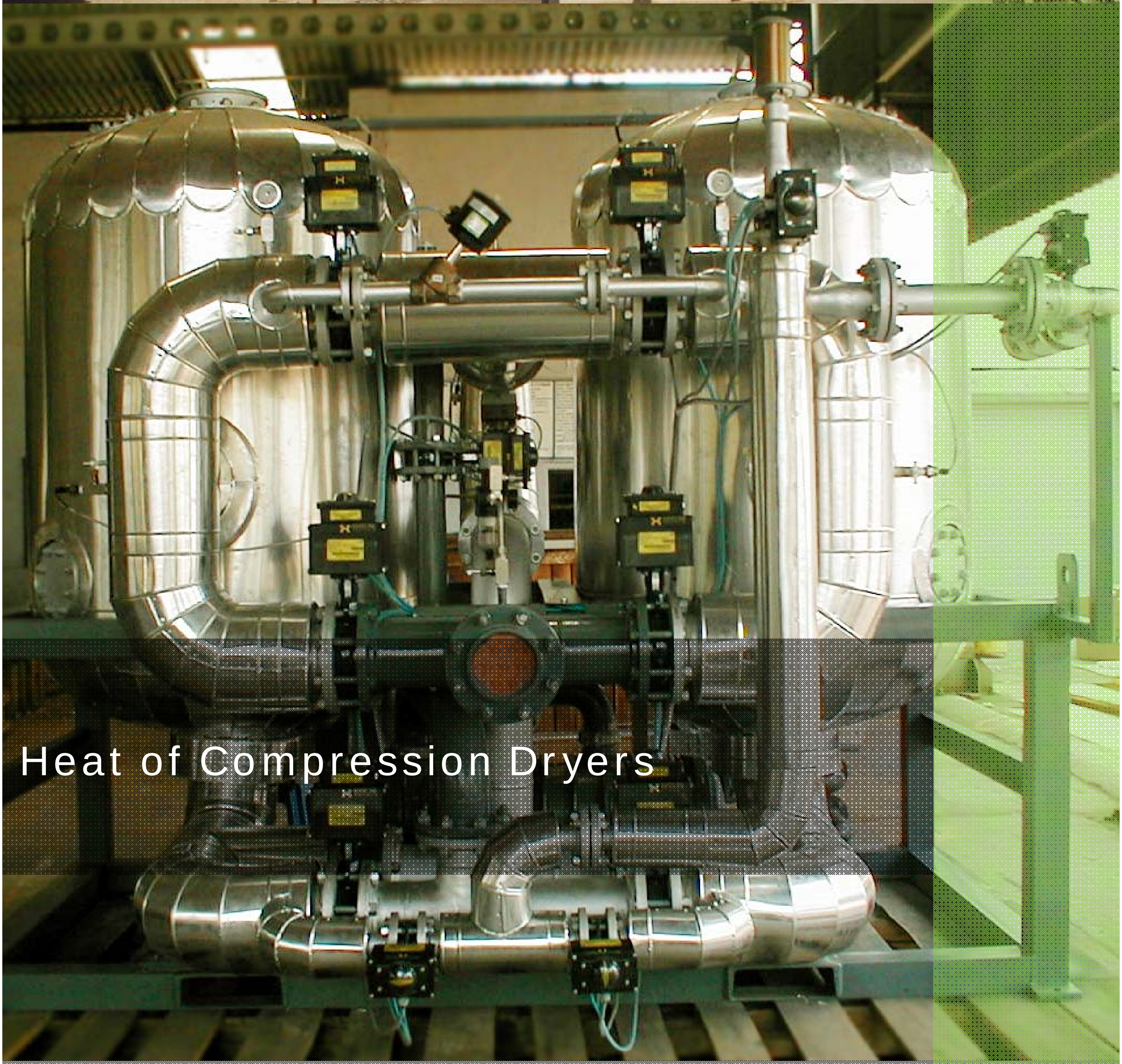
Gas Processing Equipment Pvt. Ltd.



Heat of Compression Dryers

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Gas Processing Solutions

Heat of Compression Dryers

Energy - the spiraling cost calls for in depth study on how to *save* and use the energy, instead of wasting the same. In the case of compressed air system, which is one the most expensive means of energy, this becomes more important.

Apparently, as of to-day, energy audit in compressed air system only *covers* leakage or electrical , but the main player - thermodynamics , remains unnoticed. A study of two stage Compressor will reveal excellent saving possibilities. (Applicable for more number of stages also.)

Thermodynamically, when we compress, the temperature rises as per the pressure ratio and inlet air temperature. After compression , again the air is cooled in Inter or After Cooler.so that the air temperature remains close to ambient temperature or less.

Figure a below will make it clear about how much heat is wasted in an Inter or After Cooler.

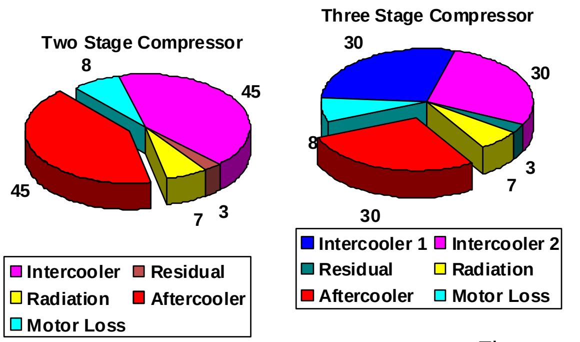


Figure-a

This means if we have a 100 kw, approximately 90 kw heat will be given away in the cooling water or air.

If we take the after cooler alone, then 45% of the input energy goes to waste. Question comes as to how to recover this energy. While planning the recovery, the foremost consideration must be given to constant usage. Lot of applications like space heating, water heating, etc., have been in existence in colder countries for many years. But an even better approach can be made by using this hot air as regeneration air for an adsorption drying system.

Quality of this air in terms of oil content and dew point becomes of prime importance , before we plan for a Heat of Compression Adsorption Dryer. Oil in the air cannot be tolerated, because of contamination, and no separation / filtration system can separate oil vapor at that temperatures normally seen at the outlet of the Compressor. Hence, Non Lubricated Compressor becomes a must.

Second factor becomes the desorption air dew point, which has to be calculated considering the whole compressor train, and knowledge of ambient condition of compressor suction, Inter Cooler/s temperature and pressure must be available with us, to size the dryer and predict the dew point.

Unlike other air dryers , this dryer depends on intercooling temperature and pressure, which determines the adsorption air dew point. Figure b Shows the various dew points attainable f rom a particular desiccant, based on compressor discharge temperature and desorption air dew point, which in turn is dependent upon intercooler temperature and pressure.

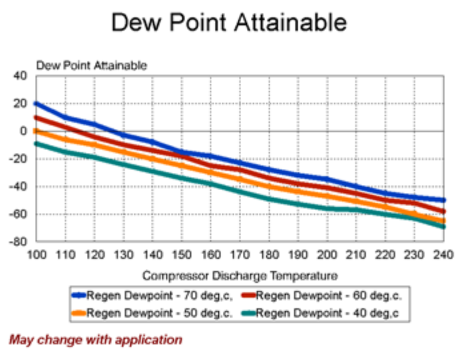


Figure -b

Hence a careful study of the stage performance of the compressor is becomes very important before deciding on the bed heating temperature.

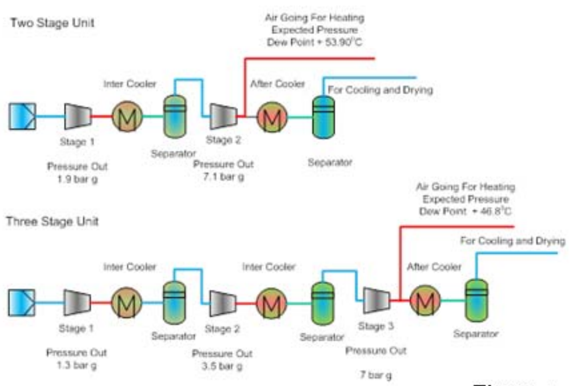
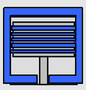
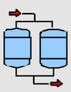
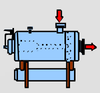


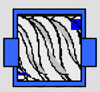
Figure-c

Choice of desiccant becomes limited due to incompatibility of some desiccants at higher desorption air dew point, and careful selection becomes a must.









Now the question comes as to what will be the required pressure dew point , or atmospheric dew point. Normal practice in the country is to take an atmospheric dew point of (-) 40°C, which corresponds to (-) 18°C pressure dew point at 9 bar.

As per Instrument Society of America (ISA) or CAGI - PNEUROP, the pressure dew point should be (-) 10°C below the lowest ambient.

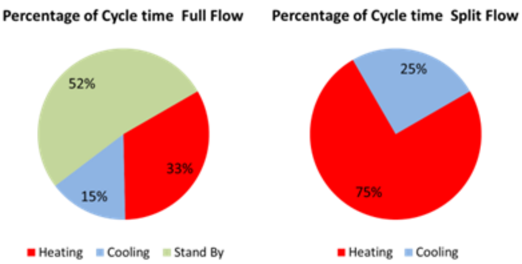
Hence in middle, South and South East Asia, where the minimum temperature never goes below 0°C, a (-) 10^{0}C PDP drying System should be more than adequate (Except cryogenic Services).

Considering the energy saving from a Heat of Compression Dryer, the above aspect requires serious consideration and the comparison given in application guide next page will make it more clear.

Operation Cycle

Hot air from the last stage discharge is fed to one of the towers (may be partially or fully depending on the design (**Full Flow or Split Flow**}, which desorbs the previously loaded bed, and the same is passed through a properly sized intermediate cooler and high efficiency separator.

In Split Flow ,to maintain the pressure balance, this circuit requires either a pre calculated orifice or, for a better control, a flow transmitter and a control valve. Here, the intermediate Cooler can be made smaller, and the unit can be less expensive, but it requires almost 75% of the cycle time for regeneration (fig. e.), where as in full flow system, it requires hardly 33 % of time which gives a stand - by time of above 50 % (fig. f).

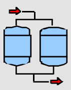


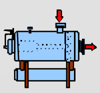
This means the unit with full flow can be operated down to 50% of the Cycle time, once the desiccant starts deteriorating, so that time between desiccant changes can be increased.

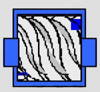
Control of this dryer has to be a perfect one, as no preset time is taken for regeneration; more over, the regeneration is dependent on compressed air demand and hence, in each cycle, the flow has to be measured and the cycle time has to be extended proportionately, in case flow required per unit time is lower than the design flow.

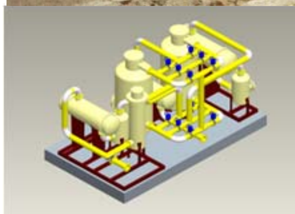
This calls for temperature based phase change over, proportionate cycle extension, utilization of stand by time to regenerate, if required. Hence, we have provided a specially developed microprocessor with mimic display, which controls the dryer automatically.

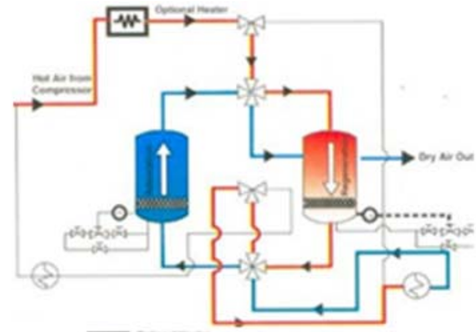
Control valves are operated by individual actuators for more reliability and easy flow of piping, and valves are used with Zero Leakage.

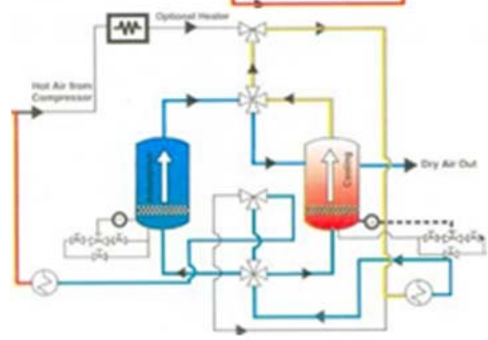


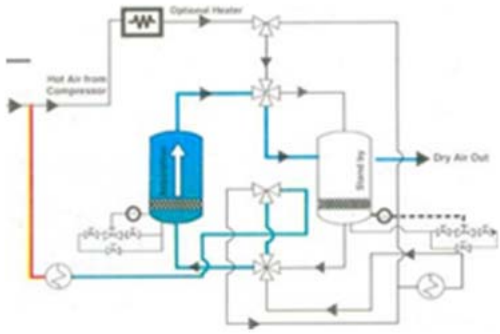












Intermediate Cooler and separators are designed for the right moisture load, which is based on compressor Intake moisture, less separated out at intercooler.

After cooler(which generally comes with compressor) can be offered as optional.

Dew point achievement depends on the regeneration temperature and regeneration air dew point. Generally, higher the regeneration air dew point, higher is the requirement for regeneration air temperature.

Application Guide of Heat of Compression Dryer with various type of Compressors

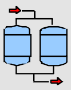
Figure - d

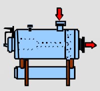
Compressor	Discharge Pressure bar g	Stages	Flow nm3/hr	Discharge Temperature for the Last Stage °C	Pressure Dew Point Possible with compression Heat °C	Pressure Dew Point Possible with Additional Heater / Chiller °C	Pressure Dew Point Possible with Additional Purge °C
Reciprocation	8	2	400 - 4000	150	(-) 15	(-) 40	(-) 70
Reciprocating	12	3	400 - 4000	150	(-) 20	(-) 40	(-) 70
Screw	10	2	400 - 6500	160	(-) 25	(-) 40	(-) 70
Centrifugal	12	3	2000-40000	140	(-) 20	(-) 40	(-) 70
Centrifugal	20	4	2000-40000	120	(-) 10	(-) 40	

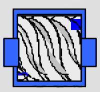
- ❑ These are based on 40°C Suction Temperature and 32°C Cooling Water Temperature with 8°C approach
- ❑ Compressor is running at full load . For Part Load , Please consult us.
- ❑ While sending an enquiry , please provide the Compressor Stage Pressure and Temperature or ask for an Enquiry Sheet.
- ❑ With our years of back ground in designing various Gas Dehydration System , we can offer you our expertise to achieve deeper dew point with different means of Regeneration Approach.

Salient Features

- Adsorption / Desorption is performed in a closed circuit hence not subjected to any decompression or pressure build-up phase.
- High efficiency separator and after filter
- Separator uses the state of the art Demister pad with 150Kg/m3 density and low velocity is maintained to achieve 99.99% separation efficiency.
- Ample volume has been provided for storage of separated water.
- Motorized valve/solenoid valves are designed properly, considering the Cv values and differential pressure, so that no over flooding takes place.(Level alarms / controls are optional)
- All the change-over valves are designed on the right flow parameters and Cv values, so that the pressure drops are not left to anybody's guess..
- Properly calculated intermediate cooler to cool the air and condense the moisture load for after cooler and desorbed water coming out, during shorter regen cycle.
- Automatic switch over with heating and cooling sensor can be provided as an optional.
- Regeneration and Adsorption are performed in counter current mode.
- Control panel is equipped with a rotary switch to shorten the drying time, to take care of desiccant deterioration in future.
- Self-Regulating Pressure Dew Point-In winter months due to Low Suction Humidity ,the drop in final discharge temperature does not effect the Dew point.
- PLC based control with MIMIC (Optional) Display for faults , with Alarm .
- Optional "Extended Time Control" which senses the loading / unloading of Compressor , and increases the tower change-over time.
- "Dew point demanded Switching" can be quoted as optional.
- Right use of adsorption and regeneration velocity based on the density of gas, desiccant, bed size so that you get the best drying result without damage to desiccant.







Our other products

- Liquid Dehydration
- Gas Screw Compressor Packages
- Gas Compression up to 400 Bar G
- Coke Oven Gas Purification
- Gas Conditioning Plants
- Methane Enrichment(Bio Gas)
- Hydrogen Enrichment(H2 PSA)
- Separation / Filtration