# Filter Selection Guide

So far we have discussed the basic questions concerning filtration and how to determine a customer's needs. Now we turn to what are the types of products available to us to meet those needs. We shall also look at how these products do the job they do, so as to better understand how they can be used in a variety of ways.

## Bag Filters

Bag filters can be as simple as the paper bag filter your mother puts in her vacuum cleaner or as complicated as a multilayer pleated polypropylene felt bag used to filter an acid solution. The filter bags used in most process lines resemble an oversized tube sock. They function as a barrier or dam to the particulates in the liquid or gas stream, capturing the "dirt" on their surface. In so doing, the bag builds up a layer of contaminant called a cake. As the cake builds up the filtering efficiency generally increases but at the cost of an increase in the differential pressure across the filter and subsequent decrease in flow. The available filtration levels for bag filters range from 1000 micron to 1 micron with submicron levels achieved in some cases by using membrane media in their construction. Media types used in common bag construction include polyester felt, polypropylene felt, nylon felt and mesh, cotton duck fabric and a type of Teflon called Gore-Tex.

Bag filters have an advantage over many other types of filters in that they generally can handle very high flow rates at very little cost per bag. This aspect, combined with the variety of materials that the bag can be made from, makes bag filters a very popular and inexpensive solution to many filter needs.

## Cartridge Filters

Cartridge filters are familiar to anyone who has a water filter installed under the kitchen sink. The idea with a filter cartridge is to maximize the surface area of a particular filter media within a given housing size. Cartridge filters lend themselves to a greater degree of options for an almost infinite number of filtration problems. Cartridge filters are made in a variety of shapes and materials of construction. The types of media used range from cotton yarn and resin treated paper to sintered metals and Teflon membranes.

In many cartridge filter applications there is usually a choice between using a surface filter or a depth filter. Some cartridges have a construction that gradually increases in density toward the center of the filter element. These are depth-type filters and they capture the fluid particulates throughout the entire thickness of the medium. Surface filters, by contrast, capture particles on or near the surface of the media. Typically the media is thin and, in many instances, pleated so as to maximize the exposed surface area to increase dirt holding capacity and available flow throughput.
The filtration range of cartridge filters can vary from 500 micron to 0.1 micron or less, depending on the type of media used and the process conditions.

## Membrane Filters

Membranes are perhaps the fastest growing area of technology insofar as filtration is concerned today. Membrane filters are typically made by taking a fairly thin film of a plastic-like material and producing pores of a specific, controlled size by means of chemical etching, atomic bombardment, or photo-etching. The media used to create the membrane can be a polymer, inorganic, organic, or metal. The membrane can be permeable or semi-permeable. Because the pore size is strictly controlled, absolute micron filtration levels can be easily achieved. Membranes are normally used only when the process calls for true-micro-filtration, typically in the range of 1 micron or less. The common construction types seen using membranes are cartridge and disc filters and, to a lesser extent, bag filters. Membrane filters have a high clean pressure drop, high cost per element, and low dirt capacity when compared to other filter types. Because of these disadvantages, it is normal to insure that the fluid being filtered has a good degree of pre-filtration ahead of the membrane.

## Strainers

Strainers were the first filters made by man. Man used, and still uses, fish nets to "filter" fish from the sea. Strainers are a surface filter of the macro-filtration variety where coarse contaminants are removed from the process stream before the finer filters downstream. Like membrane filters the strainer's hole sizes, or pores, can be strictly controlled by the type of construction process used. These processes range from punching out holes with a die stamp on a thin sheet of metal to precise, controlled weaving of thin strands of wire to create a mesh cloth.

Strainers are normally designed to be permanent, cleanable filtration equipment that can in many cases outlast the factory they are installed in. Materials used in construction range from carbon steel and 316L stainless steel to polypropylene, bronze and monel. The common configurations seen are single basket or simplex type, dual basket or

duplex type and "Y" type strainers. Simplex strainers have a single basket shaped element in them that can be removed for cleaning. They are suitable for high flow and large dirt load conditions such as debris collection in pipelines and on the suction and discharge sides of pumps. They do have a disadvantage in that the fluid flow must be stopped and the pressure relieved from the strainer housing before the strainer basket can be removed for cleaning. Duplex strainers have two strainer baskets in their single housing, separated by a diverter valve that allows flow through one basket at a time. In this way, the operator can open one side of the strainer to clean a dirt-loaded basket while maintaining fluid flow through the other basket and avoiding shutdown of the process line. "Y" type strainers have a cylindrical strainer element retained by a plug which can be plain or fitted with a valve that can be opened while under pressure to permit "blow through" cleaning. "Y" strainers get their name from the overall shape of the housing, which resembles the letter "Y". Strainers are typically used in applications of 35 microns and higher with high flow conditions, Le. greater than 5 gpm.

## Coalescing Filters

Coalescing filters are the primary means most industrial filter end-users employ to remove or separate one particular fluid from another. The two most common applications are the removal of water from a hydrocarbon product and the removal of water or oil from a gas or air stream. The primary means to accomplish this requirement are Inertial Impaction, Interception, and Gravitational. These techniques are used in both liquid-liquid separation and liquid-gas separation. With Interception the fluid is subjected to multiple changes in direction through a fibrous layer of a filter medium causing the fine droplets of the contaminant liquid to impact upon a surface where it will be further impacted upon by more fine droplets, creating larger droplets. As these ever enlarging drops work their way through the media gravity will begin to act on them, pulling them downward toward the bottom of the element and eventually to the bottom of the filter housing where the contaminant liquid can be drained off. Inertial Impaction also uses multiple changes in flow direction to allow the contaminant liquid to come in contact with a surface where coalescence can take place. Different mechanisms are used to create or use the inherent inertia of the fluid to promote coalescence such as louvers and waveform separators. Gravitational separation is normally used where there is a significant difference in the specific gravity of the two liquids and makes use of lowering the fluid velocity to the point where the two dissimilar fluids will separate of their own accord in a quiescent zone.

Most coalescing filters that we shall be involved with are of the Interception variety and entail the use of a fiberglass media of one sort or the other. The level of filtration achievable with respect to liquid droplet size can be as small as 0.1 micron at an efficiency of 99.999%. At this level a particulate filtration level of 0.01 micron is also produced.

## Dust Collection Filters

The Equipment may use a bag filter or a cartridge style filter element. The purpose of a dust collector in an industrial setting is to remove dust and potentially harmful airborne particulates from a work area or the environment and collect it in a centralized container for easy disposal. Sizing a dust collector is an involved process. It is necessary to know not only the type of dust that is to be collected but also the type of equipment creating the dust. Knowing the type of equipment tells the dust collector manufacturer how much dust of a particular size, shape, and volume is created in the course of production. Additionally, it is important to know how many pieces of equipment the customer wants to tie into the collector and if they will all be running at the same time. In the process of defining a dust collector for an application it will also be necessary to size the duct work and the number and type of collection hoods or pickup connectors for the system to be effective. Every plant is different and what works well for a cabinet shop generally does not do well for a metal fabrication shop.

**AIR INTAKE Filters**, like dust collector systems, are closely coupled to the equipment that they protect. Not only is it important to choose the right filter media for the application, but it is critically important that the filter be sized with the optimum amount of media to permit adequate air flow to enter the system even when the filter is loaded with dirt and has reached the change-out differential pressure. Air intake filters come in all sorts of sizes and shapes, ranging from cylindrical to box shaped. Most general usage filters make use of cellulose or polyester media. Other, more critical intake filters can make use of micro-fiber glass media or even Gore-Tex. Filtration ranges run the gamut from 100 micron to 0.3 micron. Many air intake filter manufacturers also make various styles of housings to hold their filter elements. By paying close attention to the pressure drop across the filter at a given air flow intake it is generally an easy exercise to find the right filter assembly for the job.

We have tried to provide the reader with a very basic understanding of filtration and the various types of filters that will be encountered. Waco can provide the technical expertise and resources to select and size the most cost-effective solution for your filter need. Call your nearest branch or fax us the application fact finder found in this catalogue to initiate the process of solving your separation problem today.