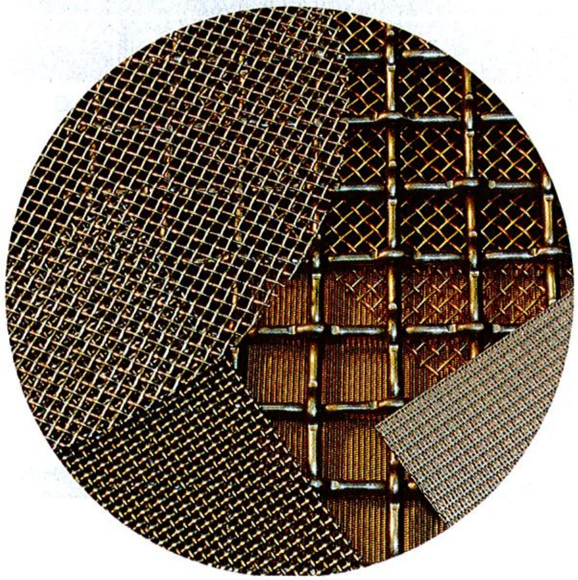

Tailor Your WIRE CLOTH

Versatile material can handle myriad duties but requires careful selection

By E. Marvin Greenstein, Newark Wire Cloth

IT IS difficult to imagine a fluid handling system that doesn't employ wire cloth, mesh or screen in one capacity or another. Wire cloth long has been used for its ability to separate the desirable from the undesirable. It can filter particulates ranging in size from inches and above to a few microns and below. Moreover, the material provides strength, rigidity and consistent sizing performance, retains impurities or treatment material and, by virtue of its design, doesn't tend to impede flow.

For instance, its capability for separating liquid from solid has made wire cloth virtually indispensable in water pollution control — e.g., for screening raw water intake and removing particulate matter from plant effluent. Likewise, the material handles a variety of duties in air pollution control: meshes woven of silver, platinum or other precious metals are used in catalytic combustion processes while more-conventional wire cloths serve as baghouse filters and backing cloths for services requiring extra strength and corrosion resistance, and as arresters on stacks to prevent escape of sparks, cinders and other coarse particulates. Wire cloth screens also are finding increasing application as a contact medium for cooling towers to control thermal pollution. In addition, the material can act as a sound barrier to abate noise.

Process uses also abound. For instance, ion-exchange-resin and activated-carbon treatment systems for process water often rely on wire cloth for collectors, under-drains and distributors. The material also serves for centrifuge cloths and backing cloths of all kinds. In addition, it frequently is used to remove scale and construction debris to protect pumps and other equipment.

CHOOSING THE CORRECT CLOTH

Proper selection of wire cloth can make a big difference in the cost and efficiency of a system. Making the right choice requires consideration of a variety of important factors. For instance, use in a liquid waste system involves coordinating pressure drop requirements with liquid temperature, viscosity and specific gravity as well as factoring in the size of particulate matter, flow rates and the nature of the contaminants or the corrosive environment to be encountered.

Once the parameters are set, there almost certainly will be a suitable wire cloth for the job. Hundreds of standard cloths are available in the common metals, stainless steels, high-nickel alloys, titanium, etc. In most cases, the engineer won't need to custom design a cloth; manufacturers are helpful with application and metallurgical assistance for specific problems.

IMPACT OF VISCOSITY

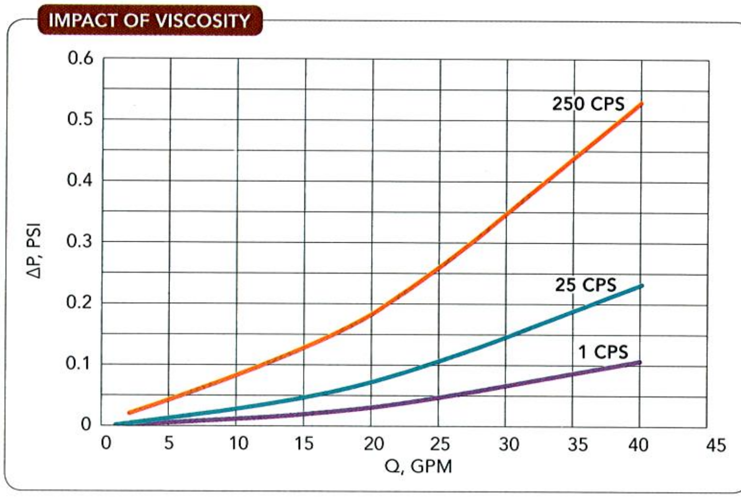

Figure 1. Pressure drop at higher flow rate can increase dramatically for more viscous fluids.

CORROSION RESISTANCE

CORROSIVE	METAL							
	Brass	Copper	Inconel	Monel	Nickel	Nichrome	Stainless Steel	Steel
Alcohol	E	E	E	F	G	G	G	G
Alkalis	F	X	E	E	E	G	E	E
Ammonia	X	X	E	G	F	E	G	G
Ammonium salts	X	X	E	F	F	E	F	F
Brine	G	G	E	E	F	G	G	X
Cyanide	X	X	G	X	F	E	E	G
Hydrochloric acid	F	X	F	G	F	E	F	X
Hydrofluoric acid	X	F	G	E	F	F	X	X
Nitric acid	X	X	G	X	X	E	E	X
Sulfuric acid	F	F	F	F	F	E	F	X
KEY: E = Excellent, G = Good, F = Fair, X = Not Recommended								

Table 1. These are only rough guidelines because suitability also depends upon other factors such as concentration, temperature, environment, etc.

Let's now look a bit more closely at some of the key parameters to assess.

RETENTION SIZE

You first must determine the retention size, often given in microns, needed to separate the particulate matter (which either may be a waste or the desired product) from the influent stream. Vendors provide charts that relate micron size to wire diameter and mesh count per inch. So-called market-grade cloths are most common but many other weaves and engineered configurations also are available. When a particular retention is critical for the filtration process, select a value slightly smaller than that actually needed, to accommodate standard tolerances and ensure the correct result.

Various wire mesh alternatives can attain equal retentions — but with different flow-rate/pressure-drop profiles. For example, a standard market-grade 40 mesh with wire diameter of 0.010 in. and an open area of 36.0%, and a "mill screen" 48 mesh with a wire diameter of 0.0055 in. and an open area of 54.2% both have a retention of 389 μ. The mill screen alternative offers a higher flow rate (or lower pressure drop) because of its greater open area but lacks the strength of its standard market-grade counterpart.

There are situations in which a standard square-weave mesh count, while adequate for retention, isn't the correct choice — e.g., in the design of filter leaves. This application calls for a more-rugged configuration such as that provided by twilled-Dutch-weave wire cloth. Twilled Dutch weaves and similar filter cloths offer a more-rugged construction suitable for the cleaning, scraping and power washing that is common to many filter operations. They also provide a smoother surface that aids in the release of filter aid and retained particles.

Where exacting retention and throughput are more crucial than strength, as in many pharmaceutical applications, the choice commonly is a mesh that conforms to a very high tolerance U.S. standard sieve grade. In these instances, the screen is manufactured taut in a frame that is shaken to aid in separation. These screens offer consistency and repeatable results.

If the flow rate is critical and regular wire cloths don't offer suitable open area, alternative engineered designs or configurations often will provide the solution. For instance, corrugated wire mesh can furnish larger effective open area in a restricted space. Economics then would become an increasingly important component to the decision-making process.

Accurate influent characteristics are critical for flow-rate/pressure-differential calculations and, thus, to proper design. For instance, as Figure 1 shows, viscosity can have a major impact. Too often, though, fluids are characterized as "similar to water" or "just like …." This lack of significant data often leads to improper mesh choice.

In every application that involves throughput of liquid or gas, the selected wire cloth's pressure differential is a critical consideration. Cloths that appear quite similar actually can differ significantly in the pressure differential they produce. Direct orifice calculations, charts and graphs are available to determine pressure differential.

Many of the finer cloths, such as the Dutch weaves, don't have an easily measurable opening. So, getting pressure differential values may require testing or tapping the manufacturer's experience and data.

The shape and style of filter — conical, fluted, corrugated, multitier or multistage — enable tailoring to achieve the desired result while passing the necessary flow.

KIND OF WEAVE

Like ordinary fabrics, wire cloth comes in a wide variety of weaves. It is made out of practically every gauge of wire and in innumerable combinations of wire diameter and mesh size (i.e., the number of openings per linear inch — for example, 10 × 10 mesh has 10 openings/linear in. or 100 holes/in.^{2}).

Every type of weave has a use. Wire cloth most typically has a square configuration, with the same count vertically and horizontally. Rectangular or off-count mesh also is available, offering greater throughput but less structural strength for the same sizing ability.

Most separation services and coarse filtrations usually use a simple double-crimp weave. Cloth made of extra-fine wire (up to 400 × 400 mesh or 160,000 holes/in.^{2}) is either double-crimp or twill. The Dutch and standard weaves don't produce square openings but rather wedge-shaped ones that aren't parallel to the surface of the cloth. These cloths serve in centrifugal and pre-coat filters, and comprise the majority of the ultra-fine wire cloths.

Wire cloth customarily is woven 100-ft long (the industry's "standard bolt") and 36- or 48-in. wide, although cloths as wide as 96 in. sometimes are made. Finer versions usually are a standard 36-in. width. Cloths of any desired width or length are attainable by welding sections together.

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WIRE MATERIAL

Cloth may be woven of any malleable metal or alloy. The choice depends upon corrosion, environmental and other issues posed by a particular application.

Cloths most commonly are made of steel, copper, brass and high-nickel alloys; aluminum, bronze, phosphor-bronze, nickel, nickel-chromium, galvanized- or tinned-steel, and stainless-steel cloths are readily available. Noble, rare and refractory metals, e.g., gold and gold-plated metal, platinum, silver, tungsten, molybdenum, columbium, tantalum and titanium, also are used.

Water applications most commonly rely on stainless steels because they have the greatest range of corrosion resistance at a practical cost. Certain concentrations of contaminants in liquids may require use of a more-exotic material. Table 1 indicates normal resistance of common wire-cloth materials to various contaminants.

In air-pollution-control baghouse applications, a wire cloth's strength and corrosion resistance frequently are crucial. For example, where free sulfides are a particular problem, titanium and other exotic alloys find use, either as a strengthening backing cloth or as the actual filter medium.

Always keep in mind that wire cloth by nature is susceptible to corrosion. Instead of attacking one surface, corrosive action will take place all around the wire. So, a corrosion rate that might be considered negligible for metal plate might be excessive for wire cloth. For this reason, it's usually wise to choose a material with the highest corrosion resistance consistent with the economics of the application.

In some applications, particularly in filtering or screening seawater or brackish water, the risk of galvanic or electrolytic corrosion due to other components in the system can impact the selection of wire cloth material. Metals close to each other in the electrolytic galvanic series are less severely affected; materials usually are chosen so that the more-active one forms the major component.

A major value of wire cloth comes from its combination of excellent physical strength with relatively light weight. Actual weight, of course, depends upon the specific metal, the diameter of the wire and the mesh of the cloth. Used as a structural member, wire cloth provides support without impeding flow and without excessive weight. Used as a screen, it resists abrasion, can be cleaned with high-velocity water or chemical cleaners, mechanically scraped or rapped, and even, in some cases, have ice pounded off with a hammer, with little chance of damage. Equally important for applications such as spark arresters, petrochemical pressure filtration, etc., is wire cloth's high-temperature strength (Table 2).

MAXIMUM OPERATING TEMPERATURE

METAL	TEMPERATURE, °F
Stainless steel, type 304	1,500
Incoloy	1,600
Stainless steel, type 330	1,650
Nichrome	1,700
Hastelloy C	1,800
Inconel	1,800
Nichrome V	2,000
Nickel	2,700
Columbium	3,000
Molybdenum	4,700
Tungsten	5,000

Table 2. Metals commonly used in high-temperature services vary significantly in their temperature limits.

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