It is obvious that the process in which heating compartments are used in the spinning stage has the greatest resources for improving yarn quality; nonheatable thermostating devices are characterized by somewhat smaller resources. This is supported by the fact that the first process assures production of grade 28 KNTS fabric; the second, grade 25 KNTS fabric; and on machines with no thermostating devices, the strength of the twisted yarns is in the range 230-240 N.

CONCLUSIONS

An approximate criterion has been developed for evaluating technological processes for preparing technical polycaproamide yarns; it is based on analysis of physicomechanical properties.

It is advisable to use the proposed method in comparing processes which differ in yarn stretch ratio.

LITERATURE CITED


VISCOSITY PROPERTIES OF SULFURIC ACID SOLUTIONS OF SOME AROMATIC COPOLYAMIDES

T. A. Rozhdestvenskaya, L. Ya. Tikanova,
A. V. Volokhina, V. D. Kalmykova,
G. I. Kudryavtsev, V. M. Savinov,
Yu. B. Rothenberg, and V. M. Ivanov

One of the premises for the preparation of high-strength, high-modulus fibres based on aromatic polyamides of the p-structure is their ability to exist in solution at a definite concentration in an equilibrium liquid-crystal (LC) state [1]. The simplest representative of such rigid-chain aromatic polyamides is poly-p-phenyleneterephthalamide (PPTA), which has the structure:

\[
\left(\text{--NH--} \right)_{n} \left(\text{--NCO--} \right)_{n}
\]

It is known from the patent literature that the lyotropic character of rigid-chain aromatic polyamides is also preserved for copolymers if the "flexible" unit content of these does not exceed 5-10 mole% [2, 3]. If the macromolecules of copolymides (CPA) are constructed of "rigid" units, then at any proportion of copolymerizable additives such polymers can go over into the LC state. There are no data in the literature about the change in viscosity of solutions on transition from a homopolymer to copolymers. It was of interest to trace the effect of the character and amount of copolymer additives to the PPTA molecule on the viscosity properties of solutions of the copolymides obtained, which was the objective of the research described in the present article.

The copolymers were prepared by the method of low-temperature polycondensation in a solvent of the amide-salt type. As such a solvent, we used N,N-dimethylacetamide containing an addition of 1.5% by wt. of LiCl. The reaction was carried out under a current of inert gas at 0-12°C. The gel-like polymers were precipitated into water, washed free of Cl⁻ ion to a neutral reaction, and dried at 100-110°C.

Fig. 1. Dependence of viscosity of CPA I solution having $[\eta] = 6.1$ on concentration at 80°C.

Fig. 2. Dependence of viscosity of CPA II solution (1) and CPA III solution (2) on amount of additive at 80°C.

**TABLE I. Values of $\eta_{inh}$ for Copolyamides at Various Amounts of Additive**

<table>
<thead>
<tr>
<th>Number of sample</th>
<th>Structural formula of monomer additive</th>
<th>Inherent viscosity, d1/g, at indicated amount of additive, in mole %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>I</td>
<td>$\text{--NH--O--CO--}$</td>
<td>---</td>
</tr>
<tr>
<td>II</td>
<td>$\text{--NH--NH--}$</td>
<td>3.9</td>
</tr>
<tr>
<td>III</td>
<td>$\text{--CO--O--CO--}$</td>
<td>2.8</td>
</tr>
</tbody>
</table>

The molecular weights of the copolymer specimens were estimated from the values of the inherent viscosity ($\eta_{inh}$) of dilute solutions (0.5 g/100 ml of concentrated sulfuric acid) and of the intrinsic viscosity ($[\eta]$) at 25°C in an Ubbelohde viscosimeter. Values of $\eta_{inh}$ for the specimens prepared are given in Table 1.

Isotropic and LC solutions of the copolymers were prepared by dissolving them in 99.5-100% sulfuric acid in the temperature range 20-80°C in a heatable reactor equipped with a worm mixer.

Viscosity of solutions was measured on a Heppler rheoviscosimeter at 80°C, in the shear stress region 100-2000 Pa. It was found that the introduction of copolymerizing additives which do not cause kinking of the molecular chain and do not hinder mutual ordering of the macromolecules in the anisotropic phase of the solution into the PPTA molecule, such as a poly-p-benzamide unit $\text{--(O--NH--NH--)}$, does not change the character of the concentration dependence of viscosity (Fig. 1) and essentially does not change the absolute value of the viscosity of equally-concentrated solutions of such copolyamides as compared with the viscosity of PPTA solutions (Table 2), that is, the anisotropic character of the solution is not destroyed, and its viscosity is maintained at an identical level for any content of "rigid" units.