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Characterization of the Wet-laid Nonwovens Made from Speciality Fibers (Ⅱ)
- Fiber Characteristics and Tensile Properties Relationship -

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1. INTRODUCTION

The principle of the formation of a fibrous layer, or in the papermaking terminology "a sheet", is based on drift deposition of a uniform fibrous layer from a fiber dispersion on a screen and on its successive dewatering. 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(1-6). Especially, speciality fibers with high modulus, high temperature stability and high tensile strength difficult making with dry web-making process due to brittle property.

Thus, we attempt to make wet-laid nonwoven by using speciality fibers and investigate process conditions and tensile properties relationship of the products.

2. EXPERIMENTAL

An experimental apparatus for this study is newly designed and the fibers used are Oxipan®, carbon and glass fibers and binder is polyester fiber.

The chopped fibers are dispersed in aqueous solution by a agitator and the web is formed on a screen in wet web-making machine. The fiber content is 30, 50, 70% of nonwovens by weight. The web is layered every 72° and bonded under pressure 50kgf/cm^2 with Labo press during 60sec.

An Instron machine(Shimadra AGS-500B, Japan) is used to study stress-strain behavior of the specimen at the strain rate of 30mm/min(Cut strip method, ASTM D 461). The thickness of specimen is measured by ASTM D 461 with thickness gauge and average value is used to calculate the breaking stress.

3. RESULTS AND DISCUSSION

3.1 Effect of fiber length

The tensile properties of wet-laid nonwovens are shown in Table 1. For the different fiber length and fiber content of carbon nonwovens, this breaking stress is

shown in Fig. 1. The breaking stress and initial modulus were increased up to 0.75cm and decreased over 0.75cm for the carbon and glass nonwovens. The breaking stress of Oxipan® nonwovens was slightly decreased with increasing fiber length. but, Oxipan® nonwovens was not shown greatly difference. The breaking strain was not shown particular trend.

3.2 Effect of fiber content

While the breaking stress and initial modulus of the carbon nonwovens were decreased with increasing fiber content and glass nonwovens was increased up to 50% and decreased over 50%, Oxipan® nonwovens was increased with increasing fiber content due to good fiber dispersion. It can be concluded that dispersion of Oxipan® fiber was better than carbon and glass fibers.

Table 1. Tensile properties of nonwovens for the manufacturing factors

specimen	properties	breaking stress (gf/mm²)			breaking strain (%)			initial modulus (kgf/cm²)		
	mixing ratio / fiber length(cm)	30/70	50/50	70/30	30/70	50/50	70/30	30/70	50/50	70/30
Oxipan®/ PET	0.50	901.86	900.67	859.85	1.71	2.11	3.24	68.70	65.37	61.06
	0.75	771.99	904.54	1008.34	1.93	2.62	4.00	50.85	61.71	66.38
	1.00	746.29	909.52	969.42	1.87	3.07	2.93	56.24	54.30	48.63
	1.50	832.75	864.74	1147.36	2.11	4.00	2.93	50.03	45.41	62.82
carbon/ PET	0.50	2670.88	2025.27	1246.86	1.13	1.13	0.84	225.64	184.48	173.35
	0.75	2788.52	2672.14	1007.38	1.36	1.27	0.80	227.38	275.99	138.32
	1.00	2423.13	2798.09	1103.02	1.00	1.00	0.93	226.41	229.28	151.93
glass/ PET	0.50	431.11	1261.03	199.11	1.64	1.33	1.04	30.02	118.21	28.99
	0.75	1381.78	1065.54	505.61	1.40	1.47	0.96	104.09	101.96	69.68
	1.00	650.78	1008.44	470.48	1.20	1.00	1.09	46.62	56.06	101.87

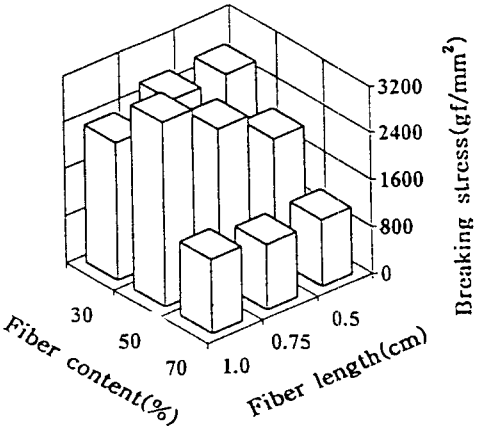

Fig. 1. Effect of fiber content and fiber length on the breaking stress of carbon nonwovens.

4. CONCLUSION

We have investigated the relationship between process conditions and tensile properties relationship of the wet-laid nonwovens produced by speciality fibers. The results obtained in this study are as follows.

(1) The breaking stress and initial modulus of carbon and glass nonwoven are increased up to 0.75cm and decreased over 0.75cm. Oxipan® nonwovens is slightly decreased with increasing fiber length. but, Oxipan® nonwovens shows not greatly difference due to better fiber dispersion. (2) The breaking stress and initial modulus of carbon nonwovens with increasing fiber content are decreased and glass nonwovens is increased up to 50% and decreased over 50%.

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