

Method to make aligned fiber filter media.

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PURPOSE:

- (1) To form nonwoven filter media with average fiber angles from 0° to 45° measured from the Z axis (Figure 1), and
- (2) To evaluate the performance of such filter media in terms of permeability and filtration efficiency.

DESCRIPTION:

Table 1 shows the effect of average angle on permeability and quality factor for coalescence filtration. The average angle is determined using a Fiber Mapping Method (G.G. Chase, V. Beniwal, and C. Venkataraman, *Chem. Eng. Sci.* **55** (12), 2151-2160, 2000).

Table 1. Effect of average fiber angle on permeability and quality factor for coalescence of propylene glycol droplets with 6 cm diameter 1 cm thick filter disks.

Average Fiber Angle, Degrees	Permeability, m^2	Quality Factor relative to 69° media
48	4.52E-08	1.35
54	3.04E-08	1.07
58	2.61E-08	1.20
69	2.01E-08	1.00

The media in Table 1 were limited to average angles between 45° and 90° by the formation method. Literature indicates that this is true of most filter media.

An electric field method is applied here to form media having average angles in the 0° to 45° degree range. Simple experiments show that glass fibers in a non-conducting liquid readily align due to an electric field (Figure 2). The challenge is making mats of such aligned fibers.

RECENT RESULTS

A piston device has been constructed to squeeze the aligned fibers to form mats (Figure 3). Microscope images in Figure 4 for the xz and yz planes show the fibers are highly oriented in the z direction. The filter samples prepared by this method have average angles of 35° to 40° . Experiments show media with smaller angles have improved quality factors. The media in Table 2 are smaller than the media in Table 1 and there may be scaling effects of the filter holder that make comparison between the filters in Tables 1 and 2 difficult, but the trends are the same.

FUTURE WORK

Future work includes (1) testing of larger filter samples, (2) forming media with angles less than 35° , (3) other fibers and binders, and (4) development of continuous forming methods.

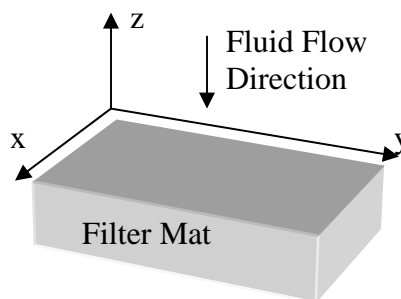


Figure 1. Z axis perpendicular to the plane of the mat.

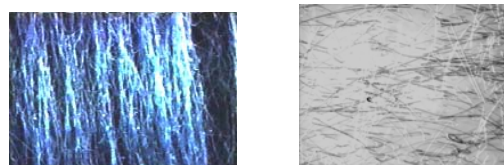


Figure 2. Chopped glass fibers (2 micron diameter and 10 to 100 micron in length) in silicon oil & carbon tetrachloride respectively, aligned by electric field.

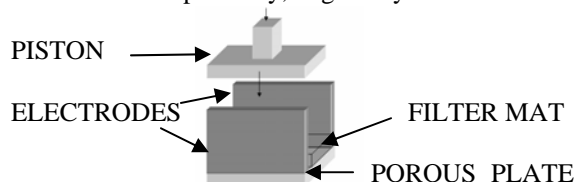


Figure 3. Electric field filter mat former.

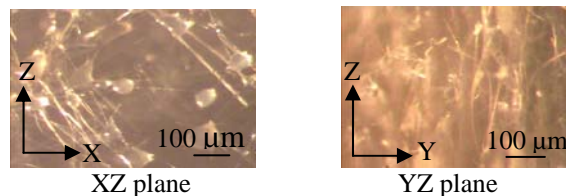


Figure 4. Images of fibers in sample mat formed in the electric field mat former (Figure 3).

Table 2: Quality factor of various media relative to 69° media for propylene glycol drop coalescence with 1.5 cm diameter 1 cm thick filter disks.

Average Fiber Angle, Degrees	Quality Factor relative to 69° media
36	1.22
40	1.14
66	1.01
69	1.00

ACKNOWLEDGEMENT

The work is supported by NSF Grant CTS-0310429 in collaboration with Parker Hannifin Corporation, Donaldson Company, Ahlstrom, Fleetguard, and Hollingsworth and Vose.

A.R. Patel, and G.G. Chase, "Control of Fiber Orientation in Non-woven Media by Electric Field," 9th World Filtration Congress, New Orleans, American Filtration Society, April 2004, paper 126-2.