CHAPTER 6

REACTIVE PROTEIN IN POST TANNING PROCESS:
RETANNING STUDIES

6.1 INTRODUCTION

Reactive protein (RP) was used as a retanning agent in post tanning of leather processing. RP at various levels (1, 2 and 3%) were treated to the chrome and vegetable tanned leathers individually and the leather characteristics were studied. The effect of RP on dye exhaustion, subjective visual evaluation properties such as grain flatness, fullness, softness, grain tightness and general appearance have been studied in comparison with control leathers. The leather was made up to crust upper leather and physical strength properties such as tensile strength, elongation at break, load at grain crack and distension at grain crack were compared with control samples.

6.1.1 Need for study

Retanning with phenolic and acrylic based gives better grain tightness grain smoothness, fullness to the leather. But above properties can be enhanced by treating protein based syntan or additional crosslinkers. Here treatment of RP with other auxiliaries and the subsequent leather properties have been studied in this chapter.
6.2 EXPERIMENTAL

6.2.1 Use of RP in Post Tanning Process

6.2.1.1 Materials and Methods

1. Chrome and vegetable tanned goat leathers processed conventionally.
2. Dye (Coloderm Blue N)
3. Fatliquors and other auxiliaries as per standard process.

6.2.2 Retanning study

RP at various levels (1, 2 and 3%) were used in post tanning process as a retanning agent for chrome and vegetable tanned leather and the resultant leather properties were studied.

6.2.3 Dye exhaustion

The procedure adopted for dye exhaustion was same as described in Chapter 5 and as outlined in section 5.2.9.

6.2.4 Pollution load generated in post tanning process

The procedure adopted for pollution load generated in post tanning process was same as described in chapter 5 and as outlined in section 2.2.18.

6.2.5 Scanning Electron Microscopic (SEM) Studies

The procedure adopted was same as mentioned in the chapter 5 and as outlined in the section 2.2.22.
Figure 6.1 Design of experiments for retanning study
6.2.6 **Subjective and visual evaluation**

The crust leathers were evaluated using subjective and visual examination for the various properties such as softness, fullness, grain flatness, grain tightness and general appearance. The leathers were rated on a scale 0-10 points for each property where a high rating indicates the better property.

6.2.7 **Physical strength properties of leather**

The procedure adopted for physical strength properties of leather was same as described in chapter 2 and as outlined in section 2.2.23.

6.3 **RESULTS AND DISCUSSION**

Figure 6.2 represent the percentage exhaustion of dye for the experimental and control leather samples.

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**Figure 6.2  Dye Exhaustion in Post tanning process**
It can be seen that by using RP at 1% level, the percentage of exhaustion of dye obtained was 98.50% for chrome leather and 96.50% for vegetable leather. The chrome leather showed slightly increase in dye uptake of 98.50% in comparison with 96.50% for vegetable leather. Experimental leathers retanned with RP 2% and 3% show increase in uptake of dye i.e. 99.20% and 99.80% for chrome leather and 97.10% and 97.40% for vegetable leather respectively. Both experimental leathers show increase in uptake of dye was because of more available crosslinks and reactive sites present in RP. The control samples showed dye exhaustion at the level of 97.10% and 95.60% for chrome and vegetable leather respectively. Similar results have been obtained by treating the metal tanned leather with vegetable tannin (Covington and Sykes 1984).

Table 6.1 represents the pollution load generated in leather processing.

Table 6.1 Pollution load generated in experimental processes (kg of effluent/tonne of leather processed)

<table>
<thead>
<tr>
<th>Sample</th>
<th>BOD (chrome)</th>
<th>COD (chrome)</th>
<th>TDS (chrome)</th>
<th>TSS (chrome)</th>
<th>BOD (vegetable)</th>
<th>COD (vegetable)</th>
<th>TDS (vegetable)</th>
<th>TSS (vegetable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RP 3%</td>
<td>3.30</td>
<td>9.10</td>
<td>18.50</td>
<td>0.80</td>
<td>4.50</td>
<td>12.00</td>
<td>22.10</td>
<td>1.70</td>
</tr>
<tr>
<td>Control</td>
<td>8.10</td>
<td>16.50</td>
<td>22.80</td>
<td>0.90</td>
<td>10.20</td>
<td>20.10</td>
<td>25.50</td>
<td>2.20</td>
</tr>
</tbody>
</table>

By using RP at 3% level showed, BOD level of 3.30 and 4.50 kg/tonne, COD level of 9.10 and 12.00 kg/tonne, TDS level of 18.50 and 22.10 kg/tonne, TSS level of 0.80 and 1.70 kg/tonne, for chrome and vegetable
leather was achieved in experimental processes, respectively. The decrease in pollution load was due to the fact that there was more uptake of leather auxiliaries used in post tanning processes of the experimental leather.

It was observed that leather processing steps proposed 59.3% this study enjoy a potential to reduce minimum level of BOD by COD by 45%, TDS by 19% and TSS by 12% in chrome upper leather. Similarly there was a reduction of BOD by 59%, COD by 40%, TDS by 14% and TSS by 32% in vegetable upper leather respectively. The reduction in pollution load may be due to the fact that there was more uptake of leather auxiliaries is post tanning process by employing RP.

Scanning electron micrographs, showing the cross section at a magnification of 2513 for C1, E3, C2, V3 are given in Figures 6.3(a), 6.3(b) - Figures 6.4(a), 6.4(b).

![Figure 6.3 Scanning electron micrographs of the experimental leather](image-url)
It can be observed that there was no surface deposition of tannin or not much difference in the fibre orientation and fibre structure of the experimental and control samples. This shows that RP employed in retanning does not affect the fibre characteristics of leather.

Bulk properties of various experimental leather were evaluated using manual and visual examination and are given in Figures 6.5 to 6.13. The softness of the experimental leather (Full chrome upper leather) were better than the control sample. This may be due to the fact that more uptake of fat liquor in the experimental leather than control leather. Fullness of the full chrome upper leather was generally good. The conventionally retanned and dyed leather exhibits better fullness to all the experimental methods. Grain tightness of the experimental leathers E1, E2 and E3, exhibits an above average rating, however the ratings were comparable lower than the control leather.
Softness property of the full vegetable upper leather (V1, V2, V3) was lesser compared to Full chrome upper leather (E1, E2, E3). Fullness of the full vegetable upper leather exhibited better ratings than full chrome upper leather. But control leather exhibiter higher rating because of the filling property of the vegetable tannin. Grain tightness of the full vegetable upper leather exhibited better ratings than full chrome upper leather. These had been retanned with RP at various levels. All of the experimental samples with the exception of V1 exhibit better ratings for general appearance compared to the control sample.

Figure 6.5  Softness of the experimental (Full chrome upper leather) and control leather
Figure 6.6  Fullness of the experimental (Full chrome upper leather) and control leather

Figure 6.7  Grain tightness of the experimental (Full chrome upper leather) and control leather
Figure 6.8 Grain flatness of the experimental (Full chrome upper leather) and control leather

Figure 6.9 Softness of the experimental (Full vegetable upper leather) and control leather
Figure 6.10 Fullness of the experimental (Full vegetable upper leather) and control leather

Figure 6.11 Grain tightness of the experimental (Full vegetable upper leather) and control leather
Figure 6.12 Grain flatness of the experimental (Full vegetable upper leather) and control leather

Figure 6.13 General appearances of various experimental and control leather
Physical strength data for the experimental and control leather are given in Table 6.2 and 6.3.

Table 6.2  Physical strength properties of Full chrome upper leather

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Experiments</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RP 1%</td>
<td>RP 2%</td>
</tr>
<tr>
<td>Tensile strength (kg/cm²)</td>
<td>222 ± 8.0</td>
<td>260 ± 7.7</td>
</tr>
<tr>
<td>Extension at break (%)</td>
<td>62 ± 1.1</td>
<td>64 ± 1.12</td>
</tr>
<tr>
<td>Tear strength (kg/cm thickness)</td>
<td>70 ± 1.4</td>
<td>72 ± 1.2</td>
</tr>
<tr>
<td>Lastometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load at grain crack (kg)</td>
<td>30 ± 1.1</td>
<td>39 ± 1.3</td>
</tr>
<tr>
<td>Distension at grain crack (mm)</td>
<td>8 ± 0.3</td>
<td>8 ± 0.2</td>
</tr>
</tbody>
</table>

Table 6.3  Physical strength properties of Full Vegetable upper leather

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Experiments</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RP 1%</td>
<td>RP 2%</td>
</tr>
<tr>
<td>Tensile strength (kg/cm²)</td>
<td>210 ± 8</td>
<td>205 ± 6</td>
</tr>
<tr>
<td>Extension at break (%)</td>
<td>42 ± 1.1</td>
<td>48 ± 1.2</td>
</tr>
<tr>
<td>Tear Strength (kg/cm thickness)</td>
<td>62 ± 1.1</td>
<td>62 ± 1.3</td>
</tr>
<tr>
<td>Lastometer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load at grain crack (kg)</td>
<td>28 ± 1.1</td>
<td>30 ± 1.2</td>
</tr>
<tr>
<td>Distension at grain crack (mm)</td>
<td>10 ± 0.1</td>
<td>10 ± 0.2</td>
</tr>
</tbody>
</table>
The leathers obtained from all experiments show higher tensile and tear strength values relative to control leather. A common feature among these leathers is that they have all been retanned with RP and dyed. In addition, it was also observed that retanning process with RP employed in this study does not affect the strength characteristics of leather. The other values, viz., elongation at break and grain crack strength for all the leathers made of this study were all well above the BIS norms. Especially, the leathers retanned with RP 2% and 3% exhibit greater grain crack strength values than control retanned one.