

MOLECULAR WEIGHT AS A FACTOR IN THE SORPTION PROPERTIES OF POLYFORMALDEHYDE FIBRES

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The molecular weight of the polymer is known to exert a specific influence on the structural characteristics of the fibre. The density is usually lower when molecular weight of the polymer is high. Researchers ascribe the lower density to a lower degree of crystallinity [1] and lower packing density of the molecules [2]. These variations of the structure must make the fibres more accessible to low-molecular-weight substances.

An investigation of the properties of polyformaldehyde (PF) fibres of dissimilar molecular weight showed that the density of the fibres varies significantly with the molecular weight which suggested that the sorption properties of the fibres were also dissimilar.

The aim of the work reported here was to determine the influence of the molecular weight of PF on the sorption properties of fibres produced under identical conditions. The experiments were carried out with fibres produced from a copolymer of trioxane with 1,3-dioxalon (not more than 5% of the latter) with the melt index (MI) varied 4-12 g in 10 min. The fibres were stretched at draw ratio 9. The theoretical mean molecular weight of the PF batches used varied 40,000-58,000 [3].

The sorption capacity of the fibres was expressed in terms of the dye uptake (Dispersed Violet 4S) from an aqueous liquor at 100°C (dye concentration 1.5 g/liter). The degree of dye fixation was expressed in terms of the ratio of the amount of the dye remaining on the fibre after washing to the dye uptake [4]. The density of the fibres was determined in a gradient tube [5].

The experimental results plotted in Fig. 1 show that the sorption capacity of the fibres is influenced to a significant extent by the molecular weight of the PF. The dye uptake increases at a peak rate, i.e., to near double its value, over the MI range 9-4 g/10 min. The degree of dye fixation tends to increase with the sorption capacity. A comparison of the curves of the dye uptake and fibre density as functions of the MI of the polyformaldehyde shows that a distinct relation exists between the increase in the density and the decrease in the sorption capacity of the fibre.

The sorption of low-molecular-weight substances and the density are both dependent the relative packing density of the structure elements and the accessibility of the internal fibre structure so that one may conclude that the increase in the sorption capacity of the fibre with the molecular weight of the PF is the result of an increase in the porosity of the fibre. It is clear that the increase in the porosity is the consequence of a significant increase in the stresses developing in fibres from high-viscosity PF during orientation stretching (the viscosity of PF with MI=4 is 19,000 P and that of PF with MI = 9 is 12,000-6000 P at 195°C and a shear stress of 140 cN/m²). The fact that stretched PF fibres possess a fine-porosity structure is borne out indirectly by the shape of the sorption isotherm [6] and by the present writers' tentative experiments to determine the specific surface by thermal nitrogen desorption, i.e., the sorption and desorption processes were very slow. A variation of the molecular weight of the fibre-forming PF over the range concerned here did not produce a change in the tenacity of the stretched fibres (60-70 cN/tex) which is indirect evidence that the small pores are evenly distributed in the fibre.

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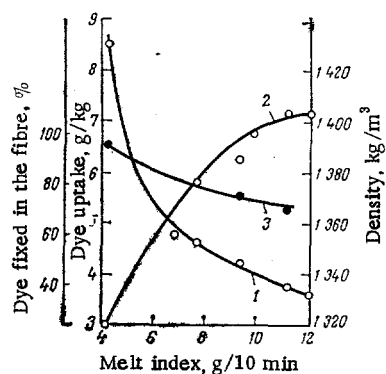


Fig. 1. The density (1), uptake of Dispersed Violet 4C (2), and dye fixation (3) of PF fibres produced from polymers of dissimilar melt index.

It follows that a system of small pores distributed evenly in the fibre can be considered a favorable component of the fibre properties and a purpose-directed change in the porosity of the fibre in the various production stages a method of physical modification.

LITERATURE CITED

1. V. M. Poludennaya et al., *Khim. Volokna*, No. 5, 6-7 (1969).
2. N. V. Mikhailov et al., *Khim. Volokna*, No. 4, 26-28 (1963).
3. I. M. Bel'govskii, N. S. Enikolopyan, and L. S. Sakhonenko, *Vysokomol. Soedin.*, No. 8, 1197 (1962).
4. V. I. Vlasenko et al., *Izv. Vuzov, Ser. Tekhnol. Tekst. Prom.*, No. 6, 98-101 (1971).
5. N. V. Mikhailov, N. N. Zav'yalo, and V. O. Gorbacheva, *Khim. Volokna*, No. 1, 19-22 (1960).
6. V. I. Vlasenko, I. B. Blinicheva, and P. V. Moryganov, *Izv. Vuzov, Ser. Tekhnol. Tekst. Prom.*, No. 5, 85-88 (1971).