New system solution

More Sure and Economical Compressed Air Treatment

Increases in application of compressed air in the chemical and food industries can be clearly seen over recent years. At the same time, the demands of quality and economy of production of this energy source are also rising. In response, the manufacturer Kaeser Kompressoren has developed a comprehensive system solution (fig. 1) for sure and cost-effective air treatment.

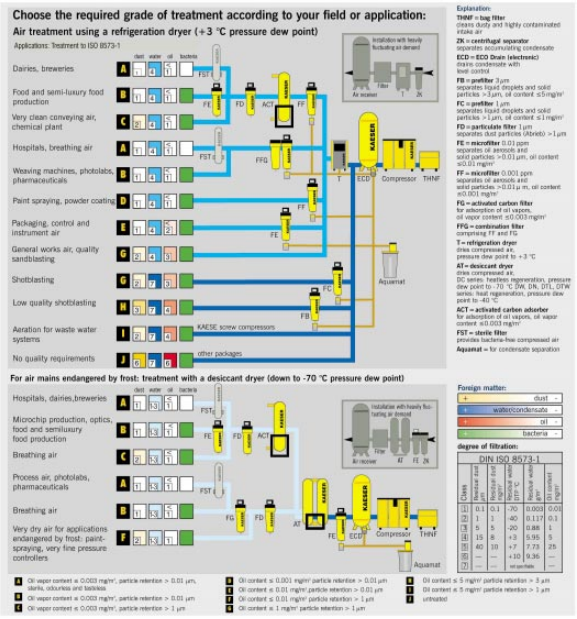

fig. 1: A modern air treatment system

The quality requirements of compressed air are as diverse as the media itself and include criteria such as availability, pressure stability, exact compliance with specified quality and, not least, economy of production. A glance into practice meanwhile shows that not a few users by no means hold step with this development; air stations often still consist of a motley collection of compressors, dryers and filters which do not really match. High energy and maintenance costs, insufficient controllability and defective monitoring, low operating security and generally poor reliability of air supply are the result.

Cleaning inlet air - the first step in air treatment

A vital component in any cost effective air treatment system is that which takes place before the air is compressed; this includes the planning and building of the compressor room itself and dealing with the air drawn into the compressor. Ambient air is contaminated, to more or lesser degree according to location and operating conditions, by water vapor, dust, rust particles, sulfur dioxide, oil and other hydrocarbons. To exclude as much of these contaminants as possible from entering the compressor various inlet filters, cooling air filter mats and even high pollution bag filters are available. Excluding contaminants at this stage not only relieves the load on subsequent devices for treating the compressed air but also contributes greatly to the reliability, maintenance costs and operating life of the compressor itself.

The compressor - the most important stage of air treatment

The function of the compressor in air treatment should not be underestimated and in applications sensitive to contamination, such as the chemical and foodstuffs industries, a fluid cooled screw compressor is to be highly recommended. The fluid used to cool and lubricate these compressors has the beneficial effect of washing impurities out of the air during compression. Furthermore, the efficient aftercoolers that they employ ensure that up to 90 percent of the moisture that the air carries is precipitated out on leaving the compressor. The compressor user should ensure that the temperature differential between that of the discharge air and that of the cooling fluid (Δ t) is less than 10°C.

Effective moisture removal

The fact that the major part of the moisture content is precipitated in the aftercoolers shows how important it is to install an effective condensate separator downstream of the compressors. Otherwise too much reliance is placed on the separator in the refrigeration dryer, which, should it fail, will allow 100 percent of the condensate through. Therefore, standard practice today is to install a condensate separator between the compressor and the dryer.

Different possibilities offer themselves here; pipework can be arranged to form a condensate trap or, if an air receiver is installed between compressor and drier, this can also be used as a condensate separator. If neither are provided, a centrifugal separator must be installed downstream of the compressor at a position as cool as possible in order to achieve maximum effectiveness.

Refrigeration drying - standard treatment with great saving potential

Eighty to ninety percent of all compressed air applications are only economical if the air is dried to the equivalent of +3° pressure dewpoint. Central air drying with a refrigeration dryer is therefore standard practice and, providing this is correctly carried out, no precipitation should occur in the air main so long as its temperature does not fall below +3°C.

Conventional refrigeration dryers run at full power continuously, consuming maximum energy, as there is no way to regulate them in accordance with fluctuating demand. The new Secotec range from Kaeser, with a cold storage mass and on/off control, realizes the full energy-saving potential of matching performance to demand without any reduction in machine capacity. The refrigerant capacity of these dryers only runs when needed and cuts out when demand falls thus saving up to 70 percent of the energy that conventional dryers consume. Generously dimensioned heat exchangers and specially designed condensate separation systems keep pressure drop over the dryer to a low 0.2 bar, a figure that is also achieved by the larger machines in the range. In the case of the larger machines, energy saving is

achieved at times when full capacity is not needed by the combined action of compressor cylinder shutdown and hot-gas bypass.

Desiccant drying - cost-effective moisture removal to very low pressure dewpoints

Desiccant dryers are employed where extreme air drying is needed to dewpoints below 0°C. These machines employ activated alumina, a desiccant renowned for its moisture adsorbing qualities and low regeneration cost.

a) Heatless regeneration

Kaeser series DC desiccant dryers of this type feature a large volume of desiccant that is regenerated by only a minimum of purge air, thus saving energy and ultimately reducing the air treatment costs. Furthermore, these dryers allow the possibility of manual adjustment to suit a variety of partial load operating conditions and so avoiding energy wastage. The “E” version of the DC range is equipped with a patented partial load controller and monitoring devices on the inlet and outlet filters that exactly determine the most economical moment to change filter elements.

b) Systems for producing pure and breathing-quality air

The special series DA, for high air purity, consists of the DC-E heatless regeneration desiccant dryer, as previously described, with the addition of an activated carbon adsorber and a monitoring system to guarantee air quality. Breathing quality air is produced by the DFH series by means of an additional stage to remove CO and CO_2.

From the handy mobile device for site application up to stationary plant for application in an breathing air production installation, all treatment systems are adjustable to suit the available compressors.

c) Heat regenerated desiccant dryer

These dryers can be further classified as internal or external types according to weather the heat for regeneration is produced within the machine or comes from an external source. The series DW is clad with Armaflex thermal insulation to prevent the loss of heat. In the interest of environment and energy conservation all such dryers should be efficiently insulated. Thanks to optimum flow control the DW machine needs only two percent of the already dried air to cool the desiccant bed prior to restarting the adsorption phase.

The DN series, on the other hand, requires none of the already dried air for this purpose, thanks to a special cooling process. Additional thermal insulation using mineral wool protected by galvanized steel sheet further reduces energy consumption. The standard control system, based on a Siemens S7 PLC, shuts the machine down to save energy when its capacity is not needed. Alternatively, a partial load controller can be provided to match a widely fluctuating demand.

d) Combined dryer system

Where large volumes of very dry air are needed the combined dryer system is to be recommended. Two stages of drying are combined in a single cost effective package with a refrigeration dryer removing most of the moisture from the air which then passes through a desiccant drying stage before being warmed to near ambient by the refrigeration dryers heat exchanger, emerging from the system with a pressure dewpoint of around -70°C. **(fig. 2)** If pure air is needed an activated carbon adsorber can be connected to the combined system outlet to remove all traces of oil aerosol and hydrocarbons. If the air’s dewpoint need not be so low, in summer season for example, the desiccant drying section can be bypassed.

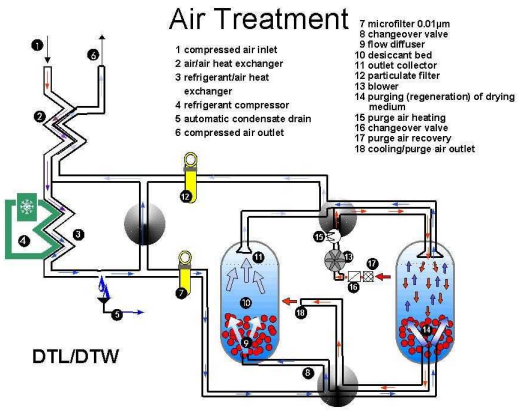

fig 2: Flow diagram of a combination dryer system

Low desorption temperature extends the desiccant life to over 20,000 hours to bring savings in maintenance costs.

Membrane drying - an economic method for specific applications

Kaeser membrane dryers are intended for treating fairly low volumes of air where a constant pressure dewpoint is not demanded or for further local drying of air supplied by a central refrigeration dryer. Their advantage lies in that they have no valves or moving parts and require no additional air for purging. A small portion of the air passing through the device diffuses through the membrane with the water molecules carrying them away. They provide a reliable means of air drying without the need for an external energy source.

Filtration - the final and highest treatment level

Even the most effective drying process cannot replace filters which are essential for the higher classes or air quality. Modern filters are normally quite effective but their economical life is often too short, frequently because they are used in a central treatment system while being actually designed for local filtration only.

Here too Kaeser is breaking new ground with a comprehensive and carefully selected range of seven different filter elements having retention grades down to 0.001 ppm of aerosols and particles. The filter range is complemented by a series of generously dimensioned activated carbon adsorbers for removing hydrocarbons. By careful design of proportion and flow control the adsorption capability has been increased by a factor of four.

The standard filter range is extended by the so-called “E class” **(fig. 3)** that feature a monitoring device and an automatic drain, known as ECO DRAIN, for removing trapped residues. The environment is protected and economy of operation too as the filter monitor not only registers pressure drop but also balances operating conditions and service life to signal the most cost-effective moment to replace the filter element.

fig. 3: FG-E series combination filters with filter monitor and Eco-Drain fitted as standard

Protecting air treatment plant

Included, naturally, in a comprehensive program of air treatment plant is the means of protecting the equipment. Kaeser’s air main charging valve, for instance, protects against overloading when starting up after a shutdown during which the air in the main has been vented or leaked away. This device is available for all compressor capacities and can be retrofitted to existing air stations. Sure drainage of accumulated condensate is also an important protective measure and this is ensured by a series of electronic level-sensing devices.

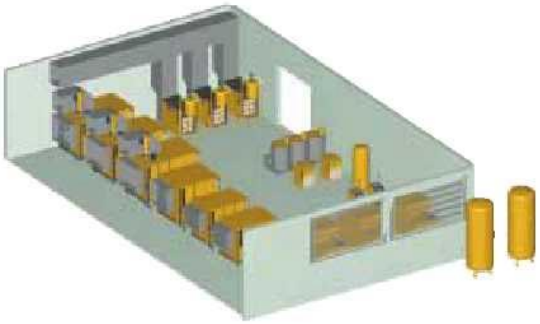

fig. 4a: 3-D representation of a compressed air station in the planning phase showing screw compressors (left and center right), screw vacuum packages (upper right), dryers (front, partially obscured) and condensate treatment plant (center right).

In conclusion it can be seen from the foregoing examples that Kaeser has developed a well considered and comprehensive air treatment system with the emphasis on availability, economy and reliability. Lower pressure drop and self-monitoring ensure cost-effective production of compressed air to any required quality class and operating conditions. A total solution is available to perfectly match and compliment any air generating plant and control system **(fig. 4a/b)** to show up to 30 percent savings in operating costs.

fig. 4b: View of the completed air station (left part of the 3-D representation)

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