Drying Compressed Air In Hazardous Atmospheres

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding

Parker Balston

ENGINEERING YOUR SUCCESS.

Drying Compressed Air in Hazardous Atmospheres

David J. Connaughton, Product Manager
Parker Hannifin Corporation
Filtration and Separation Division
Haverhill, Massachusetts

In many industries, the atmosphere, though safe to breath, may be unsafe for an electrical spark. These areas often have pneumatically operated equipment for safety. And that equipment needs a source of clean dry air or as it is called in the industry, Instrument Grade Air. Plants typically have a centralized instrument grade air line that delivers air to the instruments that need it. However, oftentimes the instrument grade air is of inferior quality and contaminated with water. This air will benefit from a point of use drying system that guarantees instrument grade air. Traditional drying systems using PSA (Pressure Swing Adsorption) or refrigerant require expensive modifications to operate within hazardous areas. Air dryers made from hollow fiber membranes can dry compressed air without the use of electricity and are therefore safe for hazardous environments.

Hazardous locations have or could potentially have high concentrations of flammable gases, vapors, combustible dusts or ignitable fibers and flyings. Refineries, chemical processing plants, mines and grain mills are examples of industries with hazardous atmospheres. Even a small spark can lead to a horrific explosion dangerous to equipment and workers in the area.

The National Electric Code (NEC) goes into great detail to discuss hazardous location types. According to the NEC there are three types of hazardous areas. The first type is called Class I. Class I areas are areas where there may be flammable gases or vapors present at a concentration that would be explosive or ignitable. Here are some examples of Class I locations:

- Refineries
- Gas Storage and dispensing areas
- Dry cleaning plants
- Spray finishing areas
- Aircraft hangars and fuel servicing areas
- Utility gas plants
- Sites that store or handle LPG or natural gas

Areas where there are combustible dusts are called Class II by the NEC. Fine dusts, due to their large surface area, when suspended in air can cause as strong an explosion as one occurring at a refinery. Here are some examples of Class II locations:

- Flour mills
- Feed mills
- Grain elevators
- Plastic manufacturers
- Starch and candy producers
- Fireworks factories
- Spice, sugar and cocoa factories
- Coal and other carbon handling sites

The last category includes areas where there are easily combustible fibers or flyings present. These are called Class III. These fibers may not be suspended in the air, but rather can collect around equipment or light fixtures where they can be exposed to heat, hot metal or a spark to cause fire but are probably not explosive. Some Class III sites include:

- Textile and cotton mills
- Wood processing facilities
- Any processing sites that generate wood or combustible fibers

In addition, the NEC specifies the type of condition that the hazards can be present. The hazards may be present normally or abnormally. Normal conditions are called “Division 1” and abnormal are called “Division 2”.

Further classification addresses the nature of the hazardous substances. These are called “Groups” and are a function of the ignition temperature, explosive pressure.

Group A is acetylene. Acetylene has extremely high explosive pressure and is the only material in this group.

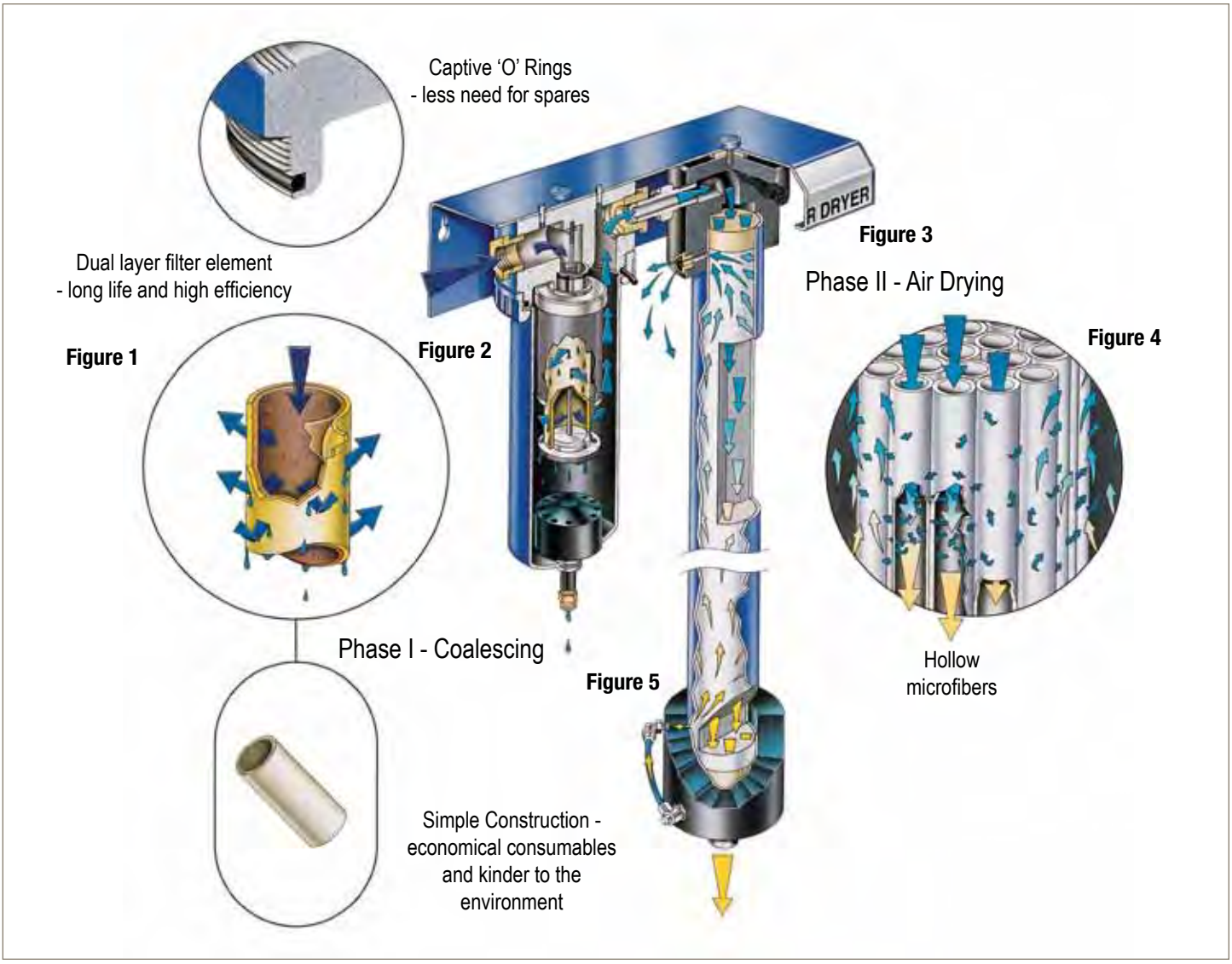
Group B contains hydrogen and a few other materials.

Group C contains ether and Group D contains most hydrocarbons, fuels and solvents.

Dusts have their own groups starting with metal dusts as part of group E. Group F are carbon, coal and other dusts and Group G which contain flours, starches, grains and other explosive dusts.

Equipment located in hazardous areas must be specifically designed to prevent ignition and explosion. Electrical enclosures that are found on traditional compressed air drying equipment like PSA and refrigerated dryers must be strong enough to contain an explosion within the cabinet. Therefore the walls must be very thick and heavy. The internals in the cabinet must operate at temperatures below the ignition temperature of the hazardous material. Lastly, the cabinet must be designed such that any ignition inside the cabinet would not immediately exit the cabinet but rather the ignited gases would need to be quenched so that the escaping gases don’t cause an explosion outside the cabinet. The added weight and heavy duty design increase the cost and size of traditional compressed air drying equipment. Fortunately there is an alternative.

Membrane air dryers, on the other hand, do not use electricity and are safe for any hazardous location whether it is Class I, Class II or Class III. Membrane air dryers have been commercially available for at least 20 years and have proven themselves in many hazardous locations. Prior to entering the membrane drying module, compressed air passes through a high efficiency coalescing filter to remove oil and water droplets and particulate contamination with an efficiency of 99.99%, The liquids are removed by the filter cartridge. They continuously drain from the filter cartridge to the bottom of the housing, where they are automatically emptied by the autodrain assembly (see figure 1 and figure 2). The air leaving the prefilter,



Membrane Air Dryer - Principal of Operation

therefore, is laden only with water vapor, which is then removed by the membrane module. The membrane module contains bundles of hollow fiber membranes that permeate only water vapor through the wall of the membrane. No oxygen, nitrogen or any other component of air permeates the membrane. Water on the outside surface of the membrane is evaporated by a sweep of low pressure dry air. (See figure 3 and figure 4). The driving force that pushes the water vapor through the wall of the membrane is the difference in partial pressure of water inside the hollow fiber (high) to the partial pressure on the outside of the fiber wall. Therefore, drying of the compressed air is accomplished without the use of electricity.

For a given cubic foot capacity, membrane air dryers are lightweight and small. This is another advantage as space is at a premium in most industrial sites.

Membrane air dryers are also exempt from ATEX certification as they do not have enough energy to cause and ignition and the air movement is unlikely to produce static electric charges.

Drying compressed air at point of use is always a challenge. In the industries that have hazardous areas, selecting the safest, smallest and most cost effective dryer is critical. Based on cost, size, and safety, membrane air dryers are clearly the best choice.

Parker Hannifin Corporation
Filtration and Separation Division
242 Neck Road
Haverhill, MA 01835
1-800-343-4048, 1-978-858-0505
1-978-478-2501 (fax)
www.parker.com/balston