The effect of the previous thermal and strain history on the viscosity properties and curing reaction kinetics of composition K18-2 has been investigated. Flow curves have been obtained for the composition over a broad range of shear rates and temperatures. The viscosity superanomaly effect has been studied. A general functional dependence of the viscosity of composition K18-2 on degree of cure, temperature, and shear rate has been obtained.

The correctness of the previously determined [1] values of the activation energy \( \Delta U_T \) and the preexponential \( \mu_0 \) as functions of the concentration \( x \) has been checked by reproducing the experimentally obtained \( \sigma(\tau) \) curves using the values of the kinetic constants \( K_0, \Delta U_T, \) and \( n \). The kinetic equation

\[
\frac{dx}{d\tau} = K_0 \exp \left( - \frac{\Delta U_T}{RT} \right) \left( 1 - x \right)^n,
\]

from which the function \( x(\tau) \) was determined, was integrated and represented in the form

\[
x = 1 - \left[ 1 + K_0 (n-1) \int_\tau^{\tau_x} \frac{d\tau}{\exp (\Delta U_T / RT(\tau))} \right]^{\frac{1}{n-1}}.
\]

The integral was evaluated graphically. A comparison of the calculated and experimental \( \sigma(\tau) \) curves revealed a perfectly satisfactory correspondence [2].

In order to check the nondependence of the \( \mu_0(x) \) and \( \Delta U_T \) obtained on the previous temperature-time influences, we conducted experiments with a cylinder-in-cylinder viscometer with various temperature regimes \( T(\tau) \) in the course of the reaction. The results of the experiments were represented in the form of \( \sigma(\tau) \) curves. When the experimental \( \sigma(\tau) \) curves and the curves calculated in the manner described above were superimposed, the discrepancy between the shear stress values at characteristic points on the curves did not exceed 4% [2]. For a composition that was similar, but had an initial degree of cure of 0.3 [3-5], from the time and temperature dependence of the shear stress at a shear rate almost 1000 times less than that used in the above-mentioned experiments we determined the functions \( \mu_0(x)/\mu_0(0.3) \) and \( \Delta U_T \), which proved to be similar to those determined in [1] (here, \( \mu_0(0.3) \) is the value of \( \mu_0 \) at a degree of cure of 0.3). Thus, these experiments and calculations made it possible to confirm the uniqueness of the dependence of the viscosity of the investigated composition on the temperature and extent of the reaction.

*For communication 1 see [1].
From the previous experiments it follows that the viscosity depends not only on concentration and temperature but also on the shear rate \( \dot{\gamma} \). In this case, generally speaking, the kinetic constants in (1) may also depend on \( \dot{\gamma} \). The experiments showed that on the range of \( \dot{\gamma} \) investigated the reaction kinetics are practically independent of the intensity of deformation and, moreover, the function \( \mu(x, \dot{\gamma}, T) \) possesses the property of logarithmic additivity

\[
\ln \mu = \mu_0 f_1(x) f_2(\dot{\gamma}) f_3(T), \tag{3}
\]

where \( \mu_0 \) is a constant.

The experiments were performed not on composition K18-2 but directly on its reaction system (resin K18 and urotropin), whose viscosity is thousands of times less than that of K18-2, the kinetic constants of K18-2 depending on the intensity of deformation of precisely this system. This made it possible, after almost eliminating the undesirable effects of dissipative heat release, accurately to control the experimental temperature regimes; the experiments themselves consisted essentially in the following. We obtained two series of specimens with different predetermined reaction times \( T_r \) in the regime \( T = \text{const} \) and compared specimens from each series with the same reaction times. In the first series the reaction was carried out without deformation, in the second series at \( \dot{\gamma}_{T_2} = 430 \text{ sec}^{-1} \).

The two series of specimens thus obtained were subjected to viscometric testing in a Rotovisko coaxial-cylinder instrument at \( \dot{\gamma}_{V_1} = 0.245 \text{ sec}^{-1} \), \( \dot{\gamma}_{V_2} = 24.5 \text{ sec}^{-1} \), and a temperature of 90°C,* at which there is almost no reaction. The choice of this range of shear rates was determined by the fact that, despite the high effective shear rates realized in certain stages of processing \((10^3-10^4 \text{ sec}^{-1})\), the true shear rates, less wall effects, are, as shown below, orders less than the effective rates and do not exceed \( 10^2 \text{ sec}^{-1} \). It was assumed that the relatively low degree of filling of the composition \((\approx 50\%)\) increases the intrinsic shear rates of the resin component - K18 resin - by not more than a factor of two or three.

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