

Nonwovens for filtration media

Lutz Bergmann

Proprietary filtration products will increase, and products based on new technologies, especially melt blown nonwovens, will penetrate additional segments of the filtration market.

In the United States, of the total nonwovens market of approximately \$2 billion, filtration media represent at least \$200-250 million worth of sales. The amount of nonwovens goods seems to vary slightly between different sources; however, most of the discrepancy in numbers comes from the lack of a clear definition of different nonwoven types. Often filter papers are mentioned, for instance, which are not strictly a nonwovens product.

Here, a distinction is made between the use of nonwovens in dry filtration, or gas-dust filtration, and liquid filtration. Nonwovens have to meet a wide variety of filtration requirements, depending on their product use.

Dry filtration

As Table I shows, one of the largest segments of nonwovens is represented by needled felts for dust filtration used in baghouses and fabric filters. In the United States, needled felts are predominantly used in outside collectors or in pulse-jet filters. These felts are manufactured from polyester, polypropylene, homopolymer acrylics. They are also manufactured for use in high temperatures from Nomex™, Teflon™, Ryton™, and P-84, a relatively new development from Lenzing, Austria.

Dry filtration used includes industrial coal-fired boilers, incinerators, cement products, and rock products. The different surroundings in which dry filtration is used include the mining industry, the chemical process industry, the iron and steel industry, lightweight aggregate plants, the primary nonferrous smelting industry (with aluminum, lead, and zinc smelting plants), and lime, clay, kaolin, and ceramic works. Fabric filters are often used in secondary filters.

Plants for hot mixed asphalt are furnished primarily with Nomex™ filter bags. There are approximately 2000 such installations in the United States alone, with an average air flow of 1699 m³ of air/min (60,000 ft³/min) and a total filter area of 929-1115 m² (10,000-12,000 ft²). Other applications include the feed, grain, and food industries, wood working, furniture, paper and related industries, textile plants, and applications in which bulk material is

handled, such as conveying, milling, mixing, and shipping.

The challenge for nonwovens in this segment of dry filtration may be represented by the expected PM 10 legislation, in which particles finer than 10 µm will be regulated. The efficiency of filter media will become more crucial. Nonwovens have exhibited the highest efficiency obtainable, and specially designed needled felts have been used to achieve remarkably low outlet emissions. Some of these developments are coming from Europe, where needled felts are specially surface treated, sometimes exhibiting a graded density when special scrim materials are used. Also, domestic manufacturers have now offered needled felts with special coatings to improve the efficiency, cleaning, and performance of such nonwoven materials.

Needled felts are also used for Torit cartridge filters, a special dust collector type using a pleated cartridge design. Although the common material currently preferred is a wet-laid paper media, the new design employing needled felts and thermobonded nonwovens is based on a different cartridge design. These relatively new cartridges offer less filter area but higher air to cloth ratios. They are highly efficient and are manufactured from a number of different materials. W. L. Gore & Associates has introduced a unique cartridge design utilizing its proprietary, expanded PTFE membrane concept. Other manufacturers are following this trend, and nonwovens should capture a large share of this huge market in filtration. In the United States alone, between 350,000 and 400,000 replacement cartridges are used annually. Currently the use of nonwovens is minor; however, this market represents a tremendous potential for new and efficient nonwovens materials.

Thermobonded, molded, and melt-blown nonwovens are being used for face masks. The two markets for industrial and medical uses represent converted nonwovens currently valued between \$40 million and \$50 million. Although this market is serviced by a relatively few manufacturers, it has caught the attention of a number of new media companies, particularly those looking at melt-blown technology. In HVAC (heating, ventilation, and air conditioning), nonwovens filters are being used predominantly as prefilters for more efficient high-efficiency particulate airfilter/ultra-low-penetration airfilter (HEPA/ULPA) filters. Ordinary heating and air condi-

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1. Market size for dust filtration: woven and nonwoven filter bags

Market	Consumption, \$ million
United States	120
Canada	13-15
Western Europe	215-245
Eastern Europe	60
Japan	50
Far East	13
Total	487

Estimates were based on exchange rates as of March 1, 1988.

tioning systems in buildings, offices, and factories are manufactured from high loft glass and from polyester. Carded rayon, cotton, polyester blends, and other materials are also being used in the low- to medium-efficiency range, according to ASHRAE 52-76.

In microglass blanket media in the range of medium to high efficiency, extended surface filters play an important role in providing the efficiency required in many critical industrial applications. These include prefilters in the pharmaceutical, medical, nuclear, and electronic industries. (Glass blanket media in the United States are supplied solely by the Manville Corp.)

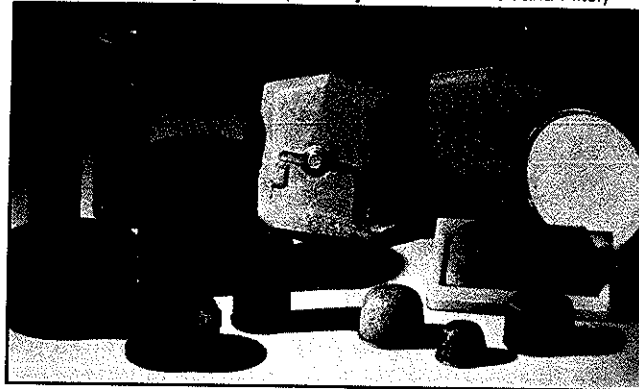
Hot-gas filtration is relatively new and is used for temperatures above 500°F. Furthermore, nonwovens are being used in air-intake filters for the protection of industrial ventilation, blower engines, turbines, pneumatic controls, compressors, silencers, and vacuum pumps. Also, Torit cartridge filters are being used for these purposes, particularly for gas pipe lines and the turbines and compressors used in these systems. The potential damage to this equipment is caused by fine particles, resulting in erosion and fouling if the equipment is not protected by efficient filter media.

Automotive air filters represent another potential market for nonwovens although only one major manufacturer offers such products at this time. Molded and shaped engine filters (Fig. 1) are predominantly used for small air-breathing applications, such as in lawn mowers, chain saws, and portable gas-powered blowers. These filters also represent a specialized market.

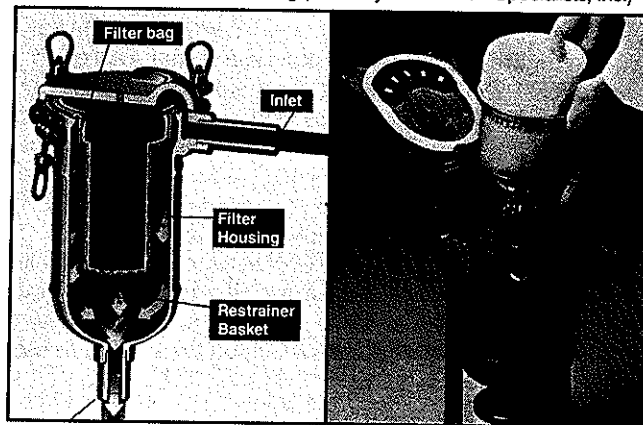
Liquid filtration

In liquid filtration, one of the largest markets is represented by micron-rated vessel bags (Fig. 2). These ring bags, or strainers, are manufactured for use as disposable filter elements in single and multiple vessels. Most of these nonwovens products are rayon or polyester needled felts for different micron ratings, typically between 3 μ m and 100 μ m. Also, nylon and polypropylene felts are used. The 3M Company has introduced a composite media based on melt-blown technology for this purpose (Fig. 3). Companies active in this field include American Felt & Filter, Filtration Specialists, Inc., Universal, Rosedale, Commercial Filters, and The 3M Company. A number of companies offer only replacement bags, which represent a total market in the United States

1. Shaped small engine filters (courtesy of American Felt and Filter)



2. Micron-rated vessel and bag (courtesy of Filtration Specialists, Inc.)



of approximately \$10-12 million for nonwovens needed felts.

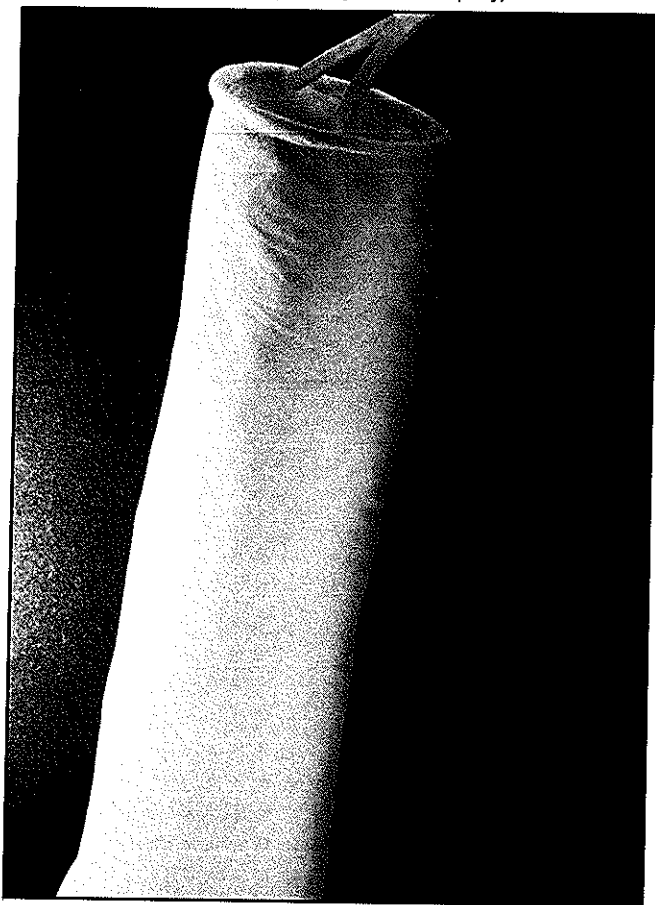
For cartridge filters, more companies are offering nonwovens. Some companies, such as Hytrec, Pall, and Facet, base their products on melt-blown technology. Cuno, a major manufacturer of disposable industrial cartridges, offers a bi-component fiber concept as well as other cartridge types based on nonwoven, pleatable filter media.

In membrane filtration, numerous companies offer new nonwoven concepts. Depending on the purpose, reverse osmosis, ultrafiltration, microfiltration, and different cartridge configurations are currently offered. Membrane filtration is one of the most promising uses for nonwovens in liquid filtration and will represent one of the largest market segments in this field.

Needled felts are being used on plate and frame presses and on drum filters. Within the last couple of years, needled felts are being used increasingly on belt filters. These felts have to be specially designed to meet different equipment features. All of these needled felts have a relatively strong and heavy scrim, to provide strength and integrity during operation. A number of domestic manufacturers of needled felts are now offering a specially designed needled felt for this equipment.

United States factories consume approximately 250 million gallons of cutting oils and grinding fluids in production machinery to move fixtures, actuate clamps, and operate cutting tools. Such coolants lubricate, clean,

3. 3M liquid bag series 100 (courtesy of 3M Company)



cool, and protect both the manufactured part and the manufacturing equipment. Filter media are used to clean such coolants, a market which consumes up to 50×10^6 m² (60 million square yards) of nonwovens. Most of this is spun-bonded supplied by major companies such as Reemay, Inc., James River, International Paper, and others. International Paper particularly offers a wet-laid material called Confil™. In addition, there are manufacturers of carded rayon nonwovens that are used particularly for high-temperature applications.

Food filtration has always consumed nonwovens, predominantly for dairy products, especially milk. A large amount of wet-laid media is used for tea bags and coffee filters; however, this material is really filter paper rather than a nonwoven. One of the major manufacturing companies is C. H. Dexter, which has a major position worldwide in this regard.

Also, edible oils and deep fat frying oils have to be filtered in manufacturing plants as well as in fast food restaurants. Additional applications in the food industry are represented by cane and beet sugar plants, in the manufacturing of beverages including beer, wine, distilled spirits, liquors, and soft drinks.

Nonwovens are used in solution polymer or viscose filtration for the manufacture of such fibers as viscose rayon, acetate, and some synthetic fibers. Different filtration steps are crucial for the manufacturing of such textile fibers. For decades, plate and frame presses have been utilized, relying on a multiple-layer, composite filter

pack. Bernhard Manufacturing is a major supplier for viscose filtration.

Other specialty purposes for nonwovens are blood filtration and dialysis, for which a relatively complex filter composite is used.

Summary

Nonwovens are widely used in filtration. Additional market penetration will depend on improvements in the products, including better uniformity, less resistance to the flow of liquids, air, and gas, and good chemical resistance. Furthermore, the price must be competitive with that of conventional textiles in terms of product life.

Proprietary filtration products will probably increase, and new technologies, especially melt-blown nonwovens, will penetrate additional filtration segments. The use of microglass fiber and fine synthetic fibers has the potential to offer greater efficiencies.

The future for nonwovens in filtration looks bright. Growth will come within the filtration industry as well as with regard to growing market segments and new opportunities. The manufacturer of nonwovens, however, has to adapt to a highly segmented market and must meet different requirements depending on the needs to be served.

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