The Compressional Properties of Needle Punched Nonwoven Fabrics

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1. INTRODUCTION

A needle punching technology is that barbs entangle fibers of web by needle penetration and fabric structures are achieved for the required properties of end-use. The application of the needle punched fabrics are mainly filtration media, geotextiles, interlining, laminated backing and carpet components. In selecting the nonwoven fabrics for specific works, we must consider the different characteristics of the fabrics as they relate to the type of the application.

The tensile property, hydraulic and porous properties have been studied for the purpose and some papers have been reported on the tensile property[1-3], hydraulic behavior[4-5] and porous behavior[6-7] of needle punched nonwoven fabrics.

These properties are changed by continuously normal pressure on the fabrics and it is important to characterize the compressional properties of nonwoven fabrics. In the present work, we have studied compressional behavior of various needle punched nonwoven fabrics.

2. EXPERIMENTAL

The fabrics are made with random-laid and blended web of 51mm polyester staple fiber(1.4, 2.5den.) and produced by preneedling and opposed double needling with different GSM of web and punching density. The preneedling density is $30/cm^2$ and preneedle and main needle punching machine are manufactured by Fehrer and Asselin company, respectively. The compressional properties such as LC(Linearity of Compression), WC (Compressional Energy), RC(Compressional Resilience), and EMC(Compressional Rate) are measured by using the KESF system and the compressional parameter(K) are evaluated.

3. RESULTS AND DISCUSSION

The compressional property data are present in Table 1. Fabric density is increased with punching density. However, the value is decreased for excessive punching density, that means fiber or entangled fiber breakage. Since with needle punching process drafting and spreading are occurred, the fabric weight is decreased with punching density. The compressional parameter of different nonwoven fabrics is analyzed to obtain the relationship between thickness and pressure. We have found the following equation for the compressional parameter:

$$K = (1-T/T_o) / \ln (P/P_o)$$

where, T_o is the initial thickness at initial pressure P_o(0.5gf/cm^2) and T is the thickness at any pressure P. The K value is decreased with fabric density, which is that more fibers are

consolidated indicating lower compressional behavior.

From the fact that LC and RC values are generally increased with fabric density and that WC and EMC are decreased, recovery behavior of fabric is considerably good, whereas the compressibility of fabric is low with fabric density.

Table 1. Compressional Data of the Different Needle Punched Nonwoven Fabrics.

Sample	Fabric Weight (g/m^2)	Thickness (mm)	Fabric Density (g/m^2)	Compressional Parameter(K)	LC	WC	RC (%)	EMC (%)
AP1	308.3	2.86	0.108	0.0490	0.490	0.086	47.14	22.73
AP2	295.0	2.71	0.109	0.0506	0.492	0.079	47.41	23.28
AP3	283.0	2.70	0.105	0.0536	0.453	0.080	46.28	24.38
AP4	268.3	2.56	0.105	0.0546	0.490	0.086	45.73	25.16
AP5	263.3	2.61	0.101	0.0547	0.466	0.083	46.16	25.16
BP1	370.0	3.10	0.119	0.0417	0.482	0.072	48.24	19.18
BP2	366.7	3.04	0.121	0.0419	0.510	0.072	46.73	19.27
BP3	356.1	2.85	0.125	0.0427	0.498	0.070	46.13	19.65
BP4	357.1	2.67	0.134	0.0427	0.521	0.068	47.09	19.67
BP5	355.0	2.86	0.125	0.0452	0.467	0.069	50.71	20.80
CP1	488.3	3.56	0.137	0.0341	0.508	0.071	48.78	15.71
CP2	480.0	3.53	0.136	0.0367	0.511	0.076	42.61	16.87
CP3	489.9	3.25	0.151	0.0334	0.505	0.061	49.77	15.39
CP4	475.1	3.21	0.148	0.0349	0.507	0.072	48.54	15.98
CP5	464.8	3.10	0.150	0.0331	0.500	0.062	50.31	15.22
DP1	674.9	4.34	0.156	0.0268	0.532	0.071	47.01	12.33
CP2	666.7	4.34	0.154	0.0255	0.527	0.067	47.63	11.75
DP3	655.0	3.80	0.173	0.0253	0.497	0.055	51.96	11.58
DP4	614.8	3.70	0.166	0.0261	0.461	0.063	52.98	12.01
DP5	586.7	3.43	0.171	0.0264	0.440	0.056	54.13	14.70

4. CONCLUSION

From the study of the compressional properties of needle punched fabrics, we have found the facts as follows: (1) The value of compressional parameter is decreased with increasing fabric density, whereas the value is increaded with decreasing the thickness, (2) The LC and RC values are generally increased with decreasing the compressional parameter, and (3) The WC and EMC values show a opposite trend with LC and RC values for the different nonwoven fabrics.

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