the dry air created. This device will constantly supply dry air at the outlet as moist air enters it.



Moist air coming in from the inlet will enter the A cylinder, have its moisture removed due to the adsorbent, and then leave from the outlet as dry air. Part of the dry air coming out of the A cylinder will flow through the orifice, be reduced in pressure to an atmospheric pressure, enter the B cylinder, remove moisture from the moist adsorbent, and be exhausted into the air.

By using a part of the air dried under pressure, when it is reduced in pressure by the atmosphere to regenerate the desiccant, the drying efficiency will increase and improve regeneration efficiency.

For example, when dry air of 0.7 MPa is reduced in pressure to the atmospheric pressure, the volume of air expands to approximately 8 times as much and the relative humidity per unit of volume becomes approximately 1/8. Accordingly, the adsorbent releases a greater amount of moisture in trying to create a state of equilibrium with that air.

After a certain amount of time, the flow of air is reversed with a timing motor for adsorption to take place in the B cylinder while regeneration will take place in the A cylinder. These operations will be repeatedly performed.

Heatless dryer system

1. Purge flow rate

The heatless dryer uses some of the dry air created by the dryer for the regeneration of the adsorbent that has absorbed moisture. The air used in this regeneration is referred to as the purge air, and the min. required volume is determined from principles.

$$\text{Theoretical purge rate} = \frac{1}{\text{Air pressure during adsorption (absolute pressure)}}$$

For example, when operating under 0.7 MPa, the theoretical purge rate is approximately 12.9% (under 100% load).

In reality, 15 to 23% is configured in consideration of the absorbing/releasing efficiency of the desiccant and the efficiency of the device. Accordingly, if the operating conditions differ, the purge rate will differ and so will the processing air rate and purge volume.
Be sure to review the catalog to make sure that the operating conditions of use and necessary outlet dew point will be satisfied.
In addition, ideal purge volumes can be set at the plant to suit the specifications of customers (custom made). As it will be necessary to reconfigure the unit when working conditions are changed due to relocation, etc., consult with CKD.

2. Oil removal

In the case of desiccant air dryers, as the desiccant adsorbing oil will interfere with the adsorption of moisture, the outlet dew point may become lower and the life of the desiccant may become shorter.
Accordingly, when installing a desiccant air dryer in an air line using a lubrication air compressor, be sure to install an oil removing filter (M type filter) on the primary side of the dryer.

3. Installation of filter on dryer secondary side

In the case of desiccant air dryers, as desiccant powder will flow out to the secondary side of the dryer, depending on the air purpose (required air quality), install a filter (a P, S, or M type filter or a combination thereof) on the secondary side of the dryer.

4. Silencer replacement

When switching the adsorbing side of the desiccant cylinder, as the cylinder (in a pressurized state) that had until then been adsorbing is suddenly reduced in pressure, a loud exhaust noise will be generated every time the switching takes place. Although a silencer is provided in order to suppress this exhaust noise, after a long period of use, the desiccant powder will build up and clog the pores thereof. Neglecting this will have an impact on the regenerating performance of the desiccant and the described dew point performance may not be exhibited. In addition, when the clogging becomes worse, the silencer may become damaged by the pressure during exhaust.
As a guideline for replacement, be sure to replace when the pressure on the side of the regenerating cylinder exceeds 0.05 MPa or when one year has passed.

5. Pressure fluctuation on dryer secondary side

Pressure fluctuates around the switching process (suction/release) for the desiccant cylinder, as air flow rate fluctuation other than the user's is caused by temporary purge stop and the pressurized filling process of the atmospheric pressure cylinder (regeneration cylinder). The fluctuation range is greatly affected by the situation of the piping with which the dryer is installed, and in the worst case may be as large as 0.1 MPa. In cases when this pressure fluctuation may impact factory operation, consider setting the source pressure higher or installing an air tank on the secondary side.

6. Bypass circuit

In most cases with dryers, a bypass circuit which bypasses the dryer is provided for emergency air supply. This can be used by opening the valve in cases when it is necessary to supply air even when the dryer is broken or in cases when repairing the dryer while allowing the air to flow as a temporary measure. However, in this case, moist air from which moisture has not been removed will of course be supplied within the factory.
When a heatless dryer is selected, it is often the case that extremely dry air is required. Use extreme caution when opening the bypass circuit since opening it will cause moisture to enter all the air pipes past the dryer, creating a great amount of work to recover from this state. In such cases, it is recommended that a spare unit be installed.

7. Dew point display

In accordance with common practice, although performance display has been the pressure dew point for refrigeration air dryers and atmospheric dew point for heatless dryers and membrane dryers (refer to page 1716 for terminology), due to establishment of JISB8392-1 there is a trend of unifying the display to the pressure dew point. At CKD, performance will be displayed with the pressure dew point from the super heatless dryer SHD3000 Series. Note that depending on the model or manufacturer, the display signals may become mixed.