Filter Paper for Industrial Filtration

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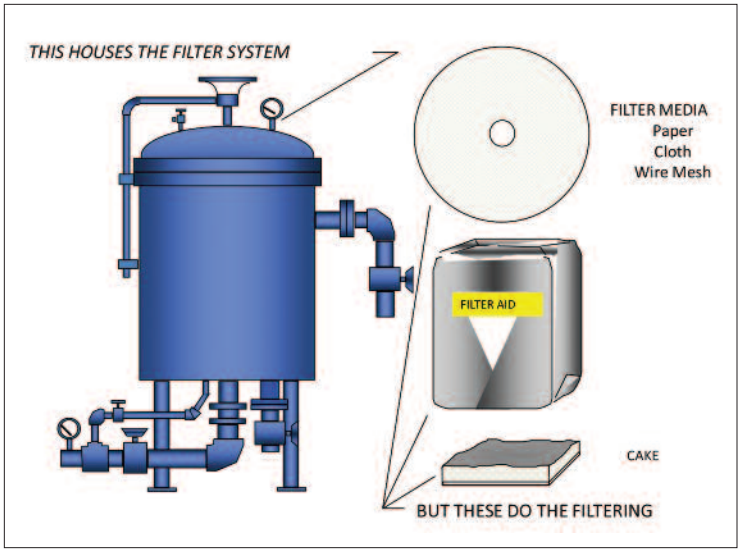


Figure 1: A typical horizontal plate filterset-up

Figure 2: A typical filter press

Filtration is the process for separating particles from a fluid by passing through a permeable medium. This paper deals with industrial filtration using a filter paper or filter pad as the permeable medium to accomplish the filtration process.

CONFIGURATION OF FILTER PAPERS

Filter papers are cut to specific requirements, depending on the design of the filter equipment being used. Filter papers are different sizes, shapes, perforated, folded, pleated, fluted and sewn or made like envelopes or pads.

Horizontal Plate Filters use circular filter paper sheets with a center hole. Single Plate Manual Nutsche Filters use circular filter paper sheets without a center hole.

Vertical Plate, Frame Filters and Filter Presses use rectangular filter paper with holes on all four corners of the sheet. Double sheets of filter paper that drape over the filter plate to cover both sides of the plate are also used.

TUBE FILTERS AND CARTRIDGE FILTERS

Another use of filter papers is in the making of pleated tubes used in tube filters. The filter paper used to make the tubes for these filters is usually treated with a resin for strength, durability and wet strength. Typically the resin is phenolic resin or another resin compatible with the process liquor. The following photos depict some of these tubes and filter housings.

Figures 3 and 4 show the filter housing (Figure 3) and the filter housing cover open to access the internal of the housing (Figure 4). The inlet and the outlet of the filter housing are the flanged ports in the bottom of the housing and the small connection in the cover is the vent valve port. A single tube of pleated paper is shown (Figure 5) and four filter tubes are shown in the next photo (Figure 6). A protective mesh covers the pleated paper tube for additional protection of the tubes. The next photo (Figure 7) shows the internal of the filter housing with the individual mounting bars for the filter tubes. Figure 8 shows the pleated paper tubes installed inside the housing.

When the tubes reach the maximum differential pressure – this will be detected by either pressure gauges on the housing and on the discharge of the filter or a differential pressure switch installed on the filter – indicating reach of maximum solids loading. Process flow is stopped by closing inlet and outlet valves and draining the filter housing by forcing the remaining liquid under air or inert gas pressure with a drain valve opened. The tank vent is opened to release pressure and then the top cover is opened. The tubes are removed and disposed. In the case of tubes made of pleated paper, the tubes are removed and discarded. In the case of tubes made of pleated synthetic materials such as polypropylene, they may be washed for reuse. After cleaning the housing internal surfaces, new tubes are placed on each individual mounting bar and checked for proper seating and sealing.

TYPES OF FILTER PAPER

Types of filter paper depend on what basic materials are used to make the filter paper. Different fibers are mixed to offer different flow rates, retention and chemical resistance. Filter paper is easy

Figure 3: Filter housing with step base

Figure 4: Filter case

Figure 5: Single tube

to handle and store. Filter papers are biodegradable and are disposed of easily. Some of the types of filter papers are:

- Cotton Rag
- Cellulose
- Bleached Wood Pulp
- Unbleached Wood Pulp
- Rag Fiber
- Nonwoven Synthetics
- Alpha Cellulose Fiber
- Rayon Cellulose Fiber
- Cotton Cellulose Fiber
- Carbon Impregnated
- Diatomaceous Earth Impregnated

These various types of filter papers are white or tan; the surface of the filter paper is smooth or creped. These filter papers are available in a variety of basis weights, thicknesses and micron retentions. Such a variety makes filter papers suitable for many different filtration processes.

CHOOSING THE PROPER FILTER MEDIA

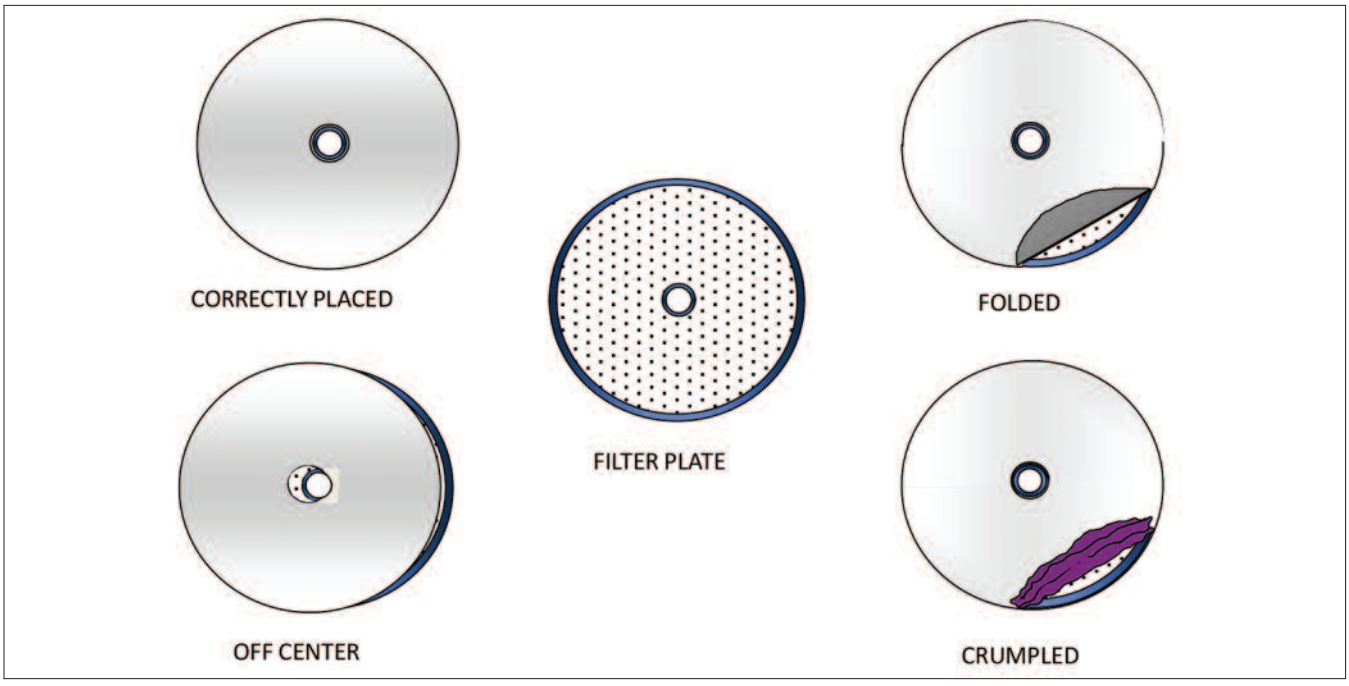
Within the recent past the filtration process has become highly specialized, depending on the process requirements of the product. Filtration is used to remove impurities from liquids and air or gases. Filtration equipment and filter media have become very sophisticated requiring more technical knowledge and expertise to select the proper system and the correct filter media for the application. Filter media are characterized by several physical tests such as rapidity, retention, basis weight, thickness, wet strength and surface that are used to select the proper media for the application requirements.

According to published literature from Ahlstrom Filtration the following terms from "INDUSTRIAL FILTRATION Choosing the Proper Media" are used:

RAPIDITY – Rapidity, or water flow rate, is defined as the number of milliliters of distilled water, at 73 °F, which

Figure 6: Multiple tubes

Figure 7: Inside of filter housing



Correct versus incorrect media placement

pass through a two-inch diameter sample of media under a two-inch head of water pressure in one minute.

RETENTION – The degree to which the filter media removes fine particles from the fluid passing through it is known as retention. This test utilizes a Coulter Counter and equates to values at 98% retention of particle size listed. Because of variations in test procedures, equipment and particles, comparison ratings between manufacturers is not recommended.

BASIS WEIGH – Since filter media are usually referred to by the pound weight per unit, it is imperative to determine the weight of each grade of media. The basis weight is defined as the weight in pounds of 500 sheets of material, 20"x 20".

THICKNESS – Thickness of filter paper is measured in thousands of an inch or mils using a TAPPI recommended bench-mounted micrometer. At Ahlstrom Filtration, uniformity of thickness is very closely controlled, because they know that this is one of the most important indicators of filter paper performance.

WET STRENGTH – The strength of the filter media under wetting conditions is important since the majority of the media are ultimately used in liquid applications. Wet bursting strength is defined as the pressure in inches of water that will rupture a two-inch diameter sample of media. FDA approved resins are added to many grades to improve the wet strength properties.

SURFACE – The surface of the filter media is referred to as either smooth or crepe. Creping is achieved in the manufacturing process, and results in rough surface, which increases rapidity or flow rate. A smooth surface is the natural condition of the media without treating or altering it.

FILTER PAPER PLACEMENT PROBLEMS

Some of the common problems that can occur with filter paper placement on horizontal plate filters are shown in Figure 3.

As the filter media is placed on the filter plate, the operator must make certain the media is correctly positioned.

Media placed off center on the plate will cause bypassing of solids when the process starts. This problem requires stopping the filter, emptying the tank and removing the filter plates to replace the filter media correctly.

Media placed incorrectly with a folded or crumpled edge will also cause bypassing and a repeat of the corrective steps above. Operators need to check that media is not crumpled during storage and take time for correct placement of filter paper on the filter plate.

For proper dressing when using filter paper, good practice is always very important in checking that there is a good seal of the media all around the sealing surfaces of the filter plates. The operator should observe the paper is extended beyond the edge of the plate by walking around the plate stack.

Filter paper is used by itself, as in the case of final polish filtration applications, or with the use of filter aids as a precoat to protect the media from becoming blinded by the particles being filtered out of the solution. Some applications may require a body feed in addition to the precoat, so that the initial porosity of the precoat is maintained throughout the filtration process.

OPERATIONAL PROBLEMS

Sometimes operational problems are experienced with filter paper during the filtration process by incorrect procedures.

Filling the filter too fast, and not allowing air entrapped in the filter plates to evacuate, will cause air bubbles to

Table 1

Industrial Filtration Media – Typical Properties

Ahlstrom Grade	Basis Weight (lbs.) 20x20x500	Caliper (in)	Rapidity (mls/min)	98% micron Retention (um)	Creped
Slow Flow Rate					
901	140	0.05	60	1.5	Smooth
904	85	0.03	70	2	Smooth
909	20	0.0063	65	3	Smooth
950	25	0.0078	14	2	Smooth
Medium Flow Rate					
923	70	0.026	200	20	Smooth
938	54	0.028	200	14	Creped
961	35	0.0183	360	40	Creped
962	20	0.0103	245	27	Creped
986	75	0.0392	100	10	Creped
992	14	0.0067	130	43	Creped
Fast Flow Rate					
933	70	0.04	435	27	Creped
963	54	0.0285	440	30	Creped
967	70	0.04	475	33	Creped
968	50	0.0275	600	40	Creped
1278	35	0.0195	1400	45	Smooth
1384	43	0.023	475	31	Creped
8301	14	0.0124	>600	171	Smooth
All grades are cellulose except for 8301, which is a cellulose / synthetic blend.					

Note: Data represents typical properties based upon Ahlstrom Filtration-designed test procedures. Direct comparison of properties between manufacturers is not recommended because of variations in test procedures and equipment.

Beverages	Alcoholic	901 923 950
	Soft Drinks	901 923 963
	Fruit Juices	901 963 967
Chemicals	Alcohol	901 1278
	Bleach	923 950
	Electroplating Solutions	901 938 950 961 967
	Metal Solutions	901 909 923 963 950
Food Processing	Beverage Syrup	901
	Cooking Oil / Shortening	963 1384 967 933
	Honey Syrup	923 963
Petroleum Products	Industrial Oils	963 950
	Transformer Oil	901 963
	Wax	963 937
	Oil/ Wax Separation	963 937
Miscellaneous	Press Cloth Cover Sheets	992 950 962 967
	Waste Water Filtration	923 963 938 968
	Wicking Paper	1278
	Plate & Frame -Metal Finishing	904

Table 2.

Application chart for industrial media

form under the filter paper. As filtration progresses, the rising operating pressure causes the bubble to burst, tearing the filter paper. This condition is avoided by slowing the filling process and allowing the trapped air to evacuate the filter through the outlet or a venting device, if one is provided with the filter.

Once the filter paper becomes wet, if the filling is too fast and the above mentioned air bubbles form, the bubbled filter paper will flatten, due to the initial operating pressure and cause wrinkles in the paper at the bubble locations. This wrinkling effect will affect the precoat procedure, as the wrinkle is unevenly covered with the particles being filtered or the filter aid used to precoat the filter. As the operating pressure is increased, particles bleed through these wrinkled spots in the media, contaminating the filtrate and affect clarity during filtration.

Filter paper can tear due to irregularities in the surfaces of the filter plate and cause loss of clarity. This condition is best observed when the filter is taken off line, during the cleaning process, when operators can note holes in the filter cake where irregular metal plate surfaces penetrate the filter paper. Good maintenance and inspection of filter plate surfaces is important to eliminate this problem.

Sometimes filter paper can radially swell, causing expansion and loss of the seal at the plate sealing surfaces. This condition is avoided by pre-wetting the filter paper with clean solution or a compatible liquid to allow the filter paper to swell and expand before placement on the filter plate. If the filter is supplied with a constant compression hydraulically operated system, this system will compensate and increase compression if a lessening of the paper seal is detected.

Erosion of filter cake, while not a problem with the filter paper, is prevented by properly baffling the inlet feed to the filter to prevent the incoming liquid from eroding or channeling the filter cake. In the worst-case sce-

nario, this channeling will cause the filter paper to tear.

Some filter papers will selectively absorb a contaminant in the solution. An example is an oil containing traces of water passes through the filter paper and the water is absorbed by the filter paper. When filtering a liquid such as water that contains traces of oil, as in condensate filtration, the paper will absorb the oil. As filtration flow and/or pressure increases, what has become entrapped in the paper is extruded from the filter paper contaminating the filtrate.

SELECTION OF FILTER PAPER

To help in the selection of filter paper for process needs, tables provided by Ahlstrom Filtration, Inc., Industrial Products Group are reproduced here for this article as authorized by them. Table 1 lists typical properties for industrial filtration media and Ahlstrom Grade Numbers. Table 2 is an application chart for industrial filter media.

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