Results are shown of an experimental study concerning electrorheological dielectric systems and the hydrodynamic characteristics of their discharge from a slotted plane-parallel channel in the presence of a constant electric field.

The aim of this study was to establish the mechanical behavior of thin dielectric suspensions during their isothermal gravity discharge from a slotted plane-parallel channel formed by two thermostatic hollow

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Fig. 1. Schematic diagram of the test apparatus: 1) copper electrodes; 2) acrylic glass insert; 3) Textolite plate; 4) fastener components; 5) vessel with graduation markers; 6) tap; 7) vessel with the test material; I) to the high-voltage source.
copper-plate electrodes (Fig. 1). For the experiment we used suspensions of diatomite earth in oil, transformer grade and AMG-10 hydraulic grade, and in lamp kerosene with the addition of polyisobutylene as an electrically neutral thickener. The suspensions used in our tests represented anhydrous dielectric polydispersions with particle sizes ranging from a fraction of a micron to 50 μ. The diatomite was first washed in water, then dried down to a 7-8% moisture level. Diatomite particles are very porous and highly heterogeneous in shape and size. The surface asperity and the serrated form of individual particles eases their coagulation and the subsequent structurization.

First we studied the mechanical behavior of the carrier fluids, transformer oil and AMG-10 oil, as well as of the polyisobutylene solution in lamp kerosene in a static electric field. A typical relation between the discharge time of a 100 ml volume unit (reciprocal of the volume flow rate) of suspension and the intensity of an externally applied constant electric field is shown in Fig. 2a (curves 1-3). The strongest effect of the electric field on the discharge time of these carrier fluids does not exceed 10%. The addition of a solid phase to the disperse medium causes a sharp increase in the electrorheological effect. According to Fig. 2b, the curve of discharge time vs field intensity has three distinct ranges: a) the "activation" range, within which the discharge time almost does not change with increasing field intensity but depends only on the hydrostatic force; b) the nonlinear range, where the discharge time rapidly becomes longer; and c) the linear range, where the discharge time becomes very long and the motion of the fluid is almost completely stopped by the action of a transverse field. The graph indicates also that the "activation" range becomes wider as the hydrostatic force F increases. It was found that the discharge process remained steady up to certain values of F and E, and that the rate of flow through a channel across section did not depend on the length of testing time. It was noted that increasing the field intensity E at a fixed hydrostatic force or decreasing the hydrostatic force F at a fixed field intensity would cause the discharge to become unsteady, i.e., the flow rate in the channel to gradually decrease. This phenomenon is explained as follows. The primary effect of an external electric field is a change in the suspension structure. Particles of the solid phase combine and orient themselves along the lines of force in the field so as to form fibrillar structures covering a channel section either partly or entirely. The stream of fluid tries to contort and disrupt these continuously regenerated fibrillar structures. At some instant of time the rates of structure formation and breakdown become equal, resulting in a dynamic equilibrium. This equilibrium...