Characteristics and Processing Performance of Pineapple Leaf fibre

R K ARORA, N P GUPTA and P C PATNI
Central Sheep & Wool Research Institute, Avikanagar 304 501, India
Received 17 December 1984; revised received 6 March 1985; accepted 6 April 1985

Spinning of the blends of pineapple (Ananas comosus) leaf fibre with wool, polyester waste and viscose rayon fibres on a worsted set of machinery gave a stronger yarn, specially useful for furnishing and decorative fabrics.

Keywords: Pineapple leaf fibre, Polyester waste, Spinning, Viscose rayon, Wool

The fibre from pineapple (Ananas comosus) leaves, a major agriculture waste, is a valuable industrial raw material. Fibre yield amounts to 2-3% of the weight of the green leaves. If properly extracted from the leaves, about 3 lakh metric tonnes (per annum) of fibre would be available in India. Work on the utilization of the fibre reported is mostly confined to yarn spinning on jute and cotton machinery. The conventional carding system for processing jute being unsuitable for processing pineapple leaf fibre, cards with higher pin density were necessary for obtaining better filamentation of the fibres. This paper deals with the spinning of the leaf fibre and its blends on a worsted system of machinery, the yarn spun being meant for making furnishing and decorative fabrics.

Pineapple leaf fibre procured from the Khadi & Village Industries Commission, Bombay; viscose staple (3 den x 65 mm) from Gwalior Rayon Silk Mfg (Wvg) Co. Ltd, Nagda; polyester waste from Petrofils Cooperative, Baroda; and indigenous coarse wool of about 35 µm fineness were used in the trials.

The gum and other extraneous materials from the fibre were removed before mechanical processing, the degumming treatment being done in 0.5% caustic soda plus 0.1% Lissapol D paste at 60°C for 24 h. The degummed material was washed thoroughly, neutralized, hydroextracted, and air-dried. The fibre was bleached with 33% hydrogen peroxide at 70-75°C and pH 10-11 (using 0.5% sodium silicate).

Blends of the fibre with polyester waste, viscose and wool were processed on a Japanese worsted set of machinery, reported elsewhere. The fibres were stack-mixed for each blend before willowing. About 12 Nm yarn was spun from each blend with a twist multiplier of about 120.

Stress-strain curves for the fibres were recorded by stretching the fibres on an Instron tensile strength tester by keeping gauge length and crosshead-to-chart speed ratio at 20 mm and 1:10 respectively. About 50 fibres of each type were tested. The linear density of individual fibres was determined with a vibroscope. The dry and wet fibre tenacities and elongations were calculated in accordance with the standard procedures. The fibre bundle tenacity, at 1/8 in. gauge length, was measured by a stelometer. Yarn tenacity and elongation tests were made on an Instron, the gauge length and crosshead speed being kept at 50 cm and 25 cm/min respectively. Yarn evenness was tested on an Uster evenness tester. The material was conditioned overnight and tested in controlled atmospheric conditions (65 ± 2% RH, 27 ± 2°C).

The properties of the pineapple leaf fibre (Table 1) show that degumming and bleaching treatments have improved the fibre fineness with the removal of gum. Fibre bundle tenacity (Table 2) and stress-strain curves (Fig. 1) for fibres show that the pineapple leaf fibre is better than viscose and wool fibres and almost equal to polyester waste in strength but the extensibility of pineapple leaf fibre is much lower in comparison with that of other fibres. The breaking load, tenacity and elongation values of pineapple leaf fibre (Table 1) show that the strength of untreated and degummed fibres
Table 3—Breaking Tenacity, Elongation and Evenness of Pineapple Leaf Fibre Blends with Wool, Viscose and Polyester Waste

<table>
<thead>
<tr>
<th>Blend proportion</th>
<th>Breaking tenacity g/tex</th>
<th>Elongation %</th>
<th>Thin places</th>
<th>Thick places</th>
<th>Neps</th>
<th>CV %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pineapple leaf fibre : Wool</td>
<td>11.12</td>
<td>4.00</td>
<td>21</td>
<td>38</td>
<td>85</td>
<td>20.0</td>
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<tr>
<td>40 : 60</td>
<td>9.06</td>
<td>3.70</td>
<td>90</td>
<td>74</td>
<td>183</td>
<td>25.0</td>
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<tr>
<td>60 : 40</td>
<td>6.46</td>
<td>4.17</td>
<td>72</td>
<td>74</td>
<td>157</td>
<td>22.0</td>
</tr>
<tr>
<td>Pineapple leaf fibre : Viscose</td>
<td>8.43</td>
<td>3.90</td>
<td>17</td>
<td>20</td>
<td>64</td>
<td>21.5</td>
</tr>
<tr>
<td>40 : 60</td>
<td>8.12</td>
<td>2.82</td>
<td>155</td>
<td>86</td>
<td>129</td>
<td>25.3</td>
</tr>
<tr>
<td>60 : 40</td>
<td>14.64</td>
<td>7.31</td>
<td>97</td>
<td>74</td>
<td>199</td>
<td>25.0</td>
</tr>
<tr>
<td>Pineapple leaf fibre : Polyester waste</td>
<td>10.82</td>
<td>3.44</td>
<td>46</td>
<td>59</td>
<td>171</td>
<td>24.5</td>
</tr>
</tbody>
</table>

Fig. 1—Stress-strain curves for different fibres

decreased by about 57% in wet condition, whereas the bleached fibre on wetting showed an improvement of about 10%. The fall in strength in wet condition could be ascribed to the penetration of water molecules in the multicellular lignocellulosic fibres, swelling up and, to some extent, loosening of the binding of the ultimate cells, resulting in cell slippage when load is applied. On wetting, extension of untreated and degummed fibres is reduced by 7 and 12% respectively, whereas in bleached fibres it is improved by 30%.

The breaking tenacity, elongation and evenness of pineapple leaf fibre blends with wool, polyester waste and viscose are given in Table 3. The results generally show that the addition of viscose, polyester and wool improves the yarn tenacity and elongation, indicating that about 60% admixture of the pineapple leaf fibre with other fibres makes a reasonable blend with good strength and evenness. The maximum strength gain in pineapple leaf fibre blends with polyester waste is mainly because of the higher initial modulus of the blend components in comparison with that of other fibres. Viscose, despite having comparatively poor fibre strength, assisted in smooth processing. The strength of pineapple leaf fibre-viscose blend yarn is sufficient for smooth weaving. The results show that these yarns after dyeing will have sufficient utility in the production of furnishing and decorative fabrics having differential types of shades.

Acknowledgement

The authors thank Dr C L Arora, Director, CSWRI, Avikanagar, for encouragement during the course of the work. They are also thankful to Shri J P Mathur for assistance in testing.

References