SPXFLOW

PCMc,
Energy Saving
Enhancer

SPXFLOW

PCMc, Energy Saving Enhancer

Automatic and Energy Saving Solutions for Tropical Regions

Nomenclature

PCM Series

PCMc [ ] – [ ]

Model	Rated Flow (Nm³/min)
22.6J-5	22.6
35.4J-5	35.4
42.5J-5	42.5
56.6J-5	56.6
84.9J-5	84.9
22.6J-5R	22.6
35.4J-5R	35.4
42.5J-5R	42.5
56.6J-5R	56.6
84.9J-5R	84.9
127.5J-5R	127.5
170.0J-5R	170.0
212.5J-5R	212.5
255.0J-5R	255.0
297.5J-5R	297.5
340.0J-5R	340.0

Options	
F1	Prefilter package for 5 years warranty on heat exchanger
I	Smart monitoring kit
T	Stainless steel 304 air inlet/outlet piping & separator
U	Stainless steel 316 air inlet/outlet piping & separator
X	Common inlet /outlet air header with isolation valve
Y	PLC & Touch screen panel

* Options 'T' and 'U' are available on models PCMc22.6J-5 or PCMc22.6J-5R and larger

* Options 'X' and 'Y' are available on models PCMc84.9J-5 or PCMc84.9J-5R and larger

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Jemaco

Why Do Compressed Air Systems Need Drying?

SPX FLOW provides compressed-air dryers and filters that remove oil, water, dirt, rust and pipe scale. Contaminants found in compressed air can adversely affect all components of an air distribution system, and can cause a malfunction of pneumatic control in the instrument air system.

Properly treated compressed air can improve work efficiency and reduces maintenance. Desiccant and refrigerated type compressed air dryers are used in the control air systems of power plants.

About SPX FLOW

SPX FLOW, Inc. (NYSE:FLOW) is a leading manufacturer of innovative flow technologies, many of which help define the industry standard in the market segments they serve. From its headquarters in Charlotte, North Carolina, it operates a sales and support network, centers of manufacturing excellence, and advanced engineering facilities, throughout the world. Its cutting-edge flow components and process equipment portfolio includes a wide range of pumps, valves, heat exchangers, mixers, homogenizers, separators, filters, UHT, and drying technology that meet many application needs. Its expert engineering capability also makes it a premium supplier of customized solutions and complete, turn-key packages to meet the most exacting of installation demands.

www.spxflow.com

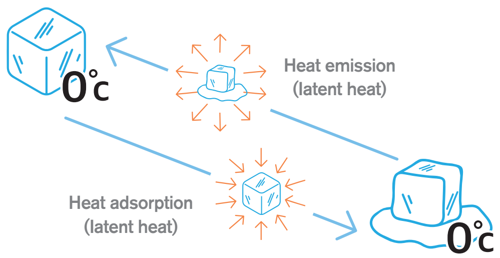
PCMc, Energy Saving Enhancer

From 200HP to 3000HP and larger PCMc Series is the ultimate solution providing perfect dehydration and enormous energy savings!

This PCM technology harnesses the latent heat occurs when PCM converts solid to liquid or liquid to solid, which automatically triggers the refrigeration compressor to switch On/Off according to varying compressed air heat loads.

Latent Heat

Latent heat is energy released or absorbed by a body or a thermodynamic system, during a constant temperature process that is specified in some way. For instance, when ice melts into water, it absorbs heat from its surroundings. Vice versa, when water freezes into ice, the same volume of the heat is released. As such, when heat flows in and out at constant temperature, we call this heat as latent heat.
In general, latent heat value is much higher than sensible heat value. For example, sensible heat value for water is 4.18KJ/kgC, but latent heat for changing water to ice at constant temperature of 0˚C is 334kJ/kg which is 80 times of sensible heat value.



Why Phase Change Material?

PCM is a substance with high latent heat which melts or solidifies at a certain temperature, thus being able to absorb or release large amounts of energy.
Taking advantage of the magnitude of latent heat (at change of phase) which is a multitude of times higher than sensible heat (at change of temperature), PCM air dryer provides sufficient cold storage with only a small amount of phase change material. As a result, PCM air dryer is in simple engineering design, compared to existing "Thermal Mass" air dryers which are available in the market.
Hence with PCM's cutting edge technology, SPX FLOW has introduced the most cost-effective and efficient high performance air dryer in the industry.

I SPX FLOW Korea

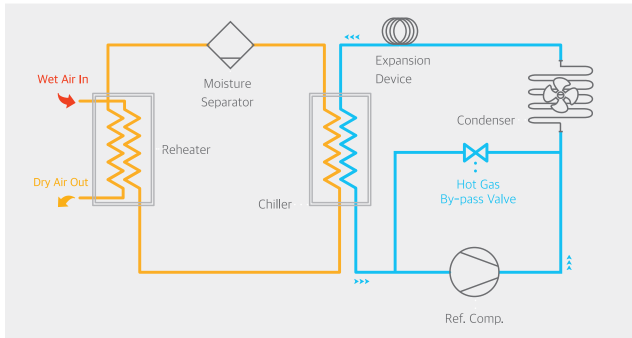
Unique Product Design
- Adapted Phase change material PCM (Patented)
- Stainless steel brazed plate heat exchanger with PCM filled in
- Automatically triggers refrigeration compressor to switch On/Off according to varying compressed air heat loads

Zero Loss Drain
- Electrostatic capacity sensor
- Zero loss of compressed air when condensate water is discharged
- Automatically switch to timer mode at malfunction

Great Energy Efficiency
- Up to 99% energy saving with the lowest cost
- Shortest period of return of investment

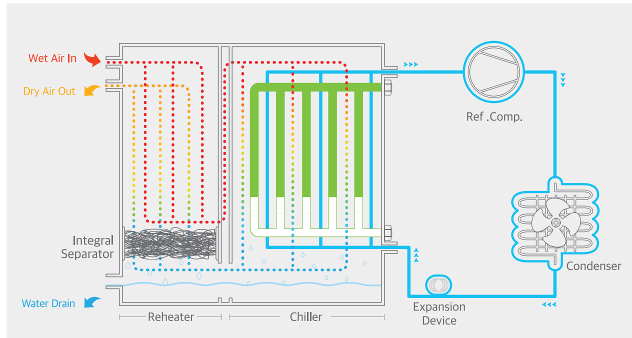
Heat Exchanger 5-Year Warranty Program
- When used with NGF filter installed upstream and filter element replacement had been in accordance with recommended maintenance
- Heat exchanger replacement is confined to its leakage or blockage problem

Non-Cycling Air Dryer (Conventional)



- Hot gas by-pass valve
- Continuous running at fixed RPM
- Simple configuration
- Low price
- Low efficiency
- Unstable dew point

Cycling (PCM Air Dryer)



- Utilize latent heat of phase change material
- Load control by On/Off cycling
- Heat exchanger with no pump/valve/tank (Simplest design)
- Competitive price
- Highest energy efficiency with minimum heat loss
- Stable dew point

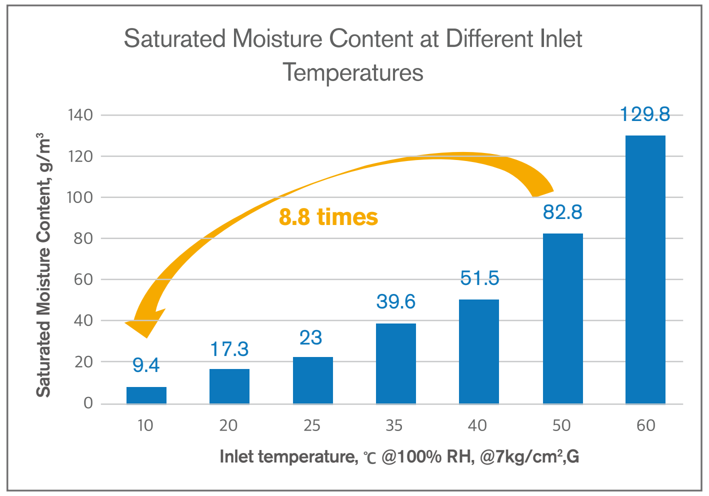
PCMc, Energy Saving Enhancer

Background

In an application which requires sub-zero pressure dew point, very often adsorption dryers such as desiccant dryers are used. Heated desiccant dryers are used for larger flow applications. However, the heaters in these dryers consume a lot of energy during the regeneration process. The amount of energy used depends on the inlet temperature and pressure, ie inlet moisture load.

Moisture Content with Air Inlet Temperature

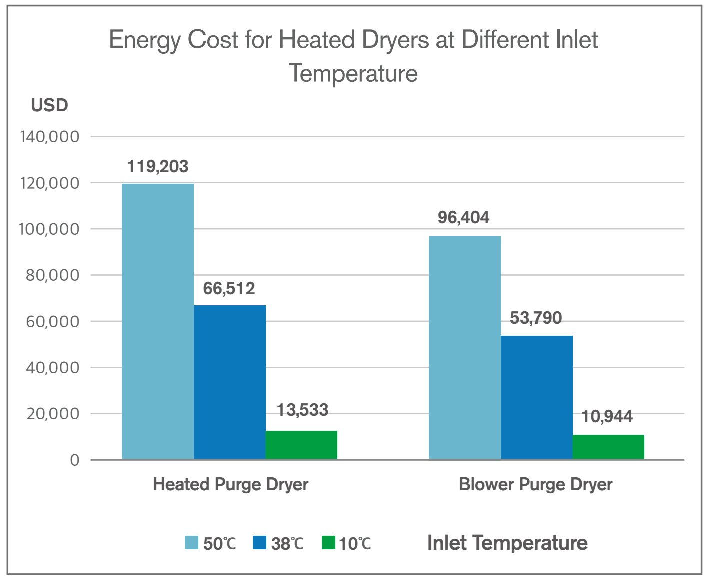
The amount of energy used depends on the inlet moisture load determined by temperature and pressure. When the inlet air temperature to desiccant dryer is lowered from 50℃ to 10℃, the inlet moisture content to the dryer will be reduced by 88.6% or 8.8 times. Energy consumption will be reduced significantly.



Energy Cost

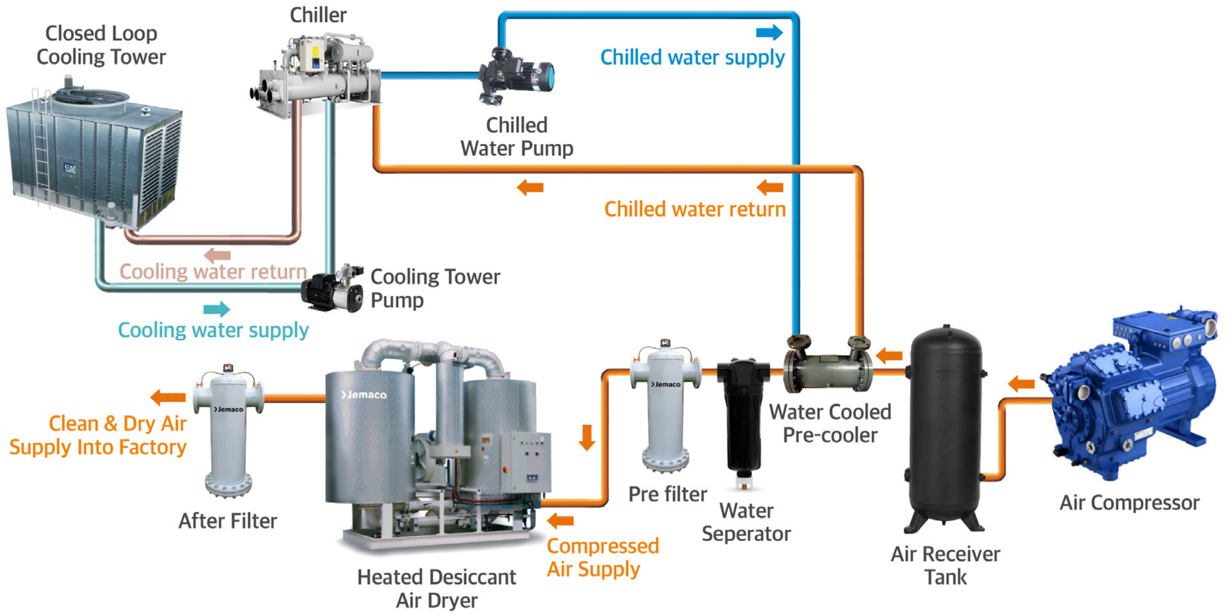
The power consumption of a desiccant dryer using electrical heater is dependent on the inlet moisture load or inlet temperature. Therefore, energy cost of running these heated dryers will be reduced by 89% if we can reduce the inlet temperature from 50℃ to 10℃.

The PCMc, energy saving enhancer air dryer can replace chiller successfully, furthermore, it is even more efficient than chiller. (The below calculation is based on inlet flow FAD 100Nm^3/min, an inlet pressure of 7kgf/cm^{2}G, inlet temperature of 50℃ 100% RH, cost of compressed air 5.77 kW/(m^3/min), energy cost of USD 0.10 per kWhr, compressed air heat load of 70% to PCMc)



Pre-cooling methods

Conventionally, water-cooled chiller is used to lower inlet temperature from 50℃ to around 25℃ before entering a heated dryer such as Blower Purge or Zero Loss Dryer.
A chiller, however, consumes a lot of energy to cool the air due to its complicated system. System shown as below :



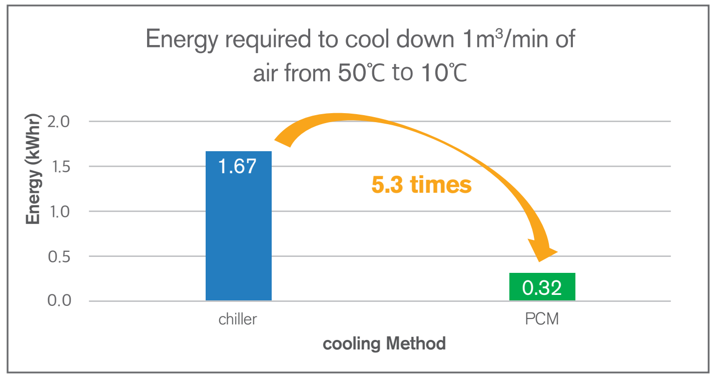
Chilled water used to cool the compressed air require the following components:

1. Closed loop cooling tower
2. Cooling tower pump
3. Chiller
4. Chiller water pump
5. Water-cooled after cooler

The number of components required to chill water require greater energy input and consequently increasing maintenance cost.
At most plants, it is common for other applications within the facility to share its supply of chilled water from a centralised system. In the event of a chiller breakdown or insufficient water flow to the dryer, the dryer's outlet dew point will be affected.

Pre-cooling using PCMc

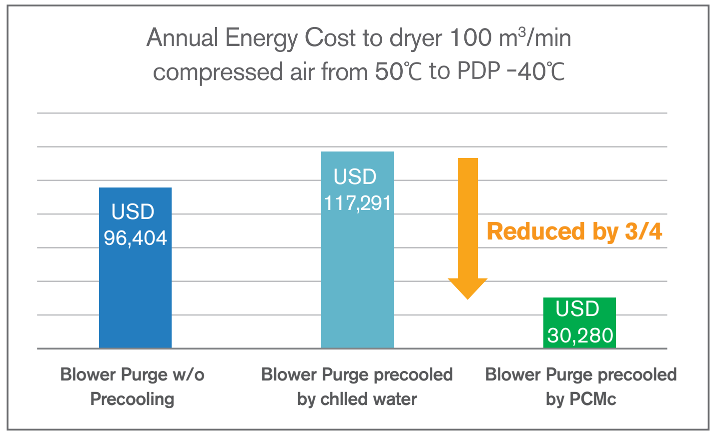
PCMc evolves from SPX Flow Technology's successful invention of PCM Dryer (Phase Change Material), which saves up to 98% of energy. PCM comes with one inlet and one outlet, while PCMc comes with two inlets and two outlets. The PCM material within the PCMc's refrigeration system precools the compressed air to approximately 10℃.



Effect of PCMc

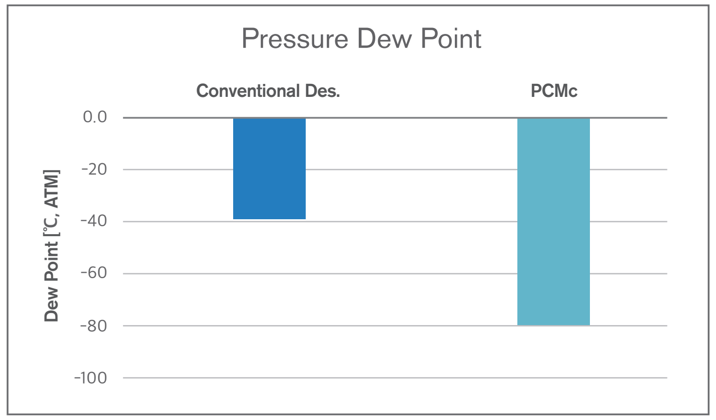
Annual Energy Cost

Using PCMc to pre-cool compressed air prior to entering a heated desiccant dryer, only 1/4 of energy is consumed as compared to using chilled water. In comparison to the energy used, it costs more to pre-cool compressed air using chilled water than using PCMc.
It costs 1.67 kWhr to cool down 1m³/min of compressed air from 50℃ to 10℃ by using chilled water, while it only needs 0.315 kWhr by using PCMc. Chiller uses 5.3 times of energy for the same amount of job.



Pressure Dew Point

Using PCMc to reduce the moisture load before desiccant dryer, dew point can be reduced to -80℃ or higher.

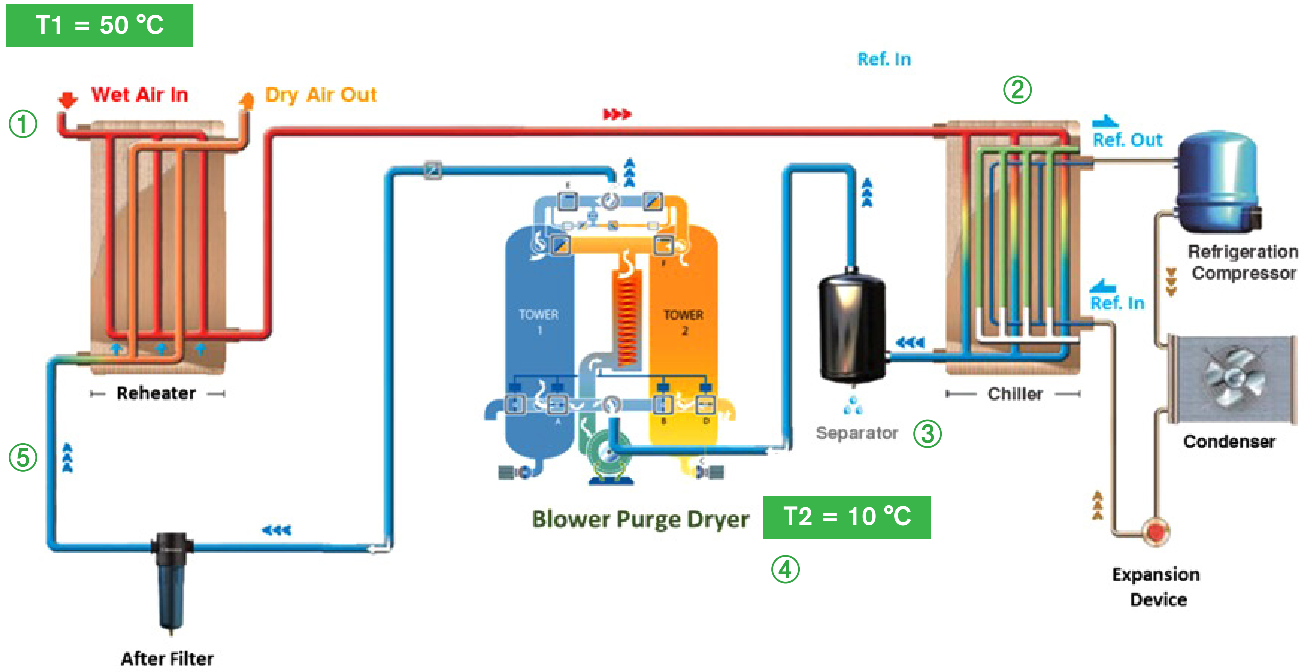


How PCMc Saves Energy

1. Drastically reduces energy consumption by pre-removing up to 75% of moisture by using the PCMc Energy Saving Enhancer.
2. PCMc, cycles (On / Off) are controlled automatically according to inlet load : e.g. lunch time, season change.
3. Reduces total energy consumption by operating PCMc alone if necessary. (except winter)
4. Reduces energy consumption by controlling the desiccant air dryer cycle time according to outlet dew point, which corresponds to inlet moisture load.
5. Integrated high efficiency blower, which regenerates with ambient air. Zero loss purge.

1 + 2 + 3 + 4 + 5 = **86%**

Flow Diagram



Dehydration of Compressed Air

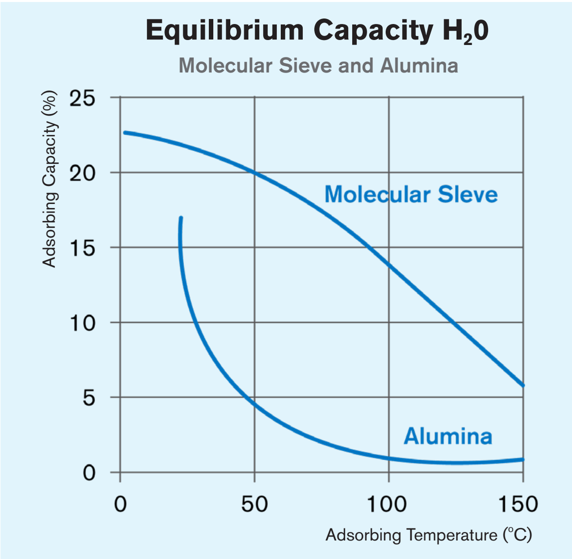
① Compressed air saturated with water vapor enters reheater, and is pre-cooled by the outgoing chilled air.
② It is then directed to chiller where it is further cooled by the Phase Change Material (PCM).
③ As the air is cooled, water vapor condenses into liquid droplets, which are then removed by high efficiency integral moisture separator with a No Loss Drain.
④ Chilled air enters the heated desiccant tower to dry and supply lower than guaranteed dew point of -40℃ or -70℃.
⑤ Dried air returns to the PCMc's reheater, where it is reheated with very low dew point. This in turn, supplies clean and dry compressed air to point of use.

Phase Change in PCMc Energy Saving Enhancer

① When the refrigeration compressor and condenser fan are running, the cold refrigerant in the chiller (evaporator) cools the liquid PCM and it gradually freezes.
② When the PCM is sufficiently cooled and subsequently frozen, the refrigeration compressor and condenser fan will stop.
③ The compressed air is continuously cooled by the PCM while the refrigeration compressor is inactive. No power is consumed during this period.
④ The PCM gradually melts as it adsorbs heat from the compressed air, and when it is fully melted, the refrigeration compressor and condenser fan will resume to cool down the PCM.

Features of PCMc

1. Energy Saving by lowering the inlet temperature, it reduces the inlet moisture content and prolongs the cycle time, hence reducing energy consumption.



2. Lower Outlet Pressure Dew Point

Desiccant has a higher absorption capacity at a lower inlet temperature, thereby producing a lower outlet dew point.

Activated Alumina has almost three to five times higher absorption capacity when the absorbing emperature is lowered from 50℃ to 10℃.

3. Shorter cooling time, ie less cooling air flow is required, average of 0.06% compared to 1.125% without pre-cooling. This is less than auto drain air loss in refrigerated air dryer

4. Cooler outlet temperature

With an inlet temperature of 50℃, the outlet temperature from a heated desiccant dryer will be greater than 50℃, while with PCMc, the outlet temperature from a heated desiccant dryer will be much lower.

5. Saves more energy compared to conventional non-cycling system, in comparison, PCMc delivers a more consistent outlet temperature and saves more energy than the pre-cooling process which uses the conventional non-cycling dryer.
When outlet temperature from a pre-cooler increases by 5℃, moisture load entering the dryer increases by 35%, and the heated desiccant dryer will subsequently cost more to run.

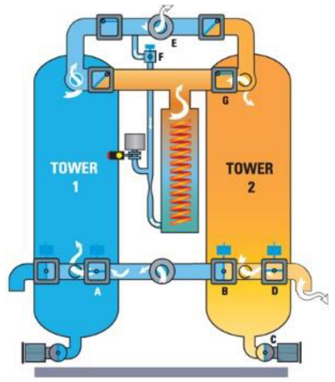
The conventional non-cycling dryer continues to run and consume energy even when there is low load.

Application of PCMc

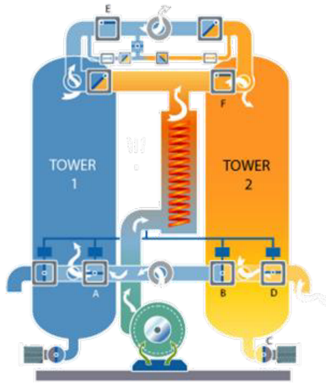
New or Existing Installations

PCMc Energy Saving Enhancer is suitable to be used in **NEW** and **EXISTING** installations of adsorption dryers as shown below, saves up to 90% of energy cost through extension of its cycle time.

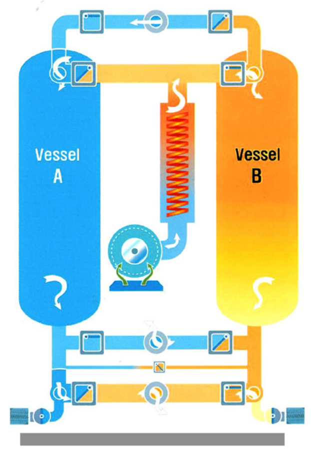
Heated Purge



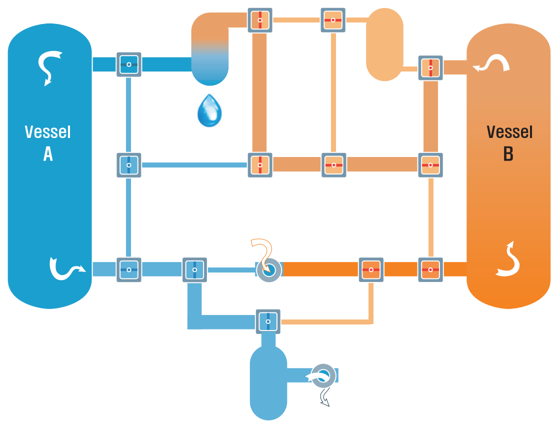
Blower Purge



Zero Loss

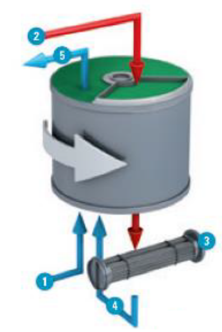


Heat of Compression

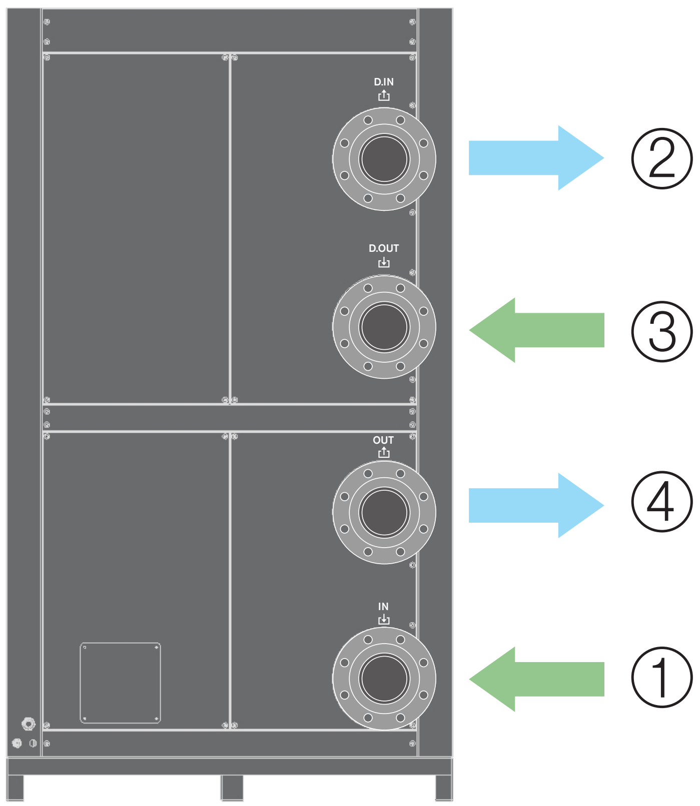


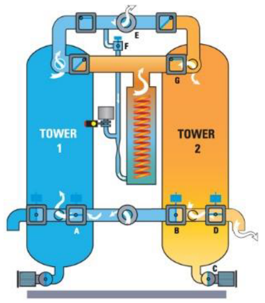
Improves outlet dew point

- For heated dryers such as Heated Purge, Blower Purge and Zero Loss Dryer: By installing PCMc upstream of the conventional adsorption dryer, it will improve the outlet dew point and save energy.
- For Heat of Compression Dryer : PCMc can be used as an auxiliary equipment installed after the Cooler Assembly. The installation is to cool down compressed air from 50℃ to 10℃, lowering the moisture content compressor air for the dryer and consequently using 5.3 times less energy.
- For Deliquescent Dryer: This dryer suppresss the dew point by 5 to 10℃. This procedure causes the outlet dew point to fluctuate according to its inlet dew point. In cases where better and more stable dew point is required, PCMc can be installed upstream of deliquescent dryer to provide constant inlet dew point to the deliquescent dryer.

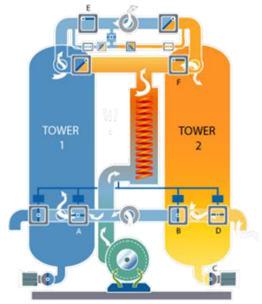


Installation Examples

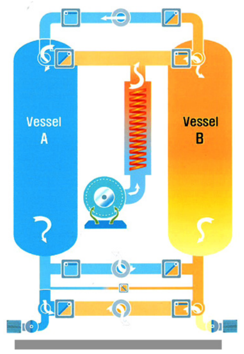




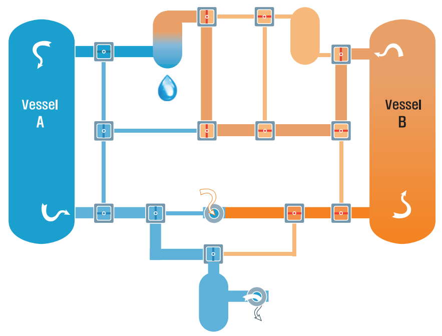
Heated Purge



Blower Purge



Zero Loss



Heat of Compression

① **Wet Air from air compressor,** T_1 = 50℃

② **Cold Air from PCMc** to adsorption dryer, T_2 = 10℃, PDP = 10℃

③ **Cold and Dried Air from adsorption dryer** to PCMc for reheat T_3 above 10℃, PDP = -40 to -80℃ PDP

④ **Warm and Dried Air from PCMc** to plant T_4 above 30℃, PDP = -40 to -80℃ PDP

Features

PCMc22.6J ~ 56.6J

* PCMc84.9J and larger

*** Common Inlet / outlet header and valves to be supplied by customer**

Specifications

Model	Rated Flow (Nm³ / min)	Lowest Air Temperature (℃)	Ambient Temperature (℃)	Inlet Temperature (℃)	Inlet Pressure (barG)	Power (V / PH / HZ)	kw	Connection	Weight (kg)	Dimensions (H x W x D mm)	Refrigerant
PCMc22.6J-5	22.6	10	2~45	4~50	3~16	380~415 / 3 / 50	6.1	FLG 3"	TBD	1,788 x 800 x 1,594	R-407C
PCMc35.4J-5	35.4						10.3	FLG 4"		1,788 x 1,000 x 1,672	
PCMc42.5J-5	42.5						13.4			1,788 x 1,000 x 1,672	
PCMc56.6J-5	56.6						14.2			1,788 x 1,000 x 1,842	
PCMc84.9J-5	84.9						26.8	FLG 6"		1,788 x 2,003 x 1,672	
PCMc22.6J-5R	22.6						TBD	FLG 3"		TBD	
PCMc35.4J-5R	35.4							FLG 4"			
PCMc42.5J-5R	42.5										
PCMc56.6J-5R	56.6										
PCMc84.9J-5R	84.9							FLG 6"			
PCMc127.5J-5R	127.5										
PCMc170.0J-5R	170.0							FLG 10"			
PCMc212.5J-5R	212.5										
PCMc255.0J-5R	255.0							FLG 12"			
PCMc297.5J-5R	297.5										
PCMc340.0J-5R	340.0										

1. **Rating Condition :** 50˚C inlet air temperature, 35˚C ambient air temperature, 7barG inlet pressure, 100% relative humidity
2. **Max. / Min. Inlet Air Temperature :** 50˚C / 4˚C 3. **Max. / Min. Ambient Air Temperature :** 45˚C / 2˚C
4. **Max. / Min. Inlet Pressure :** 16barG / 3barG
5. **** Models 84.9J and larger :** Modular design where Common Inlet / outlet header and valves to be supplied by customer
6. **** Models 22.6J and larger :** ANSI 150# for flange connection standard
7. ***** Models 84.9J and larger :** Common inlet/outlet air header with isolation valve is included in dimensions
8. **Suffix -5 :** for 50Hz, **-R :** for water cooled

Capacity Correction Factors

Inlet Air Pressure (barG)

barG	4	5	6	7	8	9	10	13	16
Factor	0.75	0.84	0.92	1.00	1.03	1.07	1.09	1.18	1.23

Inlet Air Temperature (˚C)

˚C	35	40	45	50	55	60	65
10℃ PDP	1.2	1.15	1.08	1.00	0.83	0.7	0.6

Ambient Air Temperature (˚C)

˚C	25	30	35	40	43	50
10℃ PDP	1.2	1.06	1.00	0.75	0.6	0.45