CHAPTER 13

OPTIMISATION OF HEAT SETTING AND WEIGHT REDUCTION TREATMENTS TO POLYESTER FABRICS TO OBTAIN THE DESIRED LEVEL OF QUALITY - APPLICATION OF SHEAR PROPERTIES

13.1 INTRODUCTION

Polyester fabrics are subjected to heat setting and weight reduction treatments with a view to improving their properties for the consumers. Polyester fibre possesses excellent mechanical properties such as high tenacity and considerable durability as well as easy wash-n-wear and wrinkle-free characteristics. However, apparel textiles produced from polyester fibre/filaments have some disadvantages such as a waxy and clammy feel, high static charge, hydrophobicity, oleophilicity, low moisture regain and a tendency to pill especially in blends. Several attempts have been made to overcome some of these deficiencies. One such method is the weight reduction or more precisely, the hydrolysis of polyethylene terephthalate by alkaline sodium hydroxide solution. Such weight reduction of the polyester fibre gives many advantages such as increasing the absorbency, hydrophilicity, moisture regain and dye-uptake, while decreasing the tendency to pill and generation of static charge. In addition, the process improves the fabric handle resulting in a silk-like feel. Production of silk-like polyester fabric from continuous filament yarns is of great interest to the apparel industry. Moreover, in textile processing, polyester fabrics are heatset to improve dimensional stability and prevent creases during subsequent wet processing and end use.
Fabric objective measurement has become very popular for apparel fabric assessment and optimisation of process parameters. Traditional methods to measure the fabric properties are not sensitive enough to characterise the fabric handle. In this chapter, KES system (Tensile cum shear tester) has been used to optimise the weight reduction by alkaline hydrolysis.

13.2 MATERIALS AND METHODS

Shear parameters, which comprise G 2HG and 2HG5, have been measured using Kawabata tensile cum shear tester.

A twisted polyester filament fabric commonly used as a saree material was the starting material. Details of the material are given in Table 13.1.

13.2.1 Methods of Treatment
13.2.1.1 Heat - Setting

The fabric was scoured at 70°C for 1 hour and dried; it was subsequently wound on an aluminium frame (40 cm x 40 cm) and heat set at 160°C, 180°C and 200 °C for 3 minutes in the laboratory pad dry cure machine.

13.2.1.2 Alkaline hydrolysis

Caustic hydrolysis was carried out in 15% aqueous NaOH solution at 90°C for 25 minutes in the beaker dyeing machine. In order to study the effect of percentage weight reduction, the fabric heat set at 180°C was further hydrolysed to different extents by varying the concentration of NaOH keeping the time (25 minutes) and temperature (90°C) constant. Finally, the hydrolysed fabrics were neutralised by acetic acid, washed in...
TABLE 13.1
DETAILS OF GREY FABRICS

<table>
<thead>
<tr>
<th>Yarn</th>
<th>Den/Fil</th>
<th>Threads per cm</th>
<th>Weight g/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warp</td>
<td>68/36</td>
<td>85</td>
<td>51</td>
</tr>
<tr>
<td>Weft</td>
<td>67/36</td>
<td>68</td>
<td></td>
</tr>
</tbody>
</table>
cold water and then dried. Weight loss was determined by gravimetric method.

13.3 RESULTS AND DISCUSSION
13.3.1 Effect of heat setting temperature

Figure 13.1 shows that with increasing temperature, shear rigidity increases and levels off at 200°C. Shear hysteresis (2HG) shows a decline with increase in heat-setting temperature, while 2HG5 shows no significant change. It may be noted that the heat-setting treatment was given to the fabrics under tension state. The reduction in 2HG shows that the heat set fabric recovers easily when a small shear strain is applied. An increase in G would mean an increase in stiffness and it appears that a heat-setting temperature of 180°C will suffice to bring about an improvement in quality.

13.3.2 Weight reduction treatment

It is a well known fact that weight reduction of polyester fabric leads to a silk like feel. Figure 13.2 shows clearly that G, 2HG and 2HG5 values have decreased significantly. It appears that a 5% weight loss is adequate to bring about a marked reduction in shear. These results appear to be somewhat contradictory to those obtained with heat set samples (Fig.13.1). In the latter case, it has been found that G accompanied by 2HG5, showed an increase. A consistent decrease in the shear of the weight reduced polyester fabrics has been noticed. The reasons for the decrease in shear parameters are the reduction in fibre diameter of polyester fibres following alkali treatment. Also, several studies conducted by Matsudaira and Kawabata (1988) have demonstrated that silk fabrics have the lowest shear stiffness mainly due to the existence of a small gap, called "effective gap" between the warp and weft threads at the crossover point; these are responsible for the peculiar hand. The alkali treated fabrics have low shear properties, because effective gaps are generated between fibres and/or yarns.
Figure 13.1 Effect of heat setting on fabric shear properties.

Figure 13.2 Effect of weight reduction on the shear behaviour of polyester fabrics.
Although the shear property of polyester fabrics approaches very close to the silk fabric after weight reduction treatment, there is a limit to the amount of weight reduction that is partially acceptable. Too strong a reduction makes the fabric unstable and leads to slippage of the yarns. It is reported that by alkali treatment maximum possible gap that can be generated is 5 μm. However, from aesthetic point of view a gap of 3-4 μm is partially more acceptable for the above reasons. This gap is smaller than that of the silk fabric (6-7 μm). The silk fabric is still stable even with such a large gap because it has a very small irregular natural crimp. These distinguishing features are responsible for the elegant and soft touch of the alkali treated fabrics.

13.4 CONCLUSION

The above investigation shows that KES - shear tester can be effectively used for optimizing the conditions of heat setting and weight reduction.