The main technological processes which are performed in the textile works of man-made fibre plants are the rewinding, twisting, and warping of complex yarns. These processes are necessary to give man-made yarns a set of useful properties which ensure their successful processing into textile articles and communicate high service characteristics to the articles. Twisting of yarns has the following objectives:

- to increase the density and compactness of yarns, and increase their uniformity over their cross-section to improve their ability to be processed in weaving and tricotage manufacture, and to raise the quality of the finished items;
- to improve the external appearance of complex yarns by giving individual yarns different twists or combining several yarns;
- to raise the breaking strength of yarns and give them useful service and customer properties.

In recent times the silk-processing industry has been imposing steadily higher requirements on those quality indices of man-made fibres on which their ease of passage depends during the processes of preparatory operations and weaving, as well as productivity of labor and fabric quality.

One of the ways of raising the compactness of complex yarns and improving their quality is pneumatic combining of the elementary filaments during the spinning process [1, 2]. Pneumatically combined yarns (PC) may be useful both in fill quality and also for further textile processing in processes of warping and twisting. Twisting of PC yarns to 80 twists/m would make it possible to dispense with higher twists -136 twists/m, for example.

Since the processes of twisting PC yarns and their further textile processing have been studied but little, we have carried out studies with the objective of selecting optimum parameters for the processes of spinning and pneumatic combination, and ascertaining their effect on the twisting process, the physicomechanical and quality indices of twisted PC yarns, and their processing into textile articles. As a specimen we selected a bright complex acetate yarn of 16.6 tex linear density.

The studies showed that, due to the specifics of its structure, PC yarn causes a decrease in the bulk weight of yarns wound on a bobbin (Fig. 1). This phenomenon can be explained by the fact that the untwisted yarn densely fills the package volume during the winding period. The elementary filaments in PC yarns are connected to each other at definite intervals and cannot so compactly fill up the volume of the package.

The density of yarn winding on the bobbins has a great effect on breakage in the initial period of the twisting process. To increase the winding density, the yarn tension was raised from 4-6 to 7-10 g and the spindle rotation frequency was changed from 6000-6100 rpm to 6500-6600. Breakage in the initial twisting period was reduced from 400-500 to 60-90 breaks/(1000 spindle·hours).

An increase in yarn tension involves a reduction in intensity of pneumatic coupling (Fig. 2). This decrease in intensity of pneumatic coupling may be compensated for by increasing the compressed air pressure. As is well known [3-5], PC yarns in a finished fabric cause a "streaky" effect, and this effect is intensified with increase in intensity of pneumatic coupling. So that the streaky effect would be minimal, the intensity of pneumatic coupling was selected to be small: 10-24 pneumatically coupled sections per meter of yarn. The streaky effect can be considerably reduced and can be made hardly noticeable by using various weaves; however, with increase in weaving intensity the yarn breakage is sharply increased during the initial twisting period (first 2 h):
Fig. 1. Dependence of bulk weight of yarn (δ) on relative length of pneumatic combination (S): S = \(n \times \ell/10\) (in %), where \(n\) is the number of PC sections, in number per m; and \(\ell\) is the length of the PC sections, in mm.

Fig. 2. Dependence of number of PC sections (n) on yarn tension, \(F\).

Fig. 3. Dependence of number of pneumatically combined sections (n) on lubricant content (C) of yarn.

<table>
<thead>
<tr>
<th>Intensity of pneumatic coupling, No. per m</th>
<th>Breakage (breaks per 1000 spindle-hours)</th>
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<tbody>
<tr>
<td>12-16</td>
<td>16</td>
</tr>
<tr>
<td>22-26</td>
<td>42</td>
</tr>
<tr>
<td>30-36</td>
<td>540</td>
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With increase in the intensity of pneumatic coupling, yarn elasticity is reduced, yarn stiffness is increased, and adhesion between yarn turns is decreased. On removal of yarn from the bobbin, "free" turns are formed, which the yarn pulls behind it, and the yarn breaks ahead of the balloon-limiter.

Application of a lubricant in the amount of 3.6-4.0% by wt. aids in improving pneumatic coupling (Fig. 3).

Analysis of the results shown in Table 1 shows that a low intensity of pneumatic couplings (12-16 pneumatically coupled sections per m) essentially has no effect on the physico-mechanical properties of yarns. The number of intrapackage defects is somewhat less than for ordinary twisted yarns (136 twists/m), both for PC yarn and also for twisted PC yarns.

Twisting of PC yarns was carried out on stage twisting machines, type KБ-250-I. No difficulties were observed in the twisting process: breakage in adjusting twisting machine, 35-55 breaks/(1000 spindle-hours); during twisting period, 8-15 breaks/(1000 spindle-hours).