PHYSICAL AND MECHANICAL PROPERTIES OF CORONA DISCHARGE TREATED POLYESTER FABRIC

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ABSTRACT
The Plasma and corona discharges are the eco friendly methods for treatment of the polymeric surfaces. The polyester fabric was exposed to corona discharge under different powers and number of passages. Some properties of corona discharge treated polyester fabrics were investigated. The wetting time, air permeability, strength, pilling, weight reduction, thickness, surface morphology properties of the fabrics were the selected properties for the experiments.

Key Words: Corona discharge, polyester, air permeability, surface morphology

1. INTRODUCTION
The Plasma and corona discharges are the eco friendly methods for treatment of the polymeric surfaces. These methods improve the surface with changing the bulk properties in a dry system without chemicals and water. The attention has been paid to improve the wettability, friction, adhesion, reflection of light, water repellency, soil release, printing, dyeing and other finishing process of textile fibres and fabrics by using plasma and corona technology [1].

The corona discharge occurs when a high voltage is applied between two electrodes. The electrons that are produces by this electrode are accelerated towards the isolator by a high voltage. The electrons collide with air particles, producing ozone and reach the substrate can split chemical bonds, and produces radicals on the surface of the substrate [2].

In this study, the polyester fabric was exposed to corona discharge under different powers and number of passages. Some properties of corona discharge treated polyester fabrics were investigated. The wetting time, air permeability, strength, pilling, weight reduction, thickness, surface morphology properties of the fabrics were the selected properties for the experiments.

2. MATERIALS AND METHODS

2.1. MATERIALS
The knitted polyester fabric was used for this research. Corona discharge reactor used in this research made by Azad electrical industries in Iran.

2.2 METHODS
The knitted polyester fabric was exposed to corona discharge under different powers and number of passages (500 & 1000 w, 30, 50 & 70). The thickness of the untreated and corona
treated fabrics were investigated by the BS 2544-1987 standard test method and the instrument was SDL thickness tester made by UK.

The pilling test was carried out according to the ISO 12945-2 test method by Martindale made by Nasj Sanj from Iran. The loss weight of the corona treated fabrics was determined by weighting the samples before and after corona treatment.

The wetting time of the fabrics were obtained by using the BS 4554 standard test method. Drop of distilled water was poured on the surface of the fabric by burette then wetting time of a drop was reported.

The tensile strength test was carried out using the Testometric M500 25 CT and the air permeability was done regarding the ASTM D737:2004 test method. The surface morphology of the untreated and corona treated polyester fabrics was investigated by scanning electron microscope (KYKY, model: EM 3200, made by china) with the accelerated voltage of 25kv and the magnification of 2000.

3. RESULTS AND DISCUSSION

The thickness results in Table 1 show a minor decrease in the thickness of corona treated polyester fabrics that might be because of the removing of the fleece from the fiber surface. We can see this property in the results of the pilling tests, since the pilling rate decreased by corona discharge treatment.

Corona discharge treatment reduced the weight of the treated fabrics as we can see the 3.7 % of reduction at 500w & 30 passages and it reached to 4.01 for high power and passages of the corona treatment (1000w, 70 passages).

The etching effect caused by corona discharge and by removing the etched particles the weight reduced. In table 1 we can see the decrease in wetting time of corona discharge treated polyester fabric and wettability increased by the treatment.

Table 1. The results of thickness, pilling and loss weight of untreated and corona treated polyester fabrics

<table>
<thead>
<tr>
<th></th>
<th>untreated</th>
<th>500 W</th>
<th>700 W</th>
<th>1000W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>30 P</td>
<td>50 P</td>
<td>70 P</td>
</tr>
<tr>
<td>Thickness (mm)</td>
<td>0.52</td>
<td>0.5</td>
<td>0.51</td>
<td>0.49</td>
</tr>
<tr>
<td>Pilling</td>
<td>3</td>
<td>2.3</td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td>Loss weight (%)</td>
<td>-</td>
<td>3.7</td>
<td>3.81</td>
<td>3.85</td>
</tr>
<tr>
<td>Air permeability</td>
<td>38.71</td>
<td>39.21</td>
<td>39.33</td>
<td>39.3</td>
</tr>
<tr>
<td>Wetting time (s)</td>
<td>16.7</td>
<td>12.9</td>
<td>12</td>
<td>10.7</td>
</tr>
</tbody>
</table>

Figure 1 shows the tensile strength and elongation at break for untreated and corona discharge treated polyester fabrics. The corona discharge treatment and increase of the corona passages increased the tensile strength and reduced elongation at break. The high energy electrons can etched the surface of the fiber so that changed the tensile strength and elongation.
Figure 1. Tensile strength (N/10) and elongation at break (mm) for untreated and corona treated cotton fabrics

Figure 2. The SEM micrographs of untreated polyester (a) corona treated polyester at 500 w & 30 passages (b) treated polyester at 500 w, 50 passages (c) corona treated polyester at 1000 w, 70 passages

4. CONCLUSIONS

- Corona discharge treatment at highest level of power of treatment slightly decreases the thickness.
- Wetting time reduces by corona treatment.
- Corona discharge treatment slightly decreased elongation at break for highest level of corona discharge power.
- Corona discharge treatment changes the surface morphology of polyester fabric by etching effect
- Corona discharge at highest level of power reduces the weight of polyester fabric.

5. REFERENCES
