Selecting the Proper Filter Media for Dust Collection System

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Part 1 of a 2 part series: The Basics in Media Selection

Dust collector media selection is simple if the many variables, which may be involved aren't considered. However, proper media selection takes more work. Thorough and scientific selection will yield excellent long-term results in the form of longer bag life, better bag performance, fewer maintenance headaches and no environmental issues. Follow this article series outlining the beginning of the process and anyone can achieve those better results.

Proper media selection also requires a solid understanding of process conditions (i.e., what makes up the gas stream and particulate going into the collector), and it requires knowledge of how various fibers and filter media designs perform in a given environment. This is why many companies choose to leave the filter media selection to experts who, based on their experience and industry knowledge, are able to match those process conditions to the capabilities of the available fibers and fabrics.

There are four basic questions that need to be answered. As a starting point, the first two questions to be asked are critical to the selection process and interchangeable in their priorities. These two questions will eliminate or include all the proper types of fibers and point us toward the fabric design for the dust collector system in question. The questions are:

Question #1: What is the continuous operating temperature of the gas stream at the inlet to the baghouse? Further, are there temperature surges and what is the peak temperature of those surges? What is the frequency and duration of those surges?

Question #2: What is the design of the collector: shaker, reverse air or pulsejet and exactly how is the dust to be cleaned from the media to (periodically) remove the dust cake?

The answers to the first question tell us immediately which fibers can be considered for use initially and which ones must be automatically eliminated. For example, if the operating temperature is ambient and could not possibly rise above 120°F/50°C at any time, virtually all industrial grade synthetic and natural fibers could be considered for the application. However, if the operating temperature is 450°F/232°C and there could be frequent surges to 500°F/260°C, the potential candidates list is significantly reduced by elimination of many fibers which are unable to survive at the high temperature level, continuous or surge. A brief overview of generally accepted fiber temperature capabilities* would show:

Cotton	180°F/85°C
PVC	150°F/65°C
Polypropylene	190°F/90°C
Nylon	230°F/110°C
Homopolymer Acrylic	257°F/125°C
Polyester	300°F/150°C
PPS	375°F/190°C
M-Aramid	400°F/205°C
Polyimide (P84)	450°F/235°C
PTFE	500°F/260°C
Fiberglass	550°F/285°C

** Industrial grade fibers in a dry, chemical free gas stream. Fiber capabilities will vary as moisture and potential chemical reactions are added to the decision making process.*

The second question points toward the fabric "design," i.e. does the application require a conventional woven fabric or a nonwoven such as a needled felt? The answer lies in the cleaning system of the fabric filter itself. The types of collectors below represent the general types of dust cleaning systems, ranging from the least effective cleaning to the most effective:

Reverse Air (least effective)
Shake/ Deflate
Mechanical Shaker
Pulse Jet (most effective)

Note: Envelope design such as the DCE or Sly can be found with either shaker or pulse cleaning systems.

The general rule is that the least effective cleaning system (Reverse Air) requires a smooth, lightweight and flexible woven fabric to assist in cake release while the most effective system (the Pulse Jet) allows the use of heavier, dense, sometimes stiff/boardy needle felts. There are, of course, exceptions to the general rules such as lightweight shaker felts, which have been developed in conjunction with modified shaker dust collectors. However, it is unlikely that a lightweight woven fabric would be used in a conventional pulse jet unit and it is equally unlikely that a heavy needled felt would be used in a

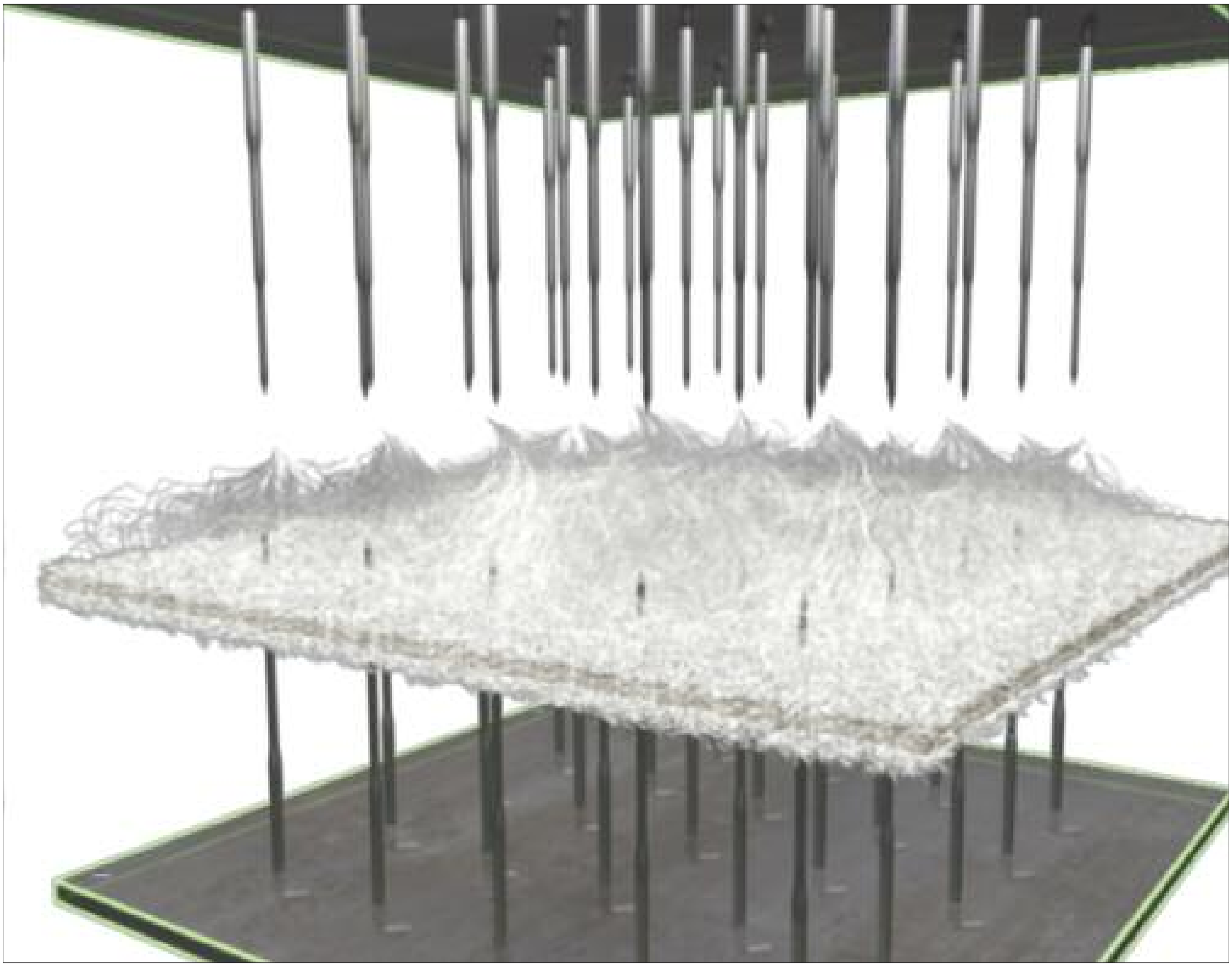

Illustration of felt needling process

standard reverse air collector. At this point, based on our early knowledge of the temperature and the cleaning system, one can determine the type of fiber and the type of filter media, which will be used in the fabric filter.

An important side note regarding the terminology used here might be appropriate at this point regarding fibers, yarns, woven fabrics, needled felts and filter bags. The base unit of this discussion is the industrial grade fiber, generally synthetic and produced by large chemical or petrochemical companies. These fibers are individually smaller than a human hair and are extruded or spun in various diameters and lengths for the next textile process. Some fibers are extruded in large numbers and the bundled, twisted and plied into multifilament yarns for weaving into conventional woven filter fabrics. Other fibers may be cut to short lengths and spun into yarns, which are bulkier and look like woolen yarns. Lastly, those cut fibers may be "carded" or formed into a web-like structure, which will eventually become a needled felt. All fibers can be processed in these various ways and once the woven fabric or the needled felt manufacturing process is completed, they are converted into finished, sewn or thermally bonded filter bags. Thus, any fiber can be processed into any woven fabric or needled felt and then made into any filter bag.

Getting back to the selection process, there are two more questions that need to be asked.

Question #3: Is there moisture in the gas stream. Most gas streams do contain water so it is the amount or percentage that is critical. Certain fibers (PVC, polypropylene, homopolymer acrylic, PPS, fiberglass and PTFE) are essentially unaffected by, and non-reactive, to moisture in the gas stream. Other fibers, nylon and cotton most notably, will absorb moisture, causing swelling and a change in dimension, but there is no real harm caused to the fiber. Worst of all, however, are fibers which will degrade in a high moisture, high temperature environment. These include polyester, aramid and P84 and the process is normally referred to as "hydrolysis" or the giving off of water. With these fiber groups, heat and mois-

FILTER MEDIA SELECTION CHART					
FIBER TYPE	TEMP LIMITS* F/C	RESISTANCE TO ACIDS	RESISTANCE TO ALKALIS	RESISTANCE TO HYDROLYSIS	RESISTANCE TO OXIDATION
COTTON	180°/85°	Poor	Good	Good	Good
PVC	150°/65°	Excellent	Excellent	Excellent	Excellent
POLYPROPYLENE	190°/90°	Excellent	Excellent	Excellent	Poor
NYLON	230°/110°	Poor	Excellent	Poor	Good
HOMOPOLYMER ACRYLIC	257°/125°	Good	Fair	Good	Good
POLYESTER	300°/150°	Good	Poor	Poor	Good
PPS	375°/190°	Excellent	Excellent	Excellent	Fair
ARAMID	400°/205°	Poor	Excellent	Poor	Fair
POLYIMIDE	450°/235°	Fair	Poor	Good	Good
PTFE	500°/260°	Excellent	Excellent	Excellent	Excellent
FIBERGLASS	550°/285°	Good	Fair	Excellent	Excellent

*Dry heat only

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ture causes the "H" and "O" molecules in the fiber's polymer chain to cleave the chain, form together as water and weaken the fiber structurally.

As an example, polyester will begin to hydrolyze at around 160°F/70°C in a gas stream with a water content of 7% or greater, but the degradation increases significantly as the temperature reaches the 225 - 250°F/107 – 121°C range. This makes polyester all but unusable in spray dryer collector applications in the 200 to 300°F/93 – 150°C range. However, when this situation arises, there are other fibers, in this case homopolymer acrylic, which will perform well in place of polyester fibers.

The difficult issue here is that two of the three fibers, which are subject to hydrolysis (polyester and aramid) are also two of the most commonly installed or recommended fibers for new equipment and for replacement bags. Therefore, the OEM, the bag manufacturer and the end user need to be aware of the potential for hydrolysis when supplying, recommending or ordering filter bags. The positive issue is that there are readily available materials, which can be used to replace these fibers when hydrolysis is a potential problem.

The last of the basic questions (Question #4) to answer is whether there is a potential for any chemical reactions such as oxidation, alkaline or acid attack. These reactions would normally be caused by the process itself, the dust or particulate and the presence of moisture, particularly as the collector passes through the dew point in start up and shut down, and with the assistance of heat. Note that, according to the Arrhenius Rule, chemical reactions double with every 50°F/10°C increase in temperature.

For example, nylon and aramid fibers perform very well in an alkaline environment (high pH) but degrade rapidly in the presence of acids (low pH). Polypropylene works very well on both sides of the pH scale, either acid or alkaline, but is subject to severe degradation if an oxidizer is present. Again, each of the major fiber types has its own strengths and weaknesses in a given chemical situation and the difficult part is predicting or understanding the potential for a chemical reaction in a specific gas stream with specific process or reactive components.

The following chart is a very simplified overview of the capabilities of the more commonly used and recommended industrial fibers in filtration. The ratings are general and must be analyzed in conjunction with all of the process, dust and reactive potential in the specific gas stream.

It is strongly recommend that users consult with a filtration professional for media selection to insure optimum filter bag and dust collector performance. In the next course, Advanced Media Selection, there will be specific information about major dust characteristics, identifying solutions to dust issues and how to prevent sparks. FN

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