cone of the sample on viscous fracture, which indicates considerable weakening of the latter owing to isothermal keeping of the steel under investigation in sulfur pulp.

Thus, the effect of the structure of stainless steels and changes therein during isothermal keeping in sulfur pulp on the micromechanism of their fracture has been established.

Analysis of the results explains to some extent the advantages of low-nickel stainless steel 15Kh17N2 of the ferrite-martensite class over other stainless steels [4] for use in working media of sulfur-smelting production.

LITERATURE CITED


CREEP OF POLYETHYLENE ON SHEAR WITH APPLICATION OF HYDROSTATIC PRESSURE

O. E. Ol'khovik

Investigations of the viscoelastic behavior of polymeric materials on elongation (compression) under pressure [1-4] showed that the behavior of polymers differs fundamentally from that of other structural materials. It was found that traditional hypotheses of the mechanics of a continuous medium (condition of incompressibility, independence of properties from mean stress, law of the single curve), which have proved to be quite valid for metals and other materials, require experimental testing when applied to polymers. From this viewpoint, study of the behavior of polymeric materials under shear stress combined with hydrostatic pressure is very urgent.

The results of tests of high-density polyethylene during shear deformation at a constant rate of $7 \cdot 10^{-3}$ min$^{-1}$ and on creep during shear with applied hydrostatic pressure are given in the present study. The hydrostatic pressure was varied up to 2500 kgf/cm$^2$. The characteristics of the testing apparatus, information on the samples, and experimental procedure are set forth in [4].

Diagrams of shear at 40°C and various pressures are shown in Fig. 1a. Evidently the effect of hydrostatic pressure increases strongly with the shear deformation; at practically any value of the latter, the pressure affects the character of the curve of $\tau$ versus $\varepsilon_{xy}$. It should be noted that, for shear deformation at any pressure, the quantity $\tau$ is equal to the magnitude of the stress $S$, and $\varepsilon_{xy}$ is the degree of deformation $E$.

According to traditional concepts [5], the degree of deformation is a function of the duration and magnitude of the stress:

$$\varepsilon = \Omega(t, S)S.$$  \hspace{1cm} (1)

Equation (1) expresses the law of the single curve, according to which shear diagrams or creep curves at various mean stresses (hydrostatic pressures) for identical degrees and rates of deformation or stresses

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must coincide, i.e., according to this law, all the shear diagrams shown in Fig. 1 must coincide with the curve obtained at atmospheric pressure. However, this is not observed in the investigated range of pressures, degrees of deformation, and stresses; in other words, the law of the single curve does not apply to polymeric materials.

A quantitative estimate of the effect of mean stress on the shape of the curve of $E$ versus $S$ may be made by using the coefficient of similarity $K$, which indicates the amount by which one should decrease all values of the ordinate $\tau$ in order to fit any of the curves of $\tau$ versus $\varepsilon_{xy}$ to the curve obtained, e.g., at atmospheric pressure (Fig. 1b). The data of this figure show that, in principle, a single curve does not exist. Nevertheless, one very often can and must distinguish the region of stresses and pressures in which the polymer conforms with acceptable error to traditional concepts or, in the case being considered, to the law of the single curve. Such data may provide a basis for using less complicated mathematical apparatus in practical calculations. Thus, for high-density polyethylene (see Fig. 1b) at 100 kgf/cm² pressure, the similarity coefficient $K = 0.95$, i.e., in this case the error due to neglect of the effect of mean stress on the shape of the curve of $E$ versus $S$ is about 5%, which is quite acceptable in engineering calculations.

Shear diagrams do not give a complete picture of the viscoelastic behavior of the polymer being investigated. In connection with this, creep tests were performed for three levels of shear stress (100, 200, and 300 kgf/cm²) at various hydrostatic pressures. The initial experimental data on the creep of high-density polyethylene are shown in semilogarithmic coordinates in Fig. 2. In creep tests the effect of hydrostatic pressure

### Table 1. Effect of Hydrostatic Pressure and Shear Stress on Activation Volume of Creep of High-Density Polyethylene

<table>
<thead>
<tr>
<th>Pressure range, kgf/cm²</th>
<th>Activation volume, cm³/mole</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\tau=100$ kgf/cm²</td>
</tr>
<tr>
<td>0--500</td>
<td>15</td>
</tr>
<tr>
<td>500--1000</td>
<td>28</td>
</tr>
<tr>
<td>1000--1500</td>
<td>25</td>
</tr>
<tr>
<td>1500--2000</td>
<td>37</td>
</tr>
<tr>
<td>2000--2500</td>
<td>27</td>
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