Theoretical and Empirical Estimation of Plain-Stitch Fabric Slurgalling

Abstract

Theoretical and empirical estimation of PA and viscose-PAN plain-stitch fabric has been carried out using computer image analysis. The border values of relative difference in the height of fabric courses εBgr and the relative changes in the length of thread in the stitch at which slurgalling occurs have been defined, whereby they have been verified by means of a model dependence εB=a·εl. The usefulness of computer image analysis as a tool for the objective and direct estimation of fabric slurgalling has been confirmed.

Key words: slurgalling, knitted fabric, plain-stitch fabric, computer image analysis, flat knitting machine.

Table 1. The list of border values of the relative difference of thread length in a stitch εlgr and relative differences of the course height εBgr at which the slurgalling fault occurs on plain-stitch fabrics from viscose-PAN yarn.

<table>
<thead>
<tr>
<th>ΔZgr pitches</th>
<th>εlgr %</th>
<th>εBgr %</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6</td>
<td>-12.2</td>
<td>-22.6</td>
</tr>
<tr>
<td>4</td>
<td>8.4</td>
<td>17.5</td>
</tr>
</tbody>
</table>

at the same time, a subjective analysis of slurgalling faults was carried out. The results of the investigation are presented in Table 1, while the diagrams of the regression equations εl=ϕ(ΔZ) and εB=ϕ(ΔZ) have been presented in Figure 2, where border values are given in bold letters.

As in the case of PA plain-stitch knitted fabrics, the εB values are about twice as large as the εl values. Thus, taking into account the simplifying assumption that the increment of thread length in a stitch Δl causes an increment of course height alone, the following can be formulated:

\[ Δl = 2 \Delta B \] (1)

and is presented as a scheme in Figure 3.

Table 2. The list of border values of the relative difference of thread length in a stitch εlgr and the relative difference in course height εBgr and εBgr(m) values.

<table>
<thead>
<tr>
<th>Parameter, %</th>
<th>PA knitted fabric</th>
<th>Viscose-PAN knitted fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>εlgr</td>
<td>-5.3</td>
<td>-12.2</td>
</tr>
<tr>
<td>εBgr</td>
<td>-9.7</td>
<td>-22.6</td>
</tr>
<tr>
<td>εBgr(m)</td>
<td>-12.4</td>
<td>-26.1</td>
</tr>
</tbody>
</table>
By converting dependence (1), the following is obtained:

\[ \varepsilon_{B} = \frac{W}{2} \cdot \varepsilon_{l} \]  

and upon taking into account the dependence determining the course knit-in coefficient for background stitches \( W_{0} \), we obtain the following:

\[ \varepsilon_{B} = \frac{W_{0}}{2} \cdot \varepsilon_{l} \]  

Treating the course knit-in coefficient \( W_{0} \) of background stitches as a constant value for particular raw-material versions of knitted fabrics, the model dependence can be presented in a simplified way as follows:

\[ \varepsilon_{B}(m) = a \cdot \varepsilon \]  

The value of the \( W_{0} \) coefficient for PA knitted fabrics is \( W_{0}=4.66 \), while it is \( W_{0}=4.27 \) for viscose-PAN knitted fabrics. Thus, with the assumption (1), the model border values of \( \varepsilon_{B_{gr}}(m) \) can be calculated for the border values of \( \varepsilon_{l_{gr}} \) determined empirically. These values and their empirical values are presented in Table 2 and illustrated in Figure 4.

A theoretical and empirical analysis of slurgalling on plain-stitch knitted fabrics has shown that the assumption taken for model (1) and dependence (4) resulting from such an assumption are correct in the case of positive values of \( \varepsilon_{l_{gr}} \) in respect of both PA and viscose-PAN knitted fabrics, while in the case of negative values of \( \varepsilon_{l_{gr}} \) obtained by reducing needle push-depth, the model values \( \varepsilon_{B_{gr}}(m) \) are lower than the empirical values \( \varepsilon_{B_{gr}} \) by 2.7% for PA fabrics, and by 3.4% for viscose-PAN fabrics.

Research carried out under the same conditions on the geometry of uniform plain-stitch knitted fabrics with distinct outlines of stitches, amounts of \( \varepsilon_{l_{gr}} \) determined by measurement in computer image analysis and estimating slurgalling faults in respect of the determined border values of \( \varepsilon_{B_{gr}} \) [5].

![Figure 3. Schematic drawing of a knitted fabric stitch, with the absolute difference of course height \( \Delta B=0.5 \Delta l \) marked on it.](image)

![Figure 2. Dependence of the relative difference of the course height \( \varepsilon_{B} \) (continuous line) and the relative difference of thread length in a stitch \( \varepsilon_{l} \) (dash line) in the function of the changes in needle push-depth \( \Delta Z \) for viscose-PAN knitted fabrics (border values are marked in bold).](image)

![Figure 4. Border values of the relative difference in course height \( \varepsilon_{B_{gr}} \) determined by measurement in computer image analysis and model values \( \varepsilon_{B_{gr}}(m) \) for plain-stitch fabrics from PA yarns and viscose-PAN yarns.](image)

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### References