# Eastman's Cyphrex Microfiber - A Fit for Versatile Filtration Applications

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***Eastman Cyphrex™*** *microfibers represent a new, versatile fiber technology for producing fine fibers. These thermoplastic microfibers can be made from a wide range of polymers in various shapes and sizes. This new technology provides very uniform and consistent fiber shapes and sizes that enable the design of wetlaid nonwoven substrates with unique characteristics to meet ever-increasing performance requirements. Current commercial Eastman Cyphrex fibers are cylindrically shaped polyester microfibers that have very narrow diameter and length distributions when compared with similarly sized microglass. This allows for nonwoven substrates to be designed with unique properties such as pore size and pore size distribution. Work on both laboratory and commercial wetlaid equipment has shown that these fibers are easily dispersed and processed, allowing for blending with other fibers including glass, cellulosic and synthetic. These materials are suitable for a wide range of applications – including but not limited to – filtration, battery separators and packaging materials.*

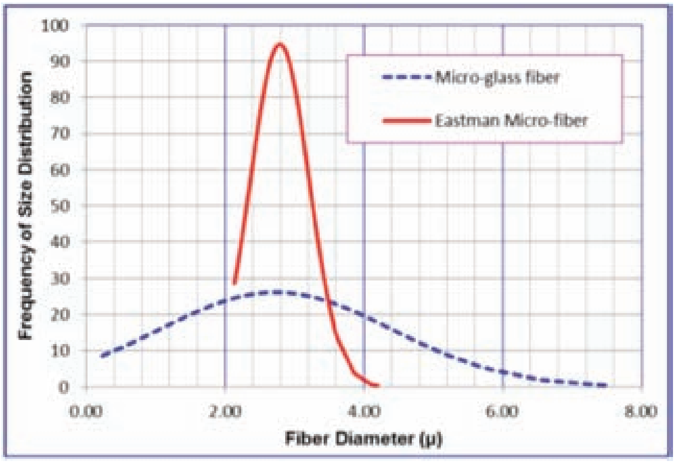



*Figure 1: Eastman Cyphrex 10001 diameter distribution, determined by utilizing scanning electron microscopy (SEM) and compared with a commercial microglass of comparable average diameter.*

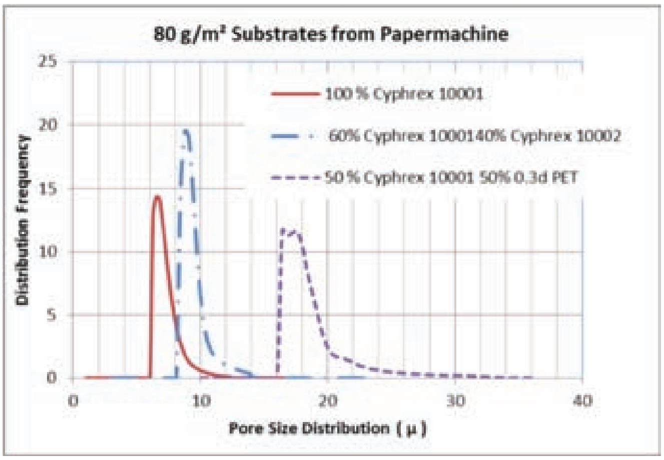



*Figure 2: Pore size distribution profiles of 80 gsm nonwoven substrates produced on a commercial wetlaid machine.*

Eastman Cyphrex microfibers represent a class of fibers that arises from an emerging yet versatile fiber technology developed by Eastman Chemical Company for producing fine fibers from a wide range of thermoplastic polymers. These fibers are specifically designed for performance in the demanding filtration, battery separator and packaging markets. The technology is versatile not only in polymer choice but also in fiber length, cross-sectional shape and area. Each feature is precisely controlled to meet end-use performance requirements.

These microfibers are designed to be easily dispersed in water and formulated into a wetlaid nonwoven substrate. They can be blended with other fibers — for example, glass, polyester, cellulose and nylon — to meet the requirements of a desired media in applications, such as for the filtration market. These fibers are suitable for wetlaid nonwovens in which there is ever-increasing demand for longer-life, high-efficiency filtration media. They also are suitable for producing low-basis-weight substrates with high tortuosity, such as battery separators and reverse osmosis (RO) membrane supports.

The initial commercial Eastman Cyphrex microfibers are polyesters, Cyphrex 10001 (2.5 µ diameter) and Cyphrex 10002 (4.5 µ diameter), both of which are precisely cut to 1.5 mm in length. Other developmental thermoplastic microfibers in the product development pipeline, including materials with differing cross-sectional shapes or areas and cut lengths, will be commercialized in the near future.

A key feature of this new technology is that it enables the production of thermoplastic microfibers with a narrow diameter distribution as compared with the most common microfibers made from glass, as illustrated in Figure 1. This narrow diameter distribution also is evident from lot to lot, and it allows a nonwovens producer to design and produce nonwoven substrates with consistent properties, especially pore size distribution and permeability. The ability to produce consistent and precise fiber diameters will ultimately provide consistent performance of the nonwoven substrate as well as allow for waste minimization in the end product.

It is hypothesized that smaller fibers and narrow diameter distributions in a wetlaid substrate should provide smaller and more narrow pore size distributions. In contrast, larger fibers should provide larger pore size distributions. Experiments with Eastman Cyphrex microfibers on a commercial wetlaid machine have confirmed this hypothesis.

Figure 2 illustrates the ability of these fibers to control pore size and pore size distribution in wetlaid substrates based on varied fiber diameters. An 80-grams-per–square-meter (gsm) sheet produced with a commercial wetlaid nonwoven paper machine shows the smaller pore size distribution when the sheet is formed with 100% Eastman Cyphrex 10001 (2.5 µ diameter). When the formulation is changed to 60% Cyphrex 10001 and 40% of a larger microfiber, Cyphrex 10002 (4.5 µ diameter), the average pore size increases. The distribution can be further shifted to a larger pore size by changing the formulation of the 80 gsm sheet to 50% Cyphrex 10001 and 50% of a larger 0.3 d x 6 mm polyester fiber (approximately 6 µ diameter). This blend also increases the pore size distribution.

This demonstration clearly illustrates the flexibility that Eastman Cyphrex microfibers can provide to a wetlaid nonwoven designer who wants to control the pore size and pore size distribution when considering various functional performance requirements.

Another unique feature of this new microfiber technology is its versatility to change the cross-sectional shape of the fibers. This enables East-

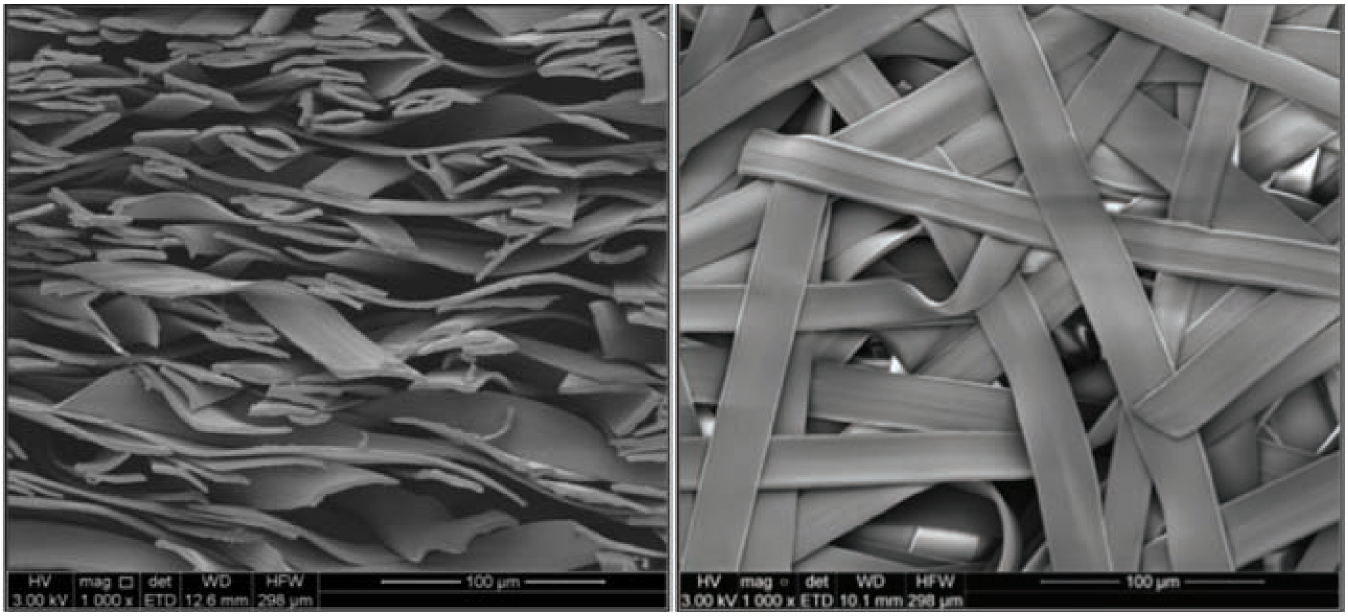


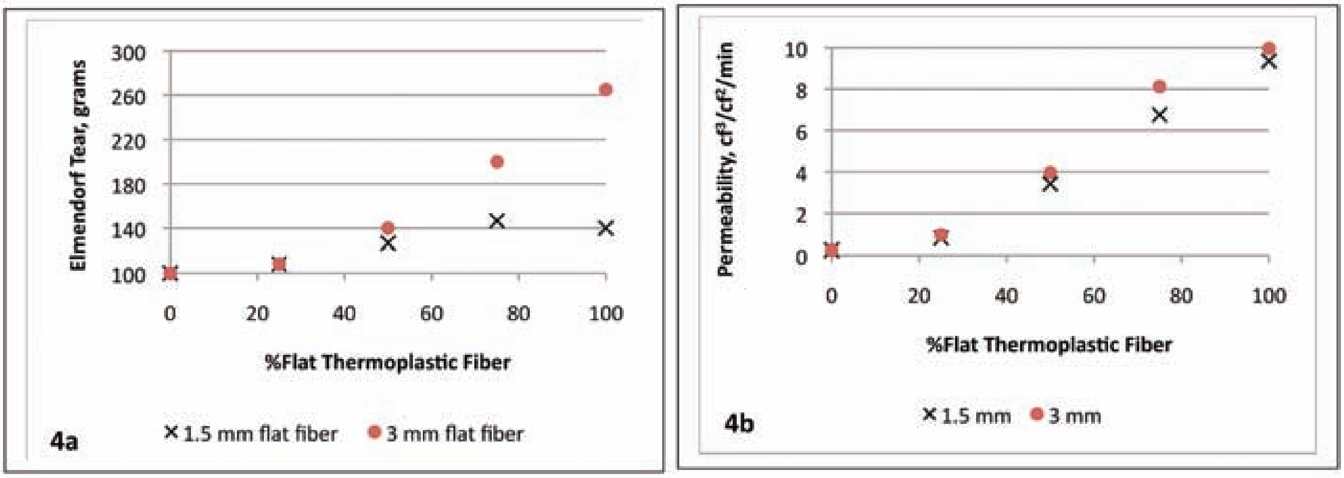
*Figure 3: SEM images (side and top views, from left to right) of a wetlaid nonwoven media composed of developmental, flat thermoplastic microfiber.*

man to design fibers that can enhance the physical properties of wetlaid nonwoven substrates as needed in certain applications. For applications in which substrate properties such as tear, tensile and burst strengths are more critical than pore size distribution, Eastman has the ability to produce synthetic microfibers with certain characteristics similar to cellulosic fibers while providing a strong and tough substrate.

An example of an alternatively shaped thermoplastic fiber is illustrated in Figure 3, in which a wetlaid nonwoven media is prepared from developmental, flat thermoplastic fibers in a laboratory handsheet mold.

A series of 80 gsm handsheets were prepared in a laboratory handsheet mold by varying the ratio of a softwood fiber and a developmental, flat thermoplastic fiber at two cut lengths (Figures 4a and 4b). Interestingly, both the tear strength and the permeability increase as the ratio of the flat thermoplastic fibers to cellulosic fibers increases. These are base sheet properties and were not saturated with a form of binder, as would be the normal case with wetlaid products.

Eastman Cyphrex microfibers are easily processed in typical wetlaid nonwoven operations at normal consistencies used for synthetic fibers. They disperse readily in standard wet-end systems and, unlike other synthetic fibers, provide enough wet strength to convey as a 100% synthetic sheet — or as blends with




*Figures 4a and 4b: Tear strength and permeability of 80 gsm handsheets as a function of softwood Kraft cellulose fiber (50 Schopper-Riegler) and flat thermoplastic fiber content.*

other synthetic fibers — from the forming wire to the dryer section of the paper machine.

Blends of Eastman Cyphrex microfibers with other synthetic or cellulosic fibers can be prepared by blending in the pulper, dispersion chest, machine chest or the fan pump. To attain an excellent distribution of the fibers in any blend, it is recommended to add the other, larger fibers into the Cyphrex dispersion. There is a wide range of processing equipment in the wetlaid industry for processing synthetic fibers, and they will all process Cyphrex microfibers. However, the specific methodology used to disperse these unique synthetic microfibers will vary somewhat based on available equipment and the level of dispersion mandated by end-use requirements. It is suggested that those unfamiliar with these materials start dispersing at a consistency not more than 1% until they develop a process based on available equipment, which allows for dispersion at a higher ratio.

The ability of Eastman Cyphrex microfibers to be easily processed, coupled with the ability to control pore size distribution of a wetlaid nonwoven, creates a unique opportunity for media designers to meet the increasing demand for longer life filters capable of fine-particle removal. These fibers also present great opportunities for producing high strength and breathable packaging materials as well as very thin and highly tortuous substrates for battery separators and RO membranes. Because these fibers blend easily with other fibers, it is believed that more opportunities are yet to be explored. FN

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