

Improve Pneumatics Performance Through Filtration System Design

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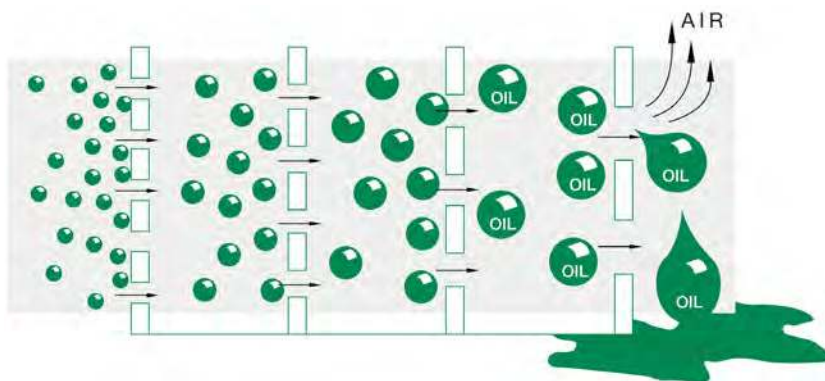
Introduction

In an ideal world, industrial air or gas supply lines would be free of particulate, water, oil and other contaminants. In the real world, however, supply lines typically deliver some contaminants along with the air or gas they were designed to carry. Left unchecked, these contaminants will cause efficiency losses, maintenance headaches and the premature failure of pneumatic components.

Cleaning up an air or gas supply can be as easy as installing a filtration system. These systems employ one or more filters to remove contaminants before they reach the pneumatic equipment. What's not so easy is selecting the right type of filtration system for a particular application.

In part, the difficulty comes from the different filtration requirements across industries. Food and beverage, semiconductor and automotive plants, for example, all have different filtration needs based on their specific pneumatic systems and operating environments.

And in part, the difficulty in choosing the right filtration approach involves differences in the filters themselves. Not all filtration technologies are created equal in terms of their intrinsic performance characteristics and suitability to a given application. Choosing the



wrong filter or applying it incorrectly can actually do greater harm than good.

Air flows from the inside to the outside of the Numatics filter element through progressively larger openings in the media. As contaminants move through the element, solid particles are trapped, and liquids are formed into large droplets. As the air exits the element, surface tension holds the liquids and allows them to drain to the bottom.



To tailor filtration systems to the job at hand, it's important to understand not only the capabilities of different filter elements but also how to combine them in series.

Filter Types

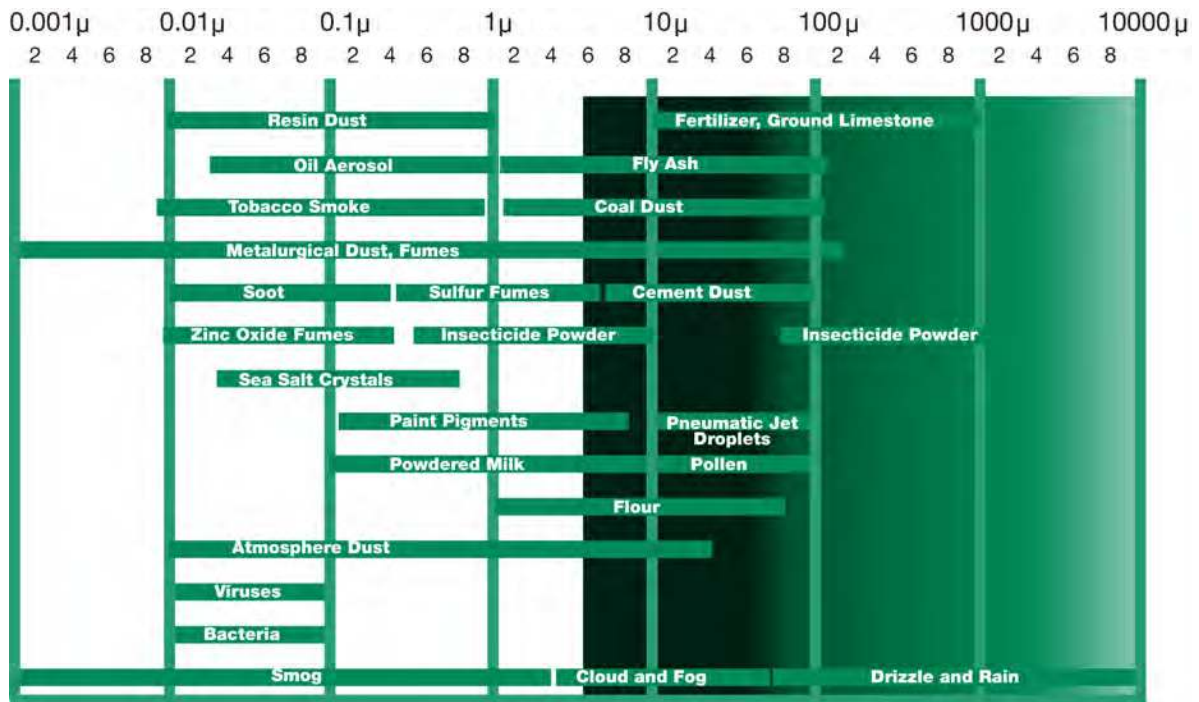
Effective air filtration starts with an understanding of the different types of filter media and what they can do. The most common types used in industrial settings include:

- **Water Separators.** Water or moisture can quickly damage pneumatic components, causing valves and cylinders to stick. Water separators use the centrifugal forces generated by an internal spinning mechanism to remove large quantities of water and water-borne contaminants. While typically used to remove bulk liquids and large water-borne solids, water separators also protect other filter elements from large liquid loads that could shorten filter life.
- **Particulate Filters.** Large particles such as rust, debris and desiccant dust can wear out pneumatic components prematurely. These contaminants are often generated by old carbon steel pipes, compressor intakes and desiccant air dryers. The best particulate filters feature pleated designs to maximize the surface area available to trap dirt particles. Particulate filters are often used to achieve up to a 3-micron particle removal in dry systems.
- **Coalescing Filters** are the next line of defense in an air filtration system and can do a good job removing water, oil, rust and other contaminants from the air supply. The design of coalescing filters differs from manufacturer to manufacturer. The Numatics Delta Series coalescing filter elements, for example, consist of a porous network of borosilicate glass fibers. As air moves through the filter element, solid particles are trapped and liquids are formed into droplets that drain away. Coalescing filters come in different grades. Coarse coalescers are often used for mainline plant filtration, while fine coalescers are used for applications such as paint spraying, robotics and pneumatic tools. The ultra fine coalescer is mainly a point-of-use filter specified for critical processes such as semiconductor packaging and instrumentation.
- **Adsorbing Filters.** As a final step in certain applications, an adsorbing filter may be added to remove oil and hydrocarbon vapor from the compressed air stream. This type of filter is used immediately downstream from a coalescing element. Because optimum adsorption





Typical Contaminant Size in Microns (μm)



takes place at lower temperatures, it's best to install the filter as close to the point-of-use as possible. Adsorbing filters are often used for breathing air preparation as well as food and drug applications that have direct product contact with exhaust air.

Filter Design and Construction

While these common filter types are sometimes referred to generically, keep in mind that there are substantial quality and performance differences between filters from different sources—even if they have the same nominal filtration specification. These differences often boil down to design and manufacturing methods.

Consider coalescing filters as a prime example of why design and manufacturing matters. Commodity coalescing elements typically employ a mechanically wound filter media. Numatics Delta Series coalescing filters, by contrast, employ a vacuum formed filter media composed of glass fibers and an epoxy binder.

This manufacturing difference is not trivial. The vacuum formed design traps contaminants through the entire cross section of the filter. The result is a lower pressure drop and more capacity than a comparable wrapped filter that traps contaminants



primarily on the surface and quickly clogs as a result. Our filters have an initial pressure drop of just 1.5 psi in a dry condition at rated flow, far lower than a typical wrapped filter.

Vacuum forming also allows the customization of filter element recipes to achieve desired filtration levels. Our engineers can tweak the vacuum forming process to an extensive range of gradient densities to form coalescing elements ranging from .01 micron to 1 micron.

Construction differences apply to other filter types too. The Delta Series adsorbing filters, for example, consist of fine activated charcoal impregnated on polyester. These activated carbon particles have a strong affinity to vapor and are highly efficient due to the extensive surface area present.

Effective Filter Combinations

Most filtration systems require multiple filter elements, working together to remove the full spectrum of particulate sizes and compositions capable of harming down stream components. The specific combination, or series, of filters will vary depending on the application's air quality requirements.

Food and beverage or semiconductor applications, for example, may require three different filters, including ones capable of removing sub-micron particles. Others such as main line plant filtration may require just a coarse particulate filter. Here are a few examples of filter combinations used in various applications:

- Blow molding — 3-micron particulate filter; 0.01-micron fine coalescer; vapor adsorber.
- Electronics — 3-micron particulate filter; 1-micron coarse coalescer; 0.01-micron ultra fine coalescer.
- Food packaging — 3-micron particulate filter; 0.01-micron fine coalescer; vapor adsorber.

Numatics Delta Details

Numatics Delta Series premium filters are ideal for any application requiring high flows, including industrial, process, medical and compressor applications. All filter types are available in ¼-in. to 3-in. port sizes and are certified to the ISO 8573 compressed air quality standard. Anodized aluminum end caps, a premium manual drain, high-temperature fluoroelastomer (FKM) seals and an optional 2- stage coalescing and 3-micron pre-filter combination guarantees optimum air preparation in these applications and many others:

- Automotive Manufacturing
- Food & Beverage Processing
- General Industrial
- Oil & Gas
- Process Control
- Paint Spraying
- Packaging
- Medical & Pharmaceutical Processing



INDUSTRY SPOTLIGHT: Proper Filtration Solves Moldy Bread Dilemma

Food and beverage processing requires compressed air filtration to protect not just the pneumatics but also the product. Recently a large commercial baker discovered that air filtration is an important ingredient in its bread making operation.

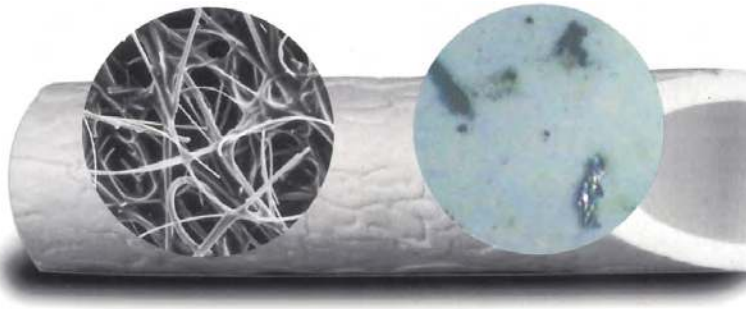
When trying to reduce unacceptable mold levels in the compressed air lines at the plant, the baker's process engineers discovered that the compressed air used to inflate bread bags and blow away the grains after the slicing process was also injecting mold spores drawn in by the compressor. A 5-micron filter had been installed on the air supply, but this level of filtration does not stop mold spores.

To solve the problem, a series of three filters were added to the compressed air supply — a particulate filter to remove water and large particles, a 0.01-micron coalescing filter to eliminate the spores and other ultra fine particulate and a vapor adsorbing filter to remove any oil or hydrocarbon vapor.

After adding these filters, lab tests confirmed that the mold spore count has been significantly reduced, extending the bread's shelf life. This three-filter solution is now being evaluated as a standard for all machines across the company's global baking facilities.

- Pneumatic control systems — 3-micron particulate filter; 0.01-micron fine coalescer.
- Process air — 1-micron coarse coalescer; 0.01-micron fine coalescer; vapor adsorber.
- Semiconductor packaging. 3-micron particulate filter; 0.01-micron fine coalescer; vapor adsorber.

Bear in mind that combinations of filters do not always require separate products. In some cases, different filter elements can be combined saving space and simplifying the ordering process. Numatics Delta Series coalescing filters, for instance, have a pleated 3-micron pre-filter available as an option, which can eliminate the need for a separate coarse particulate filter. This two-in-one approach saves both space and money because the pre-filter can share the same housing with the coalescing filter.



Delta Series coalescing filters consist of a porous network of borosilicate glass fibers that trap solids while allowing liquids to pass through. The magnified views show how effective the filters are at trapping contaminants. At left, a 228x magnification shows a new 0.01-micron Numatics filter element. At right, a 40x magnification shows a filter element that has trapped various metal, oil and hydrocarbon contaminants.

Filtration Is Part Of A System

Too many machine builders and installers fail to consider air filtration. Or if they do, it's just an afterthought. Filtration's biggest benefits, however, come when the air filter and pneumatic components work together as a system. Only then will the filter offer the maximum protection against contaminants while preserving pneumatic efficiency.

Matching the filtration technologies with specific pneumatic system can be daunting. So it's helpful to seek out an experienced filtration supplier who can help strike the right balance between air quality and pneumatic system performance.

For more information, call Numatics Inc. at (888) 686-2842 or visit us online at www.numatics.com.

Numatics Knows Air Preparation

At ASCO Numatics, experienced customer service and technical support experts provide a comprehensive range of fluid control and fluid power solutions, from valves and cylinders to air filtration to actuation. When choosing a partner for your air preparation needs, it pays to consider what each supplier has to offer. Within our Numatics division, Delta Series premium filters feature these benefits:

- Competitive pricing
- Superior product reliability
- On-time delivery
- Excellent quality control
- ISO 8573 certified filters
- Industry-leading response times
- Fast, easy access to technical experts
- Made in the U.S.A. craftsmanship



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