Hairiness of Yarns Made of Recycled Waste Fabric

G. M. El-Nouby

Department of Textile Engineering, Textile Research Division, National Research Centre, Dokki, Cairo, Egypt

Abstract: Hairiness of yarns containing cotton was compared with yarns formed from recycled waste (fabric waste). Many blended was formed a) 1st blend contains 90% recycled waste, b) 2nd blend contain 50% recycled waste (blending in blow room), c) 3rd blend contains 90% recycled waste and 10% reused cotton waste (blending with card slivers) d) 4th blend contains 90% recycled waste and 10% reused cotton waste (blending in draw frame). Hairiness test was measured to compare between different yarns blended formed and 100% cotton waste yarns, and found that as yarns count increase, the hairiness decreases, and as the percent of recycled waste increase, the hairiness increase, and produced yarns from pure cotton have lower hairiness, and for all yarns, hairiness decrease as yarn count increase for all twist factors and for produced yarn of blends No. (2), (3), and (4) hairiness increase as the No. of mechanical process increase for all yarns counts.

Key words: Hairiness, Recycled Waste and Blended Yarn

INTRODUCTION

Yarns prepared from recycled waste have similar hairiness which made of short fibres, the hairiness of these yarns is influenced with the natures of these fibres and ways of spinning type and yarns counts[1,4].

In this study had made different blends to insure this behaviour, and to compare the results of yarn hairiness. Also, the yarn that produced from recycled waste influenced with parameters other than that we study.

Experimental:
Yarn Production: After sorted and inspected of recycled waste, it was mixed with cotton waste, the blend components contains of:

- 7.5 % flats waste.
- 7.5 % combing nail waste.
- 5 % spinning waste (suction).
- 36 % sliver waste.
- 44 % long period stored cotton.

All type of cotton waste and recycled waste is Giza 83[3]

Spinning Process: The spinning process carried out by Open end system to produced yarn counts (12, 14 and 16 Ne) with three twist factor (4, 4.5 and 5) for each yarn of each blends as table 1:

<table>
<thead>
<tr>
<th>Blend No.</th>
<th>Recycled waste</th>
<th>Cotton waste</th>
<th>Blending in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90%</td>
<td>10%</td>
<td>Blow-room</td>
</tr>
<tr>
<td>2</td>
<td>50%</td>
<td>50%</td>
<td>Blow-room</td>
</tr>
<tr>
<td>3</td>
<td>50%</td>
<td>50%</td>
<td>Card sliver</td>
</tr>
<tr>
<td>4</td>
<td>50%</td>
<td>50%</td>
<td>Drawing sliver</td>
</tr>
<tr>
<td>5</td>
<td>-------</td>
<td>100%</td>
<td>Silver</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Yarn No.</th>
<th>Twist factor</th>
<th>Hairiness (1) fibres/mt</th>
<th>Hairiness (2) fibres/mt</th>
<th>Hairiness (3) fibres/mt</th>
<th>Hairiness (4) fibres/mt</th>
<th>Hairiness (5) fibres/mt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>4</td>
<td>211</td>
<td>95</td>
<td>120</td>
<td>125</td>
</tr>
<tr>
<td>2</td>
<td>4.5</td>
<td>254</td>
<td>113</td>
<td>142</td>
<td>144</td>
<td>93</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>287</td>
<td>132</td>
<td>153</td>
<td>167</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>4</td>
<td>194</td>
<td>86</td>
<td>105</td>
<td>110</td>
</tr>
<tr>
<td>5</td>
<td>4.5</td>
<td>209</td>
<td>117</td>
<td>113</td>
<td>123</td>
<td>72</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>232</td>
<td>134</td>
<td>146</td>
<td>152</td>
<td>50</td>
</tr>
<tr>
<td>7</td>
<td>16</td>
<td>4</td>
<td>183</td>
<td>74</td>
<td>85</td>
<td>90</td>
</tr>
<tr>
<td>8</td>
<td>4.5</td>
<td>194</td>
<td>98</td>
<td>107</td>
<td>115</td>
<td>61</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>210</td>
<td>118</td>
<td>132</td>
<td>141</td>
<td>35</td>
</tr>
</tbody>
</table>

Yarn Hairiness Measurements: The produced yarns hairiness was carried out using F – index to measuring the counts of protruding fibre that has 1 mm length and more, (carried out 50 measured on each yarn and calculated the average), the results was show in Table (2)

RESULTS AND DISCUSSIONS

The produced yarns from short fibres have protrudes fibre out side on the surface which lead to forming yarn hairiness.
Adding recycled waste to the blend lead to more hairiness because of the nature of internal component and the thickness of internal component of recycled waste that help the internal protrudes fibre to get out outing side on the surface.

Recycled wastes have higher stiffness, resist twist and lead to more hairiness.

The measuring of the yarn hairiness for produced yarns at different blends and studies the effect of yarn count and twist factor on the yarn hairiness.

**Yarn Hairiness of Blended No. (1):** Fig. 1 show the hairiness of produced yarn formed from 90% recycled waste and 10% reused cotton waste for the yarn counts 12, 14 and 16 Ne with twist factors 4, 4.5 and 5, we found that the number of protruding fibres – having 3mm length per meter – increase as twist factor increase and the hairiness decrease as yarns count increase.

The yarn hairiness increase as twist factor increase, the percent of increment was 17, 7.2 and 6.3 % (for yarn count 12, 14 and 16 respectively) as twist factor changed from 4 to 4.5 and the increment ratio was 12, 9.9 and 8.6 % (for yarn count 12, 14 and 16 respectively) as twist factor changes from 4.5 to 5, the total increment in yarn hairiness was 27, 16.4 and 14.3 % (for yarn count 12, 14 and 16 respectively). Also, noticed that the increment ratio in the first case was more then that in the second case.

For all produced yarns of blend No. (1), the yarn hairiness increase as twist factor increase and the yarn count (12) has the highest increment than the other yarns count (14 and 16 respectively). Also, as yarns count increase, the total increment percent of yarn hairiness decrease for yarns of all twist factors.

For all produced yarns from yarn No. 1, the average hairiness is 147, and has the highest hairiness. Also yarn count (12) has the highest hairiness than the other yarns (14, 16). The average hairiness for the three yarns counts of blend No. (1) are 218 protrude fibres having a length less than 3 mm for each 1 meter length.

The highest hairiness was for yarn count (12) with twist factor 5. The lowest hairiness was for yarn count 16 with twist factor (4).

**Yarn Hairiness of Blended No. (2):** Fig. 2 show the hairiness of produced yarn formed from 50% recycled waste and 50 % cotton waste blended in blow room for the yarn counts 12, 14 and 16 Ne with twist factors 4, 4.5 and 5, and found that yarn hairiness decrease as yarns count increase.

The yarn hairiness increase as twist factor increase, the percent of increment was 16, 26 and 24.5 % (for yarn count 12, 14 and 16 respectively) as twist factor changed from 4 to 4.5 and the increment ratio was 14, 13 and 17 % (for yarn count 12, 14 and 16 respectively) as twist factor changes from 4.5 to 5, the total increment in yarn hairiness was 28, 35.8 and 37.3 % (for yarn count 12, 14 and 16 respectively). Also, noticed that the increment ratio in the first case was more then that in the second case.

For all produced yarns of blend No. (2), the yarn hairiness increase as twist factor increase and as twist factor changed from 4 to 4.5 the yarn hairiness increase for all counts and the percent of increment is more in this case than the increment in the case of changing twist factor from 4.5 to 5. The increment percent of hairiness was 16 to 26.5 and as the yarn count increase.

As twist factor changes from 4.5 to 5, the hairiness increase for all yarn counts and the percent of increment is less than that when twist factor changed from 4 to 4.5 and the increment percent was between 13 to 17 %.

The total hairiness increment increases as twist factor increases and it was 28 % for yarn count 12 and
Fig. 3: Yarn Hairiness of Blended No. 3.

it was more in the case of yarn count 14 and 16. Yarn count 14 with twist factor, is the highest hairiness, and yarn count 16 with twist factor 4 is the lowest hairiness.

Yarn Hairiness of Blended No. (3): Fig. 3 show the yarn hairiness of produced yarn formed from 50% recycled waste and 50 % reused cotton waste blended as a card slivers and found that yarn hairiness decrease as yarns count increase.

The yarn hairiness increase as twist factor increase, the percent of increment was 14, 7.1 and 20 % (for yarn count 12, 14 and 16 respectively) as twist factor changed from 4 to 4.5 and the increment ratio was 7.2, 22.6 and 19 % (for yarn count 12, 14 and 16 respectively) as twist factor changes from 4.5 to 5, the total increment in yarn hairiness was 21.6, 28.1 and 35.6 % (for yarn count 12, 14 and 16 respectively). Also, noticed that the increment ratio in the first case was more then that in the second case.

For all produced yarns of blend No. (3), the yarn hairiness increase as twist factor increasing. As twist factor changed from 4 to 4.5 the yarn hairiness increase for all counts. Yarn count 16 has the highest increment and yarn count 12 has the lowest heiness. As twist factor changed from 4.5 to 5 the yarn hairiness increase and yarn count (14) has the highest percent in yarn hairiness and yarn count (12) has the lowest percent in yarn hairiness.

As yarn count increase, the total increment percent in yarn hairiness increase. The value of yarn hairiness of yarn count (16) is the highest than that of yarn count (12) and (14).

On the other hand, the percent of yarn hairiness increment is related to the twist factor and yarn count, and we notice that the courses count (yarn count 12) was of higher percent in yarn hairiness in the first case (when twist factor changes from 4 to 4.5) than that in the second case (when twist factor changes from 4.5 to 5), but in case of yarn count (16) we notice that the percent in yarn hairiness was nearly the same in the two cases. In case of yarn count (14), the percent in yarn increment in first case was less than that in the second case.

The value of yarn hairiness of yarn count (12) is more than that of yarn count (14) and (16) yarn hairiness decrease as yarn count increase. Yarn count (12) with twist factor 5 has the highest hairiness, and yarn count (16) with twist factor 4 has the lowest hairiness.

Yarn Hairiness of Blended No. (4): Fig. 3 show the yarn hairiness of produced yarn formed from 50% recycled waste and 50 % reused cotton waste blended as drawing slivers for the yarn counts 12, 14 and 16 Ne with twist factors 4, 4.5 and 5, and found that yarn hairiness decrease as yarns count increase.

The hairiness increase as twist factor increase, the percent of increment was 13.2, 11 and 21.7 % (for yarn count 12, 14 and 16 respectively) as twist factor changed from 4 to 4.5 and the increment ratio was 13.8, 19 and 18.4 % (for yarn count 12, 14 and 16 respectively) as twist factor changes from 4.5 to 5, the total increment in yarn hairiness was 25.2, 27 and 36.2 % (for yarn count 12, 14 and 16 respectively). Also, noticed that the increment ratio in the first case was more than that in the second case (for yarn count 12, 16), but for yarn (14), notice that the increment percent in the first case is less than that in the second case for the same twist factor.

For all produced yarns of blend No. (4), the yarn hairiness increases as twist factor changed from 4 to 4.5 and the yarn count (16) was the highest increment. Also the yarns hairiness increase as twist factor changed from 4.5 to 5 for all count and yarn count (16) was the highest increment.

Yarn hairiness increase as yarn count increase and the yarn count (16) was the highest total increment. The total yarn hairiness increment as twist factor changed from 4 to 4.5 is different than that as twist factor changed from 4.5 to 5 and yarn count (14) was of the highest difference followed by yarn count (16).
Fig. 5: Yarn Hairiness of Blended No. 5

but in case of yarn count (12) than were no difference. For produced yarns of blend No. (4), yarn count (12) is the highest hairiness followed by yarn count (14) follows by yarn count (16).

Yarn count (14) with twist factor 5 is the highest hairiness, and yarn count (16) with factor 4 is the lowest hairiness.

Yarn Hairiness of Blended No. (5): Fig. 5 show the yarn hairiness of produced yarn formed from 100 % recycled waste for the yarn counts 12, 14 and 16 Ne with twist factors 4, 4.5 and 5, and found that yarn hairiness decrease as yarns count increase.

The hairiness decrease as twist factor increase, the percent of reduction was 8.6, 22.2 and 17.6 % (for yarn count 12, 14 and 16 respectively) as twist factor changed from 4 to 4.5 and the reduction ratio was 16.3, 30 and 42.6 % (for yarn count 12, 14 and 16 respectively) as twist factor changes from 4.5 to 5, the total reduction in yarn hairiness was 26.3, 46 and 52.7 % (for yarn count 12, 14 and 16 respectively). Also, noticed that the reduction percent in the first case was less than that in the second case.

For all produced yarns of blend No. (5), the yarn hairiness decreases as twist factor increase for all twist factors. Yarn count (14) was the highest increment as twist factor changed from 4 to 4.5 and yarn count (12) was the lowest hairiness. As twist factor changed from 4.5 to 5 we notice that as yarn count increase, the reduction of hairiness percent increase and yarn count (16) has the highest reduction in hairiness.

Yarn hairiness percent depend on twist factor. The total reduction percent increase as yarn count increase for all twist factors.

Yarn hairiness increase as yarn count decrease and we notice that coarse yarn (count 12) is the highest hairiness and the hairiness decrease as yarn count increase for all twist factor. Yarn count (12) with twist factor 4 is the highest yarn hairiness and yarn count (16) with 5 twist factor is the lowest yarn hairiness.

Comparison of Produced Yarn Hairiness: Fig. 6 Show the compared between produced yarn in hairiness, and found that, the produced yarn from blend 1 is more hairiness and the produced yarn from blend 5 is less hairiness.

On the other hand, Yarn count (12) produced of all components is the more hairiness followed by yarn count (14) and (16).

Yarns produced of blends contain recycled waste are the more hairiness than that produced from waste cotton.

Yarn hairiness increase for all produced yarns from blends (1), (2), (3) and (4), and decrease for all produced yarns from blend (5) as twist factor increase. As yarn count increase, the hairiness decrease for all yarns and for twist factors.

The percent of increment and reduction of hairiness vary according to the variation of twist factor. The hairiness increase in produced yarns blends (1), (2), (3) and (4) increase as the recycled waste increase and it decrease by the addition of cotton waste. For produced yarns blends (2) and (4), the hairiness increase as the mechanical processing increase and the hairiness of produced yarn blend (2) is less than that of produced yarns blends (3) and (4).

The hairiness increase as twist factor increase for all produced yarns blends No. (1), (2), (3) and (4) due to the presence of recycled waste that makes the fibres tend to migrate towards yarn surface. For produced yarn blend No. (5), the hairiness decrease as twist factor increase because of fibre uniformity.

Conclusions: As yarns count increase, the hairiness decreases. As the percent of recycled waste increase, the hairiness increase. Produced yarns from pure cotton have lower hairiness. For all yarns, contain recycled waste, hairiness increase as twist factor increase. For all produced yarns from pure cotton waste, hairiness decrease as twist factor increase. For all yarns, hairiness decrease as count increase for all twist factors. For produced yarn of blends No. (2), (3), and (4) hairiness increase as the No. of mechanical process increase for all yarns counts.
REFERENCES


2. Faten Abdel Towab, 2002. "Yarns from Waste Cotton", Msc thesis, Textile Department, Faculty of Applied Arts, Helwan University,
