CHAPTER 7

INFLUENCE OF FABRIC INTEGRATED
FIRMNESS FACTOR ON WICKING

7.1 INTRODUCTION

This chapter is concerned with the effect of fabric integrated firmness factor; a parameter proposed by Milasius for representing weave structures, on the wickability. A survey of literature showed that there was absence of work in this area.

Fabric structure can be evaluated by seven parameters: warp and weft raw material, warp and weft linear densities, warp and weft settings and the weave of the fabric. All seven parameters of the fabric structure are included in the evaluation integrated fabric structure factors.

Various scientists Newton (1995), Seyam (1994), Galceran (1961), Brierley (1952), and Milašius (2009) proposed different methods of evaluations of all these fabric parameters. According to the methods of evaluation of these parameters, two groups of integrated factors are distinguished: the first is based on the Peirce’s theory and the second on the Brierley’s theory (Newton 1995).

Peirce’s cover factor expresses the covering of a fabric surface with thread, and Brierley’s group factors express the weavability of a fabric. These factors are more extensively described (Milašius et al 2005).
It was established in previous investigations by Kumpikaitė and Milašius (2003) that the best way to represent fabric structure was by using the factor $\phi$, as proposed by Milašius, which can be calculated by the following equation (7.1).

$$\phi_1 = \sqrt[12]{\frac{1}{\pi} \frac{1}{P_1} \frac{1}{\rho} \frac{1}{S_2} \frac{1}{\sqrt[12]{T_1}} \frac{1}{\sqrt[12]{T_2}}},$$

where $T_1$ - warp linear density,
$T_2$ - weft linear density,
$T_{\text{avg}}$ - average linear density of the woven fabric thread,
$P_1$ - Milašius’ weave factor,
$\rho$ - raw material density,
$S_1$ - Ends/cm of the woven fabric,
$S_2$ - Picks/cm of the woven fabric.

The value of the integrated fabric structure factor $\phi$ can vary from 0 to 1 depending on the density of the fabric structure, i.e. with an increase in the density of the fabric structure; the factor $\phi$ approaches the value 1.

### 7.2 MATERIALS AND METHODS

These have been already discussed in Chapter 4. (Refer 4.4.2)

### 7.3 RESULTS AND DISCUSSIONS

#### 7.3.1 Effect of Fabric Firmness Factor on Wicking

In order to study the influence of fabric integrated factor $\phi$ on fabric wickability, vertical wicking tests were carried out using fabrics of two varieties. The values of the integrated weave factor $\phi$ for the 12 woven fabrics
and the wicking time in seconds (5cm height) for both warp and weft directions are shown in Table 7.1. It is apparent that wicking behavior of fabrics, whose floats are distributed evenly throughout the entire fabric surface, and of horizontally striped fabric are entirely different.

Table 7.1 Effect of the integrated weave factor $\phi$ on wicking for different weaves

<table>
<thead>
<tr>
<th>Fabric Code</th>
<th>$\phi$</th>
<th>Vertical Wicking time in seconds (5cm Height) Warp Direction</th>
<th>Vertical Wicking time in seconds (5cm Height) Weft Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evenly distributed floats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>0.53</td>
<td>92</td>
<td>91</td>
</tr>
<tr>
<td>A2</td>
<td>0.53</td>
<td>59</td>
<td>57</td>
</tr>
<tr>
<td>A6</td>
<td>0.49</td>
<td>89</td>
<td>83</td>
</tr>
<tr>
<td>A4</td>
<td>0.43</td>
<td>75</td>
<td>70</td>
</tr>
<tr>
<td>A5</td>
<td>0.42</td>
<td>73</td>
<td>80</td>
</tr>
<tr>
<td>A7</td>
<td>0.30</td>
<td>49</td>
<td>48</td>
</tr>
<tr>
<td>Horizontally striped fabrics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A12</td>
<td>0.48</td>
<td>54</td>
<td>42</td>
</tr>
<tr>
<td>A9</td>
<td>0.46</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>A11</td>
<td>0.46</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>A3</td>
<td>0.41</td>
<td>80</td>
<td>63</td>
</tr>
<tr>
<td>A10</td>
<td>0.38</td>
<td>40</td>
<td>43</td>
</tr>
<tr>
<td>A8</td>
<td>0.29</td>
<td>49</td>
<td>52</td>
</tr>
</tbody>
</table>

With the exception of A3, fabrics with evenly distributed floats wick slower and horizontally striped fabrics wick faster. This is like to the presence of floats of threads in horizontally striped fabrics. This irregular structure may be the reason for higher rate of wicking for the horizontally striped fabrics. In the case of warp and weft way wicking, there are slight variations that are observed and in some cases the rate of weft way wicking
are higher than that of warp way wicking. This may be due to the tension variations of warp and weft threads.

7.3.2 Effect of Integrated Factor $\varphi$ on Fabric Wicking (Warp Direction)

The effect of fabric integrated factor on the fabric wicking was analyzed for both warp and weft directions. Figure 7.1 illustrates the relationship between fabric firmness factor and wickability. While an excellent relationship is noticed in the case of evenly distributed floats ($R^2 = 0.914$) the opposite is the case for horizontally striped fabrics. ($R^2 = 0.108$). The regression analysis results of the $\varphi$ Integrated factor and wicking for evenly distributed floats and horizontally striped fabrics in warp direction are given in Table A.2.1 and A.2.2 (Appendix 2)

\[ y = 153.87x + 6.9724 \quad R^2 = 0.9144 \]
\[ y = 17.142x + 38.355 \quad R^2 = 0.1082 \]

Figure 7.1 Effect of $\varphi$ on fabric wicking (Warp direction)

However, in this case we ignored the points of the warp and weft ribs’ weaves, because these weaves are non-standard and their results significantly distort the resulting dependencies. Brierley (1953) and
Galuszynski (1981) considered rib weaves as specific instances, to which the formulas and regularities valid for other weaves do not apply.

### 7.3.3 Effect of Integrated Factor $\varphi$ on Fabric Wicking (Weft Direction)

Figure 7.2 illustrates the effect of integrated factor on the weft way wickability of evenly distributed floats and horizontally striped weaves.

![Graph showing the effect of integrated factor on fabric wicking](image)

**Figure 7.2 Effect of $\varphi$ on fabric wicking (Weft direction)**

The same trend is followed in weft direction also. As the integrated firmness factor $\varphi$ increases, the wicking time decreases for the horizontally striped fabrics. Determination coefficient of dependence ($R^2 = 0.90$) for the integrated factor $\varphi$ and the fabric wicking is high for the evenly distributed floats. The regression analysis results of the $\varphi$ integrated factor and wicking for evenly distributed floats in weft direction are given in Table A.2.3 (Appendix 2)
There are slight variations observed in the rate of wicking for the horizontally striped fabrics. The significant influence of integrated factor \( \varphi \) on fabric wicking is not found and the determination coefficient of dependence \( (R^2 = 0.49) \) is low for the horizontally striped fabrics. The regression analysis results of the \( \varphi \) integrated firmness factor and wicking for horizontally stripped fabrics in weft direction are given in Table A.2.4 (Appendix 2)

### 7.3.4 Overall Dependencies of Integrated Factor \( \varphi \) on Fabric Wicking

After summarizing all the weaves, the overall dependence is shown in Figure 7.3.

*Figure 7.3 Overall Effect of \( \varphi \) on fabric wicking*

In this study, the rate of wicking decreases, as the integrated factor \( \varphi \) increases. Relationship between fabric firmness factor and wickability is found to be poor in both the cases, while a correlation of \( R^2=0.3916 \) is obtained in warp way, a very low value is obtained in weft way of \( R^2=0.5035 \). We can assert that, in view of this, the relationship between fabrics wicking
and integrated factor $\phi$ has not been established well. Underlying reasons leading to these results are difficult to explain at this point. The regression analysis results of the $\phi$ integrated factor and wicking on warp and weft direction are given in Table A.2.5 and A.2.6 respectively (Appendix 2).

### 7.4 CONCLUSION

The following conclusions emerge from this study:

1. Of all the weaves, the plain weave shows poor wickability.

2. Fabric wicking in weaves with evenly distributed floats and horizontally striped weaves is different.

3. As integrated factor $\phi$ increases, the rate of wicking shows a decreasing trend.

4. An excellent correlation is observed between the integrated factor $\phi$ and wicking for evenly distributed floats in both warp and weft directions.

5. The influence of integrated factor $\phi$ on rate of wicking could not be established as different trends for horizontally striped fabrics for both warp and a weft direction has been noticed.

6. The overall dependence of fabrics wickability on the integrated factor $\phi$ could not established.