Pak. j. sci. ind. res., vol. 35, no. 9, September 1992

THE RELATIONSHIP BETWEEN THE INTERFACIAL TENSION AND COMPRESSION OF VARIOUS FINISHED FABRICS

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(Received July 22, 1992; revised September 29, 1992)

Following brief review on softener and fabric softness, a softener parameter is described which is found to be related with fabric softness measured by fabric compression.

Key words: Softners, Surfactance, Interfacial tension.

Introduction

Fabric softness is considered to be an important component of fabric handle [1]. Softness to touch can be changed by the use of various softeners in a textile chemical finishing process. Various fabric mechanical properties are found to be related with the fabric softness. Softener parameters [2,3] including ionic nature (cationic, anionic and nonionic) concentration and treatment condition (pH, temperature and application method). In literature the relationship between any softener parameter and fabric softness is not well described and there is no simple account to be given of the effect of softener on fabric softness.

Elder [1,4] has reported the compression (mm) as a sensitive parameter of fabric softness. Compression is found to be linearly related with the subjectively assessed softness by human touch on a log scale. Syed [5] has reported a sensitive method of compression measurement for the characterization of various finishing effect ranging from softeners to urea formaldehyde resins.

Majority of softeners being the surfactant and their application is largely carried out in water. The interfacial tension of softener is being taken as a parameter of softener, for the present work and an attempt has been made to relate to interfacial tension to the compression of their treated fabric.

Materials and Method

The cotton drill was used as a control fabric. The use of Wilhelmy [6] balance is considered to be the most convenient method for the measurement of interfacial tension. It requires the dipping of a platinum plate in a test solution. The plate is attached to an analytical balance, at torsion balance that allows the surface tension to be recorded automatically on a chart recorder.

The main apparatus is assembled in plastic box or hood to minimize the amount of dust falling on the surface. To measure surface tension the device is calibrated. About 20 ml of the finishing agent dissolved in water is introduced on a china dish just beneath the edge to the plate. The height of the finishing agent is adjusted by means of screw and the plate is allowed to dip in the finishing agent that allows the surface tension to be recorded.

$$\text{Surface tension} = \frac{W \times g}{2\,(l+b)} = \text{dyne/cm}$$

where W = Difference in mass of plate in solution, l = Length of plate, b = Thickness of plate, g = Acceleration due to gravity. The dimension of the plate in our case were

Length of plate = 3.29 cm.

Thickness of plate = 0.0062 cm.

For compression measurement an INSTRON Model 1132 fitted with an appropriate compression load cell was used. Fabric samples were measured for thickness and change of thickness with increase decrease of pressure. The use of an INSTRON enabled to detect the changes in thickness which were magnified one hundred times on the chart. Similarly load sensitively was studied at X10 magnification. Both features enabled more sensitive measurements to be made than usually reported [7,8].

Results and Discussion

Table 1 shows the results obtained for the surface tension measurements of various finishing agents of different concentrations. There are two points that should be noted. Firstly the marked increasing trend in surface tension among finishing agents ranging from surfactant to urea formaldehyde resin. Secondly the smalll change in surface tension caused by the change in concentration of finishing agent. The range of concentration of finishing agent corresponding to the concentration of finishing agent used in the finishing bath to treat the control fabric in this present work.

A comparison between surface tension of finishing agents and the compression of treated fabric is also shown in Table 1. Addition of surfactant to water greatly reduces the surface tension. When fabrics were treated with surfactant a large increase in compression was observed. Part of this increase in compression is probably due to the deposition of surfactant which acts as a compressible film but more probably the

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TABLE 1. THE COMPARISON BETWEEN INTERFACIAL TENSION OF VARIOUS FINISHING AGENTS AND COMPRESSION OF THEIR TREATED FABRICS OF DRILL FABRIC.

Finishing code	Treatment	Composition	Conc. g/100 ml	Surface tension dyne/cm	Compression* (mm)
F1	Dilasoft TFM (a)	Sulphonic acid	3.0 6.0	36.8 35.5	0.19 0.16
F2A	Surfactant PEG (b) Lubricant	PEG M.W. 4000	5.0	61.4	0.15
F2B	" " " (c)	PEG M.W. 200	5.0	53.1	0.16
F3	KNITEX TC resin	Urea formaldehyde resin	15.0 20.0	70.3 71.5	0.05 0.06
F4	KNITEX TC with Knitex TCF catalyst	Urea formaldehyde resin with ammonium salts.	10.0 12.0 15.0	63.2 72.1 69.1	0.10 0.09 0.10

(a) Dilasoft TFM SANDOZ. (b) PEG Polyethylene glycol. (c) KNITEX TC = CIBA GIEGY. *(d) Compression = gf / cm^2.

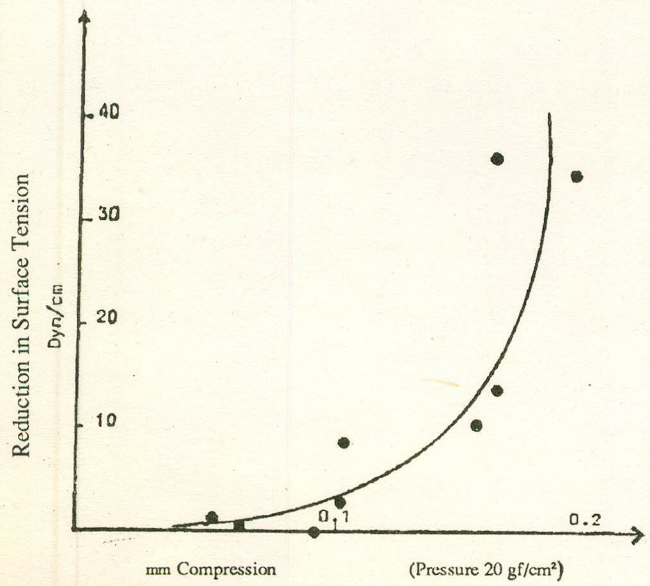

Fig. 1. Relationship between the reduction in surface tension and compression of various treated fabrics.

explanation lies in lubrication. The treated fabrics were also found to be thicker. It is interesting to compare these findings with the compression of fabrics treated with formaldehyde resin. Urea formaldehyde resin has little effect on surface tension of water and fabrics treated with urea formaldehyde resin became less compressible and showed no difference in thickness. Finishing agents which caused smaller reductions in surface tension of water such as polyethylene glycols and urea formaldehyde resin in the presence of a catalyst were observed to produce intermediate changes in the compression of their treated fabrics.

Figure 1 shows the relationship between the compression (pressure 20 gf/cm^2) of the treated fabric and reduction in surface tension of finishing agents relative to the surface tension of water. If we assume [1,4] for the present work that compression is a measure of softness of fabric then the larger the compression the softer the fabric. But a large reduction in surface increases the softness of finishing agent in its aqueous solution. Thus the larger the reduction in surface tension the softer the solution will be. This provides a basis of comparison between the softness of the finishing agent and the softness of its treated fabric.

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