Comparison between Produced Yarn from Recycle Waste and Virgin Fibres in Tenacity and Elongation

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Abstract: The tenacity and elongation of produced yarn from recycle waste was studied and compared with produced yarn from 100% waste virgin cotton fibres, whereas measured the properties for produced yarn from four blends, with 12, 14 and 16 Ne count number at 4, 4.5 and 5 as twist factor. The traditional tests was carried out for produced yarns from the mentioned blends yarn tenacity and elongation. The test had been carried out by utter tensorapid tester. As the ratio of recycle waste increases the yarn tenacity decreases, as the number of processing increases, the yarn tenacity decrease (for the same type of blend). Yarn elongation decreases as twist factor increase for all yarns, as the ratio of recycle waste increases, the yarn elongation decreases, all yarns contain recycle waste have higher elongation than the yarn made from colon waste.

Key words: Recycle Waste, Tenacity and Elongation

INTRODUCTION

Many researchers [1,3] produced same products made from recycle fibres using non-woven technology, because these product have many uses in several field and used many types of hard waste (textile waste and non-textile waste), and used many types of row materials using different systems such as needle bonding or chemical and heating bonding or all of them.

These systems can't need specified properties or fibre lengths for production processes of yarns [4,5]. There is a comparison between tenacity and elongation of produced yarns from recycle and virgin fibres.

Experimental:

Blending Production: Four blends containing different percentage of opened hard waste were produced

- Blend (1) produced from 90% recycle waste + 10% cotton waste,
- Blend (2) produced from 50% recycle waste + 50% cotton waste (blending in blow room),
- Blend (3) produced from 50% recycle waste + 50% cotton waste (blending in card silvers), and
- Blend (4) produced from 50% recycle waste + 50% cotton waste (blending in draw silvers).

And compared with produced yarn from 100% cotton waste

<table>
<thead>
<tr>
<th>Yarn</th>
<th>Twists</th>
<th>Blend 1</th>
<th>Blend 2</th>
<th>Blend 3</th>
<th>Blend 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Count</td>
<td>Factor</td>
<td>Blend 1</td>
<td>Blend 2</td>
<td>Blend 3</td>
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<tr>
<td>1</td>
<td>12</td>
<td>4</td>
<td>7.7</td>
<td>11.4</td>
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<td>2</td>
<td>4.5</td>
<td>7.8</td>
<td>11.9</td>
<td>13.1</td>
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<td>3</td>
<td>5</td>
<td>8.2</td>
<td>12.4</td>
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<td>4</td>
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<td>7</td>
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<td>13.3</td>
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<tr>
<td>9</td>
<td>5</td>
<td>8.8</td>
<td>13.6</td>
<td>12.9</td>
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</tr>
</tbody>
</table>

From above blends 9 samples had produced, with yarn count 12, 14 and 16 Ne at 4, 4.5 and 5 twist factors.

Measurements: The traditional tests was carried out for produced yarns from the mentioned blends yarn tenacity and elongation.

The test had been carried out by utter tensorapid tester in the textile department laboratory, the No. of readings was 50, and the results were shown in Tables 1 and 2.

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RESULTS AND DISCUSSIONS

Tenacity of Blended Yarns: According to the random of homogeneity in internal component in yarn and increasing of mechanical processing and blending, the fibre tenacity was decreasing and the short fibre percent increasing.

The tenacity of produced yarn depending on the nature of raw material and the mechanical properties of these components and the mainly reason for the tenacity is the method of connection between component not on the number of twist.

The tenacity of produced yarn is equal to half of sum of the components, but may be some components have the higher tenacity than that of the other component due to its properties and the self resistance for tension, which led to the other component have higher tension and then yarn will cut.

As known, when the yarn straining in linear direction, the cut will occur at weaken point, so the non homogeneity between the components may be led to formation of some weaken point on the yarn, which led to decreases of yarn tenacity.

Tenacity of Blended Yarn No. (1): Fig. 1 show the tenacity of produced yarns from 90 % recycle waste and 10 % cotton waste, yarn counts were 12, 14 and 16 Ne with twist factors 4, 4.5 and 5 for each yarn count, notice that the yarn tenacity was between 7.7 and 8.8 gm/tex, yarns count (12) with twist factor (4) was the lowest tenacity, yarn counts (16) with twist factor (5) was the highest tenacity and as twist factor increase, yarn tenacity increase for all counts.

Yarn tenacity increases as twist factor changed from 4 to 4.5, the ratio of increment was 1.2, 2.4 and 2.4 % (for yarn count 12, 14 and 16 respectively), and yarns tenacity increases as twist factor become (5), the increment percent was 4.8, 3.5 and 6.8 % (for yarn count 12, 14 and 16 respectively).

These improvements in tenacity are due to the decreasing in internal component which led to introduce the effect of twist, which gives a better attachment of the internal component of yarn.

In general, yarn tenacity increases as twist factor increases for all produced yarns from blend No. 1, and this effect is higher for higher counts, also the tenacity increases at all twist factors.

Tenacity of Blended Yarn No. (2): Fig. 2 show the tenacity of produced yarns from 50% recycle waste and 50% cotton waste, blending was carried out in blow room, the yarn counts were 12, 14 and 16 with twist factors 4, 4.5 and 5 for each yarn count, and found that the values of tenacity were between 11.4 and 13.9 gm/tex, and yarn count (16) with twist factor (5) was has the lowest tenacity, and yarn count (14) with twist factor (5) has the highest tenacity.

Yarn tenacity increases as twist factor changed from 4 to 4.5, the ratio of increment was 5.6, 10.4 and 4.2 % (for yarn count 12, 14 and 16 respectively), and yarns tenacity increases as twist factor become (5), the increment percent was 2.2, 2.8 and 4 % (for yarn count 12, 14 and 16 respectively), the total increment in yarn tenacity was decreases by 60, 80 % (for yarn count 12, 14 respectively).

To observe the nature and shape of the internal component of yarn, and the blending had been carried out in blow room, the yarn was more uniform and fibres were tighter as a result of twist.

Also, notice that the yarn tenacity increment decreases as twist factor increases for both yarns (12) and (14), but yarn count (14) is better that yarn count (12).

On the other hand, notice that the effect of twist is more in the case of yarn count (16) more than that yarn count (12) and (14) because of the number of fibres per crone-section is less, and notice that yarn tenacity increase as twist factor increase and increment percent of tenacity due to the increment of twist factor, decrease as yarn count Increase.

Tenacity of Blended Yarn No. (3): Fig. 3 Shows the tenacity of produced yarns from 50% recycle waste and 50% cotton waste (as card slivers), yarn count were 12, 14 and 16 with twist factors 4, 4.5 and 5 for each yarn
count, from the figure found that the values of tenacity were between 11.8 and 13.4 gm/tex, for yarn count (16) and the yarn count (16) was the lowest tenacity and yarn count (12) with twist factor (5) was the highest tenacity.

Yarn tenacity increases as twist factor changed from 4 to 4.5, the ratio of increment was 2.2, 3.1 and 4.8 % (for yarn count 12, 14 and 16 respectively), and yarns tenacity increases as twist factor become (5), the increment percent was 2.2, 1.5 and 3.8 % (for yarn count 12, 14 and 16 respectively), the total increment in yarn tenacity was 4.5, 4.5 % (for yarn count 12, 14 respectively).

In general, notice that the decreases ratio in yarn tenacity decreasing as twist factor increase from 4 to 5, these decreases ratio is due to the increases of twist factor effect in adhesion and twisting processes, so decreasing the efficiency of blending processes, which led to decreases of yarn tenacity of the produced yarn. However, notice that the increasing ratio in yarn tenacity increasing as yarn count increase. Also, notice that yarn tenacity increase for all twist factors, but found difference in increases ratio.

Tenacity of Blended Yarn No. (4): Fig. 4 shows the tenacity of produced yarns from 50 % recycle waste and 50 % cotton waste, (blending of slivers in draw frame), yarn counts were 12, 14 and 16 with twist factors 4, 4.5 and 5 for each yarn count, and found that the values of tenacity were between 11.4 gm/tex, for yarn count (12) with twist factor (4), and 12.6 gm/tex for yarn count (14) with twist factor (5).

Yarn tenacity increases as twist factor changed from 4 to 4.5, the ratio of increment was 1.7, 5.6 and 1.7 % (for yarn count 12, 14 and 16 respectively), and yarns tenacity increases as twist factor become (5), the increment percent was 10.2, 1.5 and 3.2 % (for yarn count 12, 14 and 16 respectively), the total increment in yarn tenacity was 11.8, 7 and 4.9 % (for yarn count 12, 14 and 16 respectively).

The ratio of increment as twist factor changed from 4 to 4.5 is lower than that as twist factor changed from 4.5 to 5 (for yarn count 12 and 16 respectively), but for yarn count 14 the increment ratio in the first case is higher than that in the second case.

In general, the increment ratio increases as yarn count increases for all twist factors, the yarns tenacity increases as yarn count increases for all twist factors, also the average value of tenacity for yarn count (12) is 11.8 gm/tex, and the average value of tenacity for yarn count (14) is 12.2 gm/tex and the average value of yarn tenacity for yarn count (16) is 12 gm/tex.

Tenacity of Blended Yarn (waste cotton): Fig. 5 show the tenacity of produced yarns from 100 % cotton waste, yarn counts were 12, 14 and 16 with twist factors 4, 4.5 and 5 for each yarn count, from the figure found that the values of yarn tenacity is between 13.6 gm/tex, for yarn count (16) with twist factor (4) and 15.9 gm/tex for yarn count (14) with twist factor (5).

Yarn tenacity increases as twist factor changed from 4 to 4.5, the ratio of increment was 6, 7.1 and 5.6 % (for yarn count 12, 14 and 16 respectively), and yarns tenacity increases as twist factor become (5), the increment percent was 4.5, 2.5 and 2.7 % (for yarn count 12, 14 and 16 respectively), the total increment in yarn tenacity was 10.1, 9.4 and 8.1 % (for yarn count 12, 14 and 16 respectively).
Fig. 6: Compassion of Produced Yarn Tenacity.

As twist factor changed from 4 to 4.5, the yarn tenacity increased from 5.6 to 7.1 %, but this ratio decreases as twist factor changed from 4.5 to 5 and becomes 2.5 to 4.4 %.

The total increment percent of yarn increases for caresses count, and it decreases for firer yarns due to the effect of twist factor in the first case is lower than that in the second case.

Compassion of Produced Yarn Tenacity: From Fig (6) and the other figures notice that the produced yarns from blend No. 1 have the lowest tenacity followed by yarns made from blend (2) followed by yarns made from blend (3) followed by yarns made from blend No. 4 followed by yarns made from cotton waste.

Tenacity of produced yarns from blends 2, 3 and 4 are of different values in spite of they have the same types of fibres and the same ratios, this due to mixing procedures.

Tenacity of produced yarns from cotton waste are the highest tenacity, and the ratio between the values of produced yarns tenacity from cotton waste and that produced from recycle wastes + cotton waste varies between 13 to 44.9 %.

Tenacity of yarn count (12) is nearly equal the tenacity of yarn count (14), and this value is higher than that of yarn count (16).

As yarn count increases, the tenacity decreases for all produced yarns from all blends except that produced from blend No. 1.

Yarn count (14) that produced from cotton waste is the high tenacity. Yarn count (12) that produced from blend (1) is the lowest tenacity.

Elongation of Blended Yarns Elongation of Blended Yarn No. (1) Fig. 7 shows the tenacity of yarns made from blend 1 (90% recycle waste +10% cotton waste), from the figure notice that the values of yarn elongation were 8.2% for yarn count (12) with twist factor (4) and 7.6 % for yarn count (16) with twist factor (4).

Yarn elongation decreases as twist factor changed from 4 to 4.5 (for yarn count 12, and 14), the ratio of decrement was 3.2, 1.2 % (for yarn count 12, and respectively), and increases as twist factor changed from 4 to 4.5 by 2.6 % for yarn count 16, and yarns tenacity increases as twist factor become (5) (for yarn count 12, and 16), the increment percent was 1.2 and 1.3 % (for yarn count 12 and 16 respectively), and decreases as twist factor changed from 4 to 4.5 by 1.3 % for yarn count 14 due to the effect of twist, the total reduction for yarn count 14 was 2.5% and the total increment for yarn count 16 was 4%.

These is due to increasing of yarn count, where the internal component decreases in the cross-section of the yarn, so increasing the effect of the twist factor, so the internal component work as spiral which due to elongate, and by twist factor increase the spiral effect decrease.

The average elongation of produced yarn from blend No. 1 is 8 %. As yarn count increases, the yarn elongation decreases. The average elongation of yarn count (12) and (14) are more then the average elongation yarn count (16), and as yarn count (12) and (14), the elongation decreases as twist factor increase, but it increases in the case of yarn count (16).

There are other parameters affect on yarn elongation and will study it later.

Elongation of Blended Yarn No. (2): Fig. 8 shows the elongation percent of yarn made from blend No. 2 (50 % recycle waste + 50 % cotton waste). Notice that the values of yarn elongation were 7.7 % for yarn count (14) with twist factor (4) and 7 % for yarn counts (12) and (16) with twist factor (5).

Yarn elongation increases as twist factor changed from 4 to 4.5, the ratio of increment was 6, 7.1 and 5.6 % (for yarn count 12, 14 and 16 respectively), and yarns tenacity increases as twist factor become (5), the increment percent was 4.5, 2.5 and 2.7 % (for yarn count 12, 14 and 16 respectively), the total increment in yarn tenacity was 10.1, 9.4 and 8.1 % (for yarn count 12, 14 and 16 respectively).
As twist factor changed from 4 to 4.5 the elongation of yarn decreases, the reduction percent was 5.6, 4.1 and 4.2 % (for yarn count 12, 14 and 16 respectively), and yarn elongation decreases as twist factor becomes (5), the reduction percent was 2.9, 4.2 and 1.4 % (for yarn count 12, 14 and 16 respectively), the total reduction was 8.6, 8.5 and 7.5 % (for yarn count 12, 14 and 16 respectively), the reduction in the first case was more than that in the second case for yarn count 12 and 16, but for yarn count 14 the reduction in the first case is nearly equal to that in the second case.

As twist factor changed from 4 to 4.5, the reduction of elongation is more in the case of yarn count (12) and yarn count (16), the total reduction of elongation decreases as twist factor increase, and it decreases as yarn count increases.

The average elongation of produced yarns from blend (2) is 7.3 %, the values of elongation were between 7.2 to 7.4 %, and yarn counts (14) have the highs elongation for all twist factors.

**Elongation of Blended Yarn No. (3):** Fig. 9 shows the elongation of produced yarns from blend No. 3 (50 % recycle waste +50 % cotton waste as a card silvers).

**Elongation of Blended Yarn No. (4):** Fig. 10 show the elongation of produced yarns from blend No (4) (50% recycle waste +50% cotton waste blended as a drawing slivers).

As twist factor changed from 4 to 4.5 the yarn elongation decreases, the reduction percent was 4.9, 9.1 and 1.6 % (for yarn count 12, 14 and 16 respectively), and yarn elongation decreases as twist factor becomes (5), the reduction ratio was 3.2, 9.1 and 0 % (for yarn count 12, 14 and 16 respectively), the total reduction is 5.6, 6.7 and 1.6 % (for yarn count 12, 14 and 16 respectively).

For yarns have count number 12, found that the reduction of elongation in the first case more than that in the second case, and for yarns have count number 14, found that the reduction of elongation in the first case is the same as that in the second case, as well as found that there was no change in yarn elongation in first and second case of yarn have count number 16.

For all yarn counts as twist factor increases, the yarn elongation decreases and yarn count (14) has the higher elongation than that of yarn count (12) and (16).
As twist factor changes from 4.5 to 5, the reduction of elongation increases for yarn count (14) but it decreases for yarns count (12) and (16) with the same twist factor, and yarn count (14) has the highest total reduction followed by yarn count (12) followed by yarn count (16).

Yarn count (16) has the lowest reduction and yarn count (14) has the highest elongation with decreasing twist factor and yarn count (12) with twist factor (4), has the lowest elongation.

**Elongation of Produced Yarn (cotton waste):** Fig. 11 shows the elongation of produced yarns from (100% cotton wastes). As twist factor changed from 4 to 4.5, yarn elongation decreases; the reduction ratio was 3.9, 7.2 and 5.7% (for yarn count 12, 14 and 16 respectively), and yarn elongation decreases as twist factor becomes (5), the reduction ratio was 4.1, 5.8 and 3.8% (for yarn count 12, 14 and 16 respectively), the total reduction was 8.2, 14 and 9.8% (for yarn count 12, 14 and 16 respectively).

As twist factor increases, the reduction of elongation decrease, the yarn count (12) has the highest reduction as twist factor changes from 4 to 4.5, while the yarn count (16) has the lowest reduction followed by yarn count (14) than that of yarn count (16).

Elongation of yarn count (12) is higher than that of yarn count (14), as twist factor changes from 4.5 to 5, yarn count (14) has the highest reduction followed by yarn count (16) followed by yarn count (12), with twist factor 5.

**Compasison of Produced Yarn Elongation:** Fig. 12 shows the comparison of yarn elongation and notice that the yarn elongation decreases as twist factor increases for all yarns.

Produced yarns from blend No. 1 are the highest elongation followed by produced yarns from blends No. 2, 3, 4 and cotton waste respectively. The elongation of produced yarns from blend No. 1 is higher than that of cotton waste, the ratio of increment is 50% and the elongation of produced yarns from blend (2) is higher than that of produced yarn from blend No. 3 and 4, the increment ratio was 27% for blends No. 3 and 4.

**Fig. 12: Compasison of Produced Yarn Elongation**

The average elongation of yarn (14) is higher than that of yarn count (12) and (16); reduction of elongation as twist factor changes from 4 to 4.5 is higher than that as twist factor changes from 4.5 to 5.

**Conclusions:** The linear density of yarn has a direct influence on yarn tenacity; the tenacity of yarn count (12) is nearly the same as yarn count (14), as count increases, the tenacity decreases.

As the ratio of recycle waste increases the yarn tenacity decreases, as the number of processing increases, the yarn tenacity decrease (for the same type of blend).

Yarn elongation decreases as twist factor increase for all yarns, as the ratio of recycle waste increases, the yarn elongation decreases, all yarns contain recycle waste are of higher elongation than that made from reused colon waste.

There are other parameters other than twist factor and yarn count affect yarn tenacity and elongation.

**REFERENCES**