Design and Sizing of Compressed Air Dryers

An Online Continuing Education Course for Engineers

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Design and Sizing of Compressed Air Dryers

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Water is a challenge in every air compressor system. As air is compressed, water is brought into the air stream. During cooling, that water condenses and is mixed with the compressed air that's delivered to your tool or application. Some water is okay for most applications, but too much water can be a problem. If this moisture is not properly removed, it may cause major problems with downstream compressed air equipment and manufactured products it comes into contact with. Your compressed air system can lose efficiency and require dramatically increased maintenance, which can result in costly downtime. That's where air-drying comes in.

A compressed air dryer is a device for removing water vapor from an air system by lowering the dew point. The lower you drive the compressed air dew point, the drier the air will be, but it will increase both the capital and operating costs. Therefore, the important thing to note is that you should dry compressed air only to the extent required by the application.

In this course, you will learn why and how the compressed air should be dried to meet specific needs. The course will be useful to chemical and mechanical design and consulting engineers, production engineers, O&M engineers, plant managers, facility engineers, energy auditors, safety, and loss prevention engineers.

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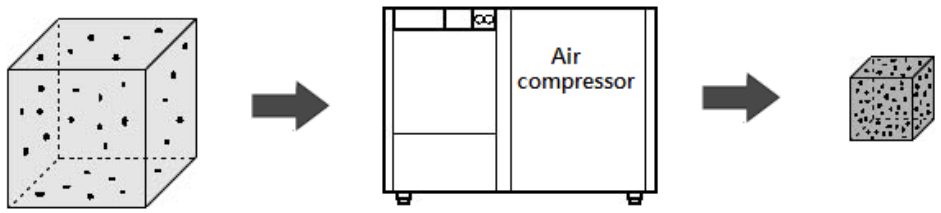
Chapter 1: Compressed Air Systems

Compressed air is considered a versatile energy source for reliable operations of modern equipment and processes. The many conditions in which it is used range from untreated blowing air to absolutely dry, oil-free, and sterile compressed air.

The quality of compressed air is very important. Compressors draw in atmospheric air, including the water vapor and impurities contained in the air, and concentrate them many times. For example, the air compressor sucks in approximately 7 cubic feet of atmospheric air at 0 psig (14.7 psia) and compresses it into 1 cubic foot of air at 100 psig. The water vapor and impurities that were in 7 cubic feet of atmospheric air now get concentrated into 1 cubic foot of compressed air.



Concentration of Impurities in the air during compression

These impurities in the compressed air system can seriously impede the process operations and have an adverse effect on the final quality of products.

1.1 Quality of Compressed Air

The quality of compressed air is determined primarily by measuring three contaminants: Dust, oil, and water vapor.

1.1.1. Dust in Compressed Air

Dust and other particles cause scuff. These particulates usually come from the air that is sucked in by the compressor. The best thing you can do is to install proper, quality air inlet filters on the suction side of your compressor and also in the compressed air line near the end consumers (machines, tools, etc.).

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1.1.2. Oil in Compressed Air

Oil usually comes from the compressor itself. To get oil-free air:

a. Make sure oil will never enter the compressed air in the first place.
b. Filter out all the oil from the air before it leaves the compressor room, or before it enters the equipment that requires oil-free air.

The first option is the safest one and produces the cleanest air. Not surprisingly, it's also the costliest one, as it requires an oil-free compressor. The oil-free compressor is always more expensive than oil-lubricated compressors, and the maintenance costs will often be higher.

The second option is a good alternative for non-critical applications. There are special oil filters that will filter out most oil from the air.

1.1.3. Water in Compressed Air

Having water in your compressed air is never a good thing for many applications. The presence of water will lead to the formation of rust and scale in the air piping system, machinery, and end devices. It can cause numerous problems in the operation of pneumatic tools, spray guns, control valves, actuators, and other air drives. The nozzles and orifices can get clogged, and pneumatic instruments may give false readings, interrupting or shutting down plant processes. The quality of the final products may get affected by too much moisture. For example:

- Bubbles occur during varnishing and paint spraying
- With pneumatic conveyance, the hygroscopic products, such as food powders, spices, sugar, and plastics, can stick and agglomerate during transportation
- In the food and pharmaceutical industry, the final product quality can get contaminated

The overall effect of unchecked moisture accumulation is increased spending on repairs and loss of valuable revenue from avoidable downtime.

The water vapor comes from the surrounding air sucked in by the compressor. When the air is compressed, it cannot hold all of the vapors, and these get precipitated and trapped during the compression process. The first step to eliminate the bulk of liquid water condensate is installing

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an after-cooler, a filter, and a separator. The second step is to eliminate the water vapor in an air dryer downstream of the compressor and after-cooler.

The amount of water vapor present in the air is very often expressed in terms of dew point temperature. The higher the dew point, the higher the water vapor in the air. The purpose of an air-dryer is to lower the dew point of the air.

1.2 Air-Dryers

A compressed air-dryer is a device that removes water vapor from an air system. Note that the dryer does not remove liquid water. That's the role of after-coolers, liquid separators, and coalescing filters upstream of a dryer. A dryer is intended to find and remove water vapor by lowering the dew point. The lower you drive the compressed air dew point, the drier the air will be, but it will be excessively expensive and would increase o nal costs. Therefore, you should dry compressed air only to i ation.

In this course, we v nd the use of air dryers.

1.3 The ISO Qua

In the world of comp ernational Standards Organization, ISO 85 s of air quality:

a. Dust or solid p r concentration
b. Oil content as
c. Water vapor cc e dew point temperature

Each category is given a to the reference values shown in the tab

To view the remainder of the course material and to take the quiz for PDH credit, you must purchase the course.

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