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Structure of Non-Woven Fabrics Part V-New Parameters for Assessing Structure of Laminated Non-Woven Fabrics.

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STRUCTURE OF NON-WOVEN FABRICS
PART V -NEW PARAMETERS FOR ASSESSING STRUCTURE OF LAMINATED NON-WOVEN FABRICS.

By

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الخـلاصـه :

تركيب الاقمشة الغير منسوجة عديدة الطبقات يمكن تعينه باستخدام معاملات جديدة مثـل صـلابة القماش ودليل طاقة الامتصاص . هذه المعاملات يمكن تعينها أثناء تعرض القماش للانضغاط، للاقمشة المعبئة جيدا (التى معامل تعبئتها كبير) تكون صلابتها كبيرة فحين ان دليل طاقـة امتصاصها يكون قليل ـ والعكس يمكن قوله حول الاقمشة التى معامل تركيبها يكون أقـل .

ABSTRACT

The structure of laminated non-woven fabric could be assessed by two new parameters namely fabric hardness (H) and energy-absorbed index (b). These two parameters are obtained when the fabric is subjected to compression. For highly packed structures, i.e. those with hgih packing density coefficient (Ø) fabric hardness is high and the energy absorped in compression is low. The opposite is to be said about structures of low packing of fibres.

1. INTRODUCTION

In part I of this series of articles is given the various methods used for the time being to assess the structure of non-woven fabrics (1). One of these methods is the method of determining the packing density coefficient (Ø). The equation for this structural parameter is:

$$Ø = M/\bar{\rho} d \qquad \text{......(1)}$$

where M = mass/unit area of laminated NW fabric ($Kg.m^{-2}$)
d = laminated NW fabric thickness (m)
$\bar{\rho}$ = average fibre density of the composite layer/adhesive ($Kg.\ m^{-3}$)

The literature available shows that the thickness (d) is measured under arbitrarly pressure, ranging between 1 and 5 g/cm^2, and in some cases under a pressure of 24 g/cm^2 (2,3,4,5,6,7 and 8).

Since no standard is available for measuring the thickness of various non-woven fabrics, it was decided to examine first the nature of the relationship between thickness and pressure for each of the fabrics under consideration. The thickness of fabric was measured at twelve pressure ranging between 0.20 and 104.2 g/cm^2 using the Shirley Thickness Gauge with the largest foot (Area = 50 cm^2).

The equation of thickness-pressure proposed by Bogaty was used and found suitable. This equation is in the form of;

$$d = a + b/p+c \qquad \text{......(2)}$$

where; d = thickness of fabric at any pressure (mm)
a = limiting thickness (mm)

p = pressure (g/cm^2)
c = correction of pressure (in the low range)
b = parameter describes the energy absorped per unit area of fabric.

The procedure of using this equation is given in Ref.(9). In the present investigation the mean b-value was determined from the b-values (obtained at the low-range pressures), that give a c.v.% of not more than 10%.

Since we are looking for new parameters to describe the structure of a non-woven fabric, it was thought of a parameter that is related to the resistance of the fabric to deformation under compression. This resistance depends on many factors and among it is fibre packing within the structure. Therefore it was decided to use the hardness value as a structural parameter. According to Peirce (10) the hardness (H) of a textile fabric could be determined from the equation;

$$H = P_2 - P_1/t_1 - t_2 \qquad ......(3)$$

where t_1 and t_2 are fabric thickness measured at two arbitrarly pressures P_2 and P_1 respectively.

2. RESULTS AND CONCLUSIONS

2.1. Relationship Between Pqcking Density Coefficient (Ø),Fabric Hardness (H) and Energy Absorbed Index (b):

The values of the packing density coefficient (Ø) were calculated from equ. 1. For any particular N W. fabric, the value is not constant since thickness various with pressure. The value of Ø was calculated at twelve pressure ranging between 0.20 and 104.2 g/cm^2 and the mean Ø-value was obtained for the values that it's c.v.% is not more than 10%. It was interesting to find for the fabrics examined that these values are those calculated for thickness values measured at pressure ranging between 0.20 and 2.4 g/cm^2 and for majority of fabrics Ø could be considered constant between pressures 0.20 g/cm^2 and 1.2 g/cm^2 .

For the laminated NW fabrics examined the value of Ø ranges between 0.0439 and 0.1689. Naturally as the value of Ø approaches unity (Ø = 1) the packing of fibres within the fabric is maximum.

With respect to fabric hardness, it was calculated using equ.3 at two arbitrarly pressures namely 0.20 and 104.2 g/cm^2. The value of H ranges between 17.255 and 67.883 $g/cm^2/mm$.

Plotted in Fig. 1 the values of Ø versus H. It is interesting to observe from the figure that the packing density coefficient Ø tends to be high for hard to press fabrics and vice-versa. The ranking correlation coefficient R = 0.86 and highly significant at the 5% level. In fact this trend indicated that when the fibres are well show more resistance to deformation under compression, than when the fibres are less packed.

The correlation found between Ø and H indicated that the hardness value could be used instead of the packing density coefficient when assessing the structure of laminated N W fabrics and hence could be used as a structural parameter.

No doubt from the practical point of view the determination of fabric hardness is much easier than the packing density coefficient, since in the latter structural parameter three values have to be known (fabric mass/unit area, fabric thickness and fibre density). While in calculating fabric hardness, all needed is the measurement of thickness at two arbitrarly pressures and using the equation of hardness directly.

Since we are looking for new parameters to describe the structure of N W fabric, it was also thought of a parameter that is related to fibre packing in the structure. The energy absorbed when a laminated N.W fabric is subjected to compression depends on many factors such as surface hairness fibre packing, fibre compression modulus and others. Therefore one would expect the energy absorped to be high for deformable fabric and low for hard to press fabric.

The energy absorbed index "b" was determined according to Ref.9, using the thickness-pressure equation of each fabric. The value of b ranges between 5.526 and 21.740 g.cm/cm^2.

It was found that the product of laminated NW fabric hardness H and compression energy index for all tested NW fabrics is constant, i.e. Hb = 375.

Plotted in Fig. 2 the values of b versus H. It is interesting to observe from the figure that high values of H are associated with low values of b and vice-versa. Since H is well related to Ø, hence one would expect a strong relationship between Ø and b. The value of b is fairly constant between pressures 0.20 and 4.20 g/cm^2, and for majority of fabrics between 0.20 and 1.20 g/cm^2.

Plotted in Fig.3 the values of b versus Ø. It is evident from the figure that the energy absorped in compression tends to be less for fabrics of high packing density and vice-versa. Again the parameter b could be used as a structural parameter for laminated N W fabric instead of the packing density coefficient Ø, but here again the procedure is length since the thickness-pressure relationship has to be known first for each fabric. It is evident again that generally fabric hardness could be used as a quick and easy structural parameter for laminated non-woven fabric of reasonable constructions.

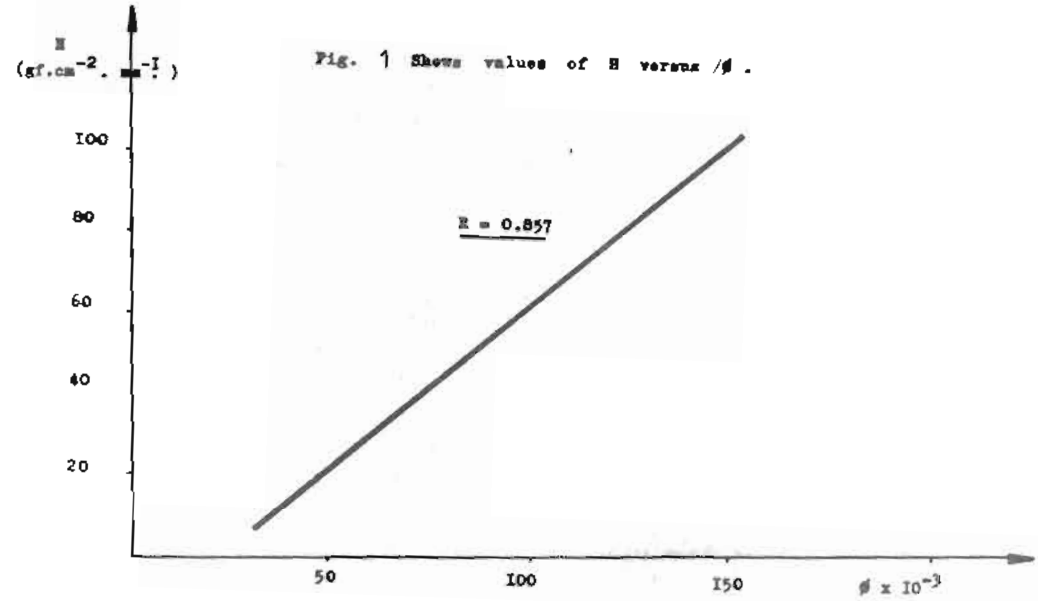


Fig. 1 Shows values of H versus /ø .

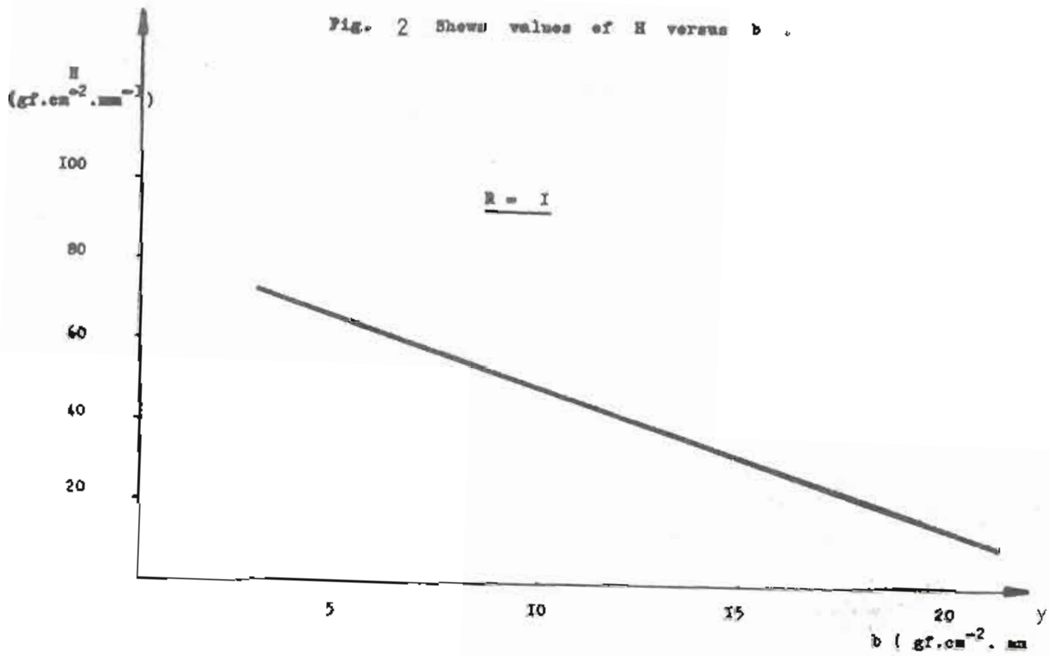
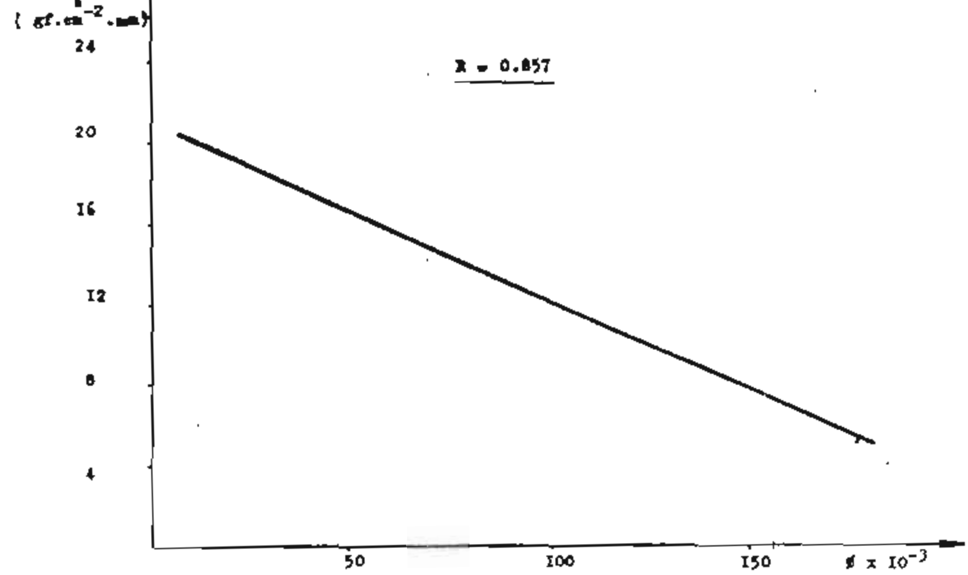


Fig. 2 Shows values of H versus b .

Fig. 3 Shows values of b versus ø



APPENDIX:

Available details of the laminated NW fabrics are given in Table I.

	Composte of the laminate	Mass/area $Q_s(g.m^{-2})$	Thickness t(mm) $0.6(g.m^{-2})$	Thickness t(mm) $104.2(g.cm^{-2})$	Packing den. coef. Ø	Fabric hardness $H(g/cm^2.mm)$	Energy absorbed $b(g\ cm^{-2}.mm)$	H.b
1-	Mech. punched fabric Composed of two leyers of 100% wool fibres.	958.766	7.530	4.378	0.0920	28.331	13.241	375.125
2-	- Surface from 100% POP ground synth. leather	864.290	3.700	2.384	0.1689	67.883	5.526	375.119
3-	Mech. quilted NW composed of:- two layers from cotton fabric + one layer from PES.	437.227	5.355	1.740	0.0503	24.698	15.188	375.110
4-	chem. quilted NW from:- two layers from cotton fabric + one layer from PES.	487.000	7.160	1.985	0.0439	17.255	21.740	375.113
5-	Jute layer sandawitched between two layers of PES.	2300.000	18.017	16.207	0.0900	45.337	7.603	375.110
6-	Jute layer sandawitched between four layers of PES.	642.762	7.336	5.094	0.0600	39.832	9.418	375.135
7-	- Surface 100% PES, intermedite from PES waste, - ground from Jute.	1600.000	10.400	8.800	0.1130	55.812	6.721	375.109

NW = Non-woven.

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