Characterization of the Wet-Laid Nonwovens Made From Speciality Fibers (Ⅲ) : - Effect of Surface Treatment on the Porous Characteristics of Carbon Nonwovens -

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1. INTRODUCTION

The principle of the formation of a wet-laid web is based on drift deposition of a uniform fibrous layer from a fiber dispersion on a screen and on its successive drying. Compared to the dry web-making processes, the distinctive features of the wet method are isotropic properties of products and wide range of application. As well as all types of fibrous material can used to make wet-laid nonwovens. Especially, carbon fibers with high modulus, high temperature stability and high tensile strength are difficult to make with dry web-making process due to brittle properties(1-5).

The geometrical structure of wet-laid nonwovens is different from not only web manufacturing conditions but also the fiber properties. These parameters have influenced on the physical and mechanical properties of nonwoven fabrics.

In general, the application of speciality fibers used wet-form system is mainly high-temperature insulation, high-temperature filtration, replacement of asbestos-based backing materials and furnace lining. Particularly, the filter performance of nonwoven fabrics depends to a large extent on the web structure of the fabrics such as the porosity, thickness and the spaces between the fibers(4-9).

However, carbon fibers are not dispersed satisfactory in aqueous state since carbon fibers were treated with coupling agents. Accordingly, it is important to improve water dispersion of carbon fibers. Therefore, we have investigated the effect of fiber characteristics and surface treatment on the pore size distribution of wet-laid nonwovens made from the corona discharge treated or untreated carbon fibers.

2. EXPERIMENTAL

An web-making apparatus for this study was newly designed. The fiber used was carbon fibers and binder is polyester fibers. Carbon fibers were not dispersed satisfactory in aqueous state since carbon fibers were treated with coupling agents. Before the fiber cut, carbon fibers are treated with the corona discharge machine shown in Fig. 1. And then carbon fibers cut into fiber length 0.5, 0.75 and 1.0cm and binder

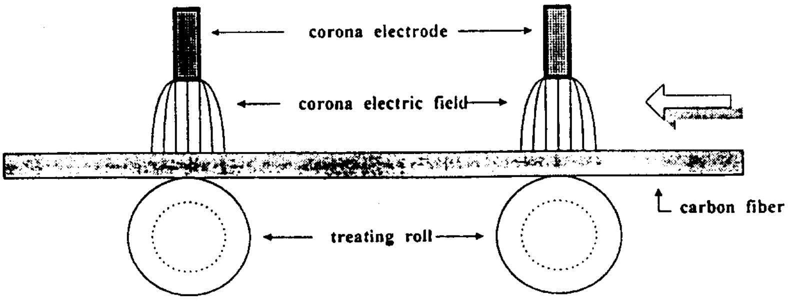

Fig. 1 . Schematic diagram of corona discharge system.

fibers cut into fiber length 0.5cm by a cutting machine.

The chopped fibers were dispersed in aqueous state by a agitator and the web was formed on a screen in wet web-making apparatus. The fiber contents were 30, 50, 70% of nonwovens by weight. The web was layered every 72^0 angle and bonded under pressure $50kgf/cm^2$ with Labo press during 60sec.

The basic weight per unit area, thickness and pore size of the nonwovens were subsequently measured. The basic weight(ASTM D3776) and thickness(ASTM D461) were measured with an electronic balance and a thickness gauge, respectively. The thickness and basic weight of specimen are applied to calculate the porosity of nonwovens. The pore size distribution was determined by the bubble point test with ethylalcohol media according to ASTM F316.

3. RESULTS AND DISCUSSION

3.1 Mean pore diameter

Fig. 2 shows the effect of fiber length and corona treatment on the mean pore diameter of carbon nonwovens. The mean pore diameter was increased with increasing the fiber length. It is considered that dispersion of the fiber having short length is better dispersed than that of long fiber length.

The effect of fiber contents and corona treatment on the mean pore diameter of carbon nonwovens is shown in Fig. 3. The mean pore diameter for the corona treatment nonwovens has decreased with increasing the fiber content, while for the untreatment nonwovens has increased with increasing the fiber content. It can be concluded that fiber aggregation like dumbbell types is much presented than in untreated carbon nonwovens, because the dispersion of untreated carbon fibers is less than that of treated carbon fibers.

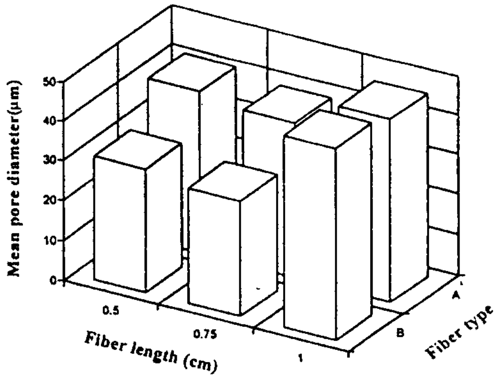

Fig. 2 . Effect of manufacturing condition on the mean pore diameter of carbon nonwovens.
(fiber content : 50%)
A : corona untreatment carbon fiber
B : corona treatment carbon fiber

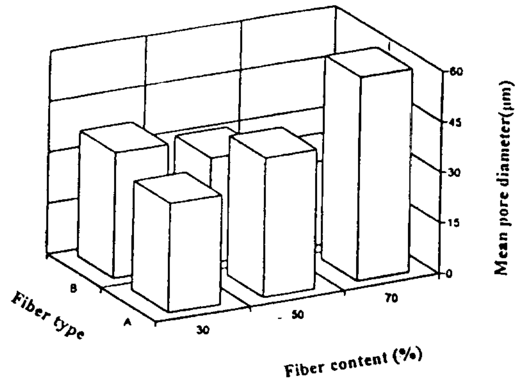

Fig. 3 . Effect of manufacturing condition on the mean pore diameter of carbon nonwovens.
(fiber length : 0.5cm)
A : corona untreatment carbon fiber
B : corona treatment carbon fiber

3.2 Cumulative filter flow

Fig. 4 shows the effect of different fiber length and corona treatment on the cumulative filter flow of carbon nonwovens. From this figure, it can be observed that the maximum pore size of carbon nonwovens has decreased with decreasing fiber length due to fiber dispersion. It is considered that pore size distribution of short fiber length is better than that of long fiber length.

Fig. 5 shows the effect of fiber contents and corona treatment on the cumulative filter flow of carbon nonwovens. The pore size distribution for the treatment carbon nonwovens is better than that of untreatment carbon nonwovens.

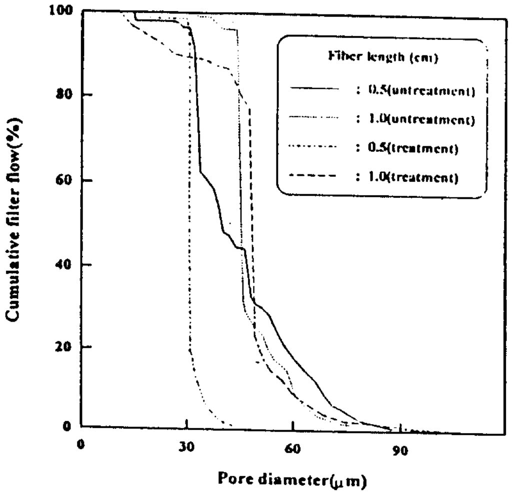

Fig. 4 . Effect of fiber length on the cumulative filter flow of carbon nonwovens.

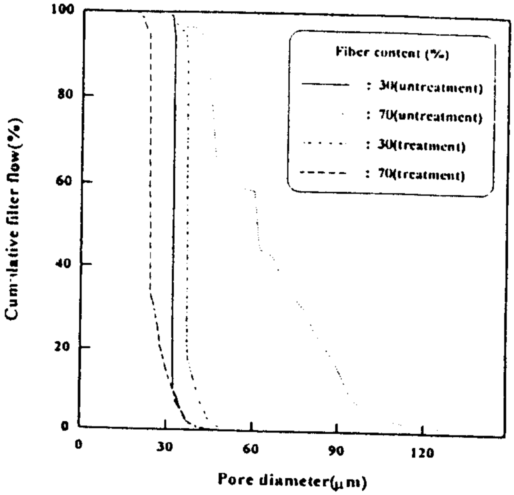

Fig. 5 . Effect of fiber content on the cumulative filter flow of carbon nonwovens.

4. CONCLUSION

we have investigated the effect of fiber characteristics and its surface treatment on the pore size distribution of wet-laid nonwovens made from the corona discharge treated or untreated carbon fibers. The results obtained in this study are as follows:

(1) The mean pore diameter is increased with increasing the fiber length.

(2) The mean pore diameter for the corona treatment nonwovens has decreased with increasing the fiber content, while for the untreatment nonwovens has increased with increasing the fiber content.

(3) the maximum pore size of carbon nonwovens is decreased with decreasing fiber length.

(4) The pore size distribution for the treatment carbon nonwovens is better than that of untreatment carbon nonwovens.

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