Studies in Sublimation Transfer Print Process: Part III—Fastness Ratings of Non-ionic Dyes on Polyester*

KESHAV V DATYE
Sir Padampat Research Centre, J.K. Synthetics Ltd, Kota 324003
Received 14 February 1980; accepted 3 February 1981

Twelve commercial disperse dyes were transferred from filter paper to polyester staple fabric and polyester-cotton (66:33) blend fabric by the sublimation transfer print process. The wash fastness, light fastness and sublimation fastness of the printed samples were recorded before and after the conventional reduction clear-washing treatment. It has been found that the fastness to washing and light is not affected, while the fastness to sublimation appears to improve by the aftertreatment.

One of the major advantages of the sublimation transfer print (STP) process is that the printed fabric does not need any reduction clear-washing aftertreatment to achieve the maximum fastness ratings. However, the STP process involves condensation of dye vapour on the fibre surface followed by diffusion into the fibre phase. The latter is said to be a slower process than the former. This means that at any time of transfer, there has to be some dye on the fibre surface. It has been reported by Anselrode that the fastness to washing is very good even when the transfer period is as short as 1 sec, indicating the total absence of any dye on the fibre surface. We have also noticed that cold acetone extraction of prints fails to give a significant drop in the concentration of dye on the fibre. However, there was a slight colouring of the acetone extract, which may be because of the surface dye or the dye extracted by acetone from the fibre; this was always ignored. If the printed fabric is given the conventional reduction clear-washing aftertreatment, the condensed dye on the fibre surface is removed and it may influence the fastness ratings. In the present paper, the results of a study on fastness of printed fabric to washing, light and sublimation, before and after the washing aftertreatment, are reported.

Experimental Procedure

Twelve commercial disperse dyes—Cl Disperse Yellow 65(80), Orange 38(100), Orange 45(80), Brown 1(150), Red 56(100), Red 86(150), Violet 10(120), Violet 8(150), Blue 54(150), Blue 5(150), Terasil Black B(200) and Terasil Black SL(300 g/litre)—were dispersed in distilled water. The concentrations of the dyes are given in parantheses. Filter papers (Whatman No. 1) were padded through the dye liquor and dried at 120°C for 2 min. Pieces of the dried filter paper were sandwiched in a polyester staple fabric and polyester-cotton (66:33) blend fabric and heated in a BASF precision hot press at 210°C for 60 sec. The printed fabric sample was divided into two parts; one part (Sample A) was stored, while the other part (Sample B) was further treated in a reduction clear bath, rinsed and dried.

Samples A and B of printed fabrics were tested for their fastness to washing (95°C/30 min, SNV method) by evaluating staining on polyester test piece (Table 1), to light (200 hr, Xenotest machine, Standard Blue Scale) (Table 2), and to sublimation (210°C/30 sec) by evaluating staining on polyester test piece (Table 3). The polyester test piece was extracted with refluxing chlorobenzene and the dye was estimated spectrophotometrically. The results calculated as percentage of dye on the test piece with unwashed sample (that with washed sample being taken as 100) are given in Table 3.

<table>
<thead>
<tr>
<th>Dye</th>
<th>Polyester samples</th>
<th>PET:CO blend samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unwashed A</td>
<td>Washed B</td>
</tr>
<tr>
<td>Yellow 65</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Orange 38</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Orange 45</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Brown 1</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Red 56</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Red 86</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Violet 10</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Violet 8</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Blue 54</td>
<td>5–</td>
<td>5–</td>
</tr>
<tr>
<td>Blue 55</td>
<td>4–</td>
<td>4–4–</td>
</tr>
<tr>
<td>Terasil Black B</td>
<td>4–</td>
<td>4–5–</td>
</tr>
<tr>
<td>Terasil Black SL</td>
<td>5–</td>
<td>5–</td>
</tr>
</tbody>
</table>

PET, polyester, and CO, cotton.

*SPRC contribution No. 51
Table 2—Light Fastness of Dyes

<table>
<thead>
<tr>
<th>Dye No.*</th>
<th>Polyester samples</th>
<th>PET:CO blend samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unwashed A</td>
<td>Washed B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>6-7</td>
<td>6-7</td>
</tr>
<tr>
<td>2</td>
<td>5-6</td>
<td>5-6</td>
</tr>
<tr>
<td>3</td>
<td>5-6</td>
<td>5-6</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>4-</td>
<td>4-</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>6+</td>
<td>6-7</td>
</tr>
<tr>
<td>8</td>
<td>5-6</td>
<td>5-6</td>
</tr>
<tr>
<td>9</td>
<td>5+</td>
<td>5+</td>
</tr>
<tr>
<td>10</td>
<td>5-6</td>
<td>5-6</td>
</tr>
<tr>
<td>11</td>
<td>5+</td>
<td>5+</td>
</tr>
<tr>
<td>12</td>
<td>4-5</td>
<td>4</td>
</tr>
</tbody>
</table>

*Dye Nos. correspond to the dyes listed in column 1 of Table 1. PET, polyester; and CO, cotton.

Table 3—Sublimation Fastness of Dyes

<table>
<thead>
<tr>
<th>Dye No.*</th>
<th>Polyester samples</th>
<th>PET:CO blend samples</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Washed B:100 Unwashed A</td>
<td>Washed B:100 Unwashed A</td>
</tr>
<tr>
<td></td>
<td>Assessed</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>+3</td>
<td>-3</td>
</tr>
<tr>
<td>2</td>
<td>+4</td>
<td>-4</td>
</tr>
<tr>
<td>3</td>
<td>-4</td>
<td>-4</td>
</tr>
<tr>
<td>4</td>
<td>+4</td>
<td>-4</td>
</tr>
<tr>
<td>5</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>6</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>7</td>
<td>2-3</td>
<td>2-3</td>
</tr>
<tr>
<td>8</td>
<td>3-4</td>
<td>3-4</td>
</tr>
<tr>
<td>9</td>
<td>-3</td>
<td>-3</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>-3</td>
<td>-3</td>
</tr>
</tbody>
</table>

*Dye Nos. correspond to the dyes listed in column 1 of Table 1. PET, polyester; CO, cotton.

Discussion

The fastness to washing is found to be excellent and the same for washed and unwashed samples of polyester and blend fabric (Table 1). Since the quantity of condensed dye on the polyester surface is likely to be very small, the drop in its concentration due to washing aftertreatment is likely to be too small to exhibit any significant influence on the fastness to washing. It is, therefore, not surprising to find that the test piece does not receive any significant amount of the dye in the washing test. The dye which comes out of the printed piece remains in the aqueous bath and the test bath may remain fairly unsaturated with the dye with both the test samples. Under these dyeing conditions, the dye in the test bath will not be taken up by the test piece and thus samples A and B may exhibit identical excellent wash fastness.

The fastness of samples A and B to light is almost the same (Table 2). Probably, the condensed dye on the fibre surface of unwashed sample may fade rapidly, but the drop in concentration of the dye on the fibre due to loss of condensed dye is too small to exhibit any drop in light fastness.

The sublimation fastness ratings of STP samples before and after washing aftertreatment are given in Table 3. The sublimation fastness, as judged visually from the staining of polyester test piece, appears to improve by the aftertreatment in 9 cases, while in 15 cases there is no difference between unwashed and washed samples. However, the colorimetric estimation of dye on the test pieces clearly shows that the washed STP sample invariably exhibits better resistance to sublimation. Thus, unwashed samples lose 2-46% more dye than washed samples in the sublimation test. The total quantity of sublimed dye in all the STP samples is, however, very small and insignificant in comparison to the total dye present on the STP samples. The dye on the fibre before and after washing thus remains unchanged within the limits of experimental error.

Conclusion

The reduction clear-washing aftertreatment does not influence or improve the washing and light fastness, while it may slightly improve the sublimation fastness of STP samples. A small amount of dye condensed on the surface of the fibre is removed by the reduction clear-washing aftertreatment. The quantity of condensed dye is too small to influence the fastness ratings of STP samples.

References