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The Motion of Propping Agent in an Opening Crack in Hydraulic Fracturing Plast

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In the present study the process of hydraulic fracture formation when pumping a viscous fluid with an admixture of particles into a well is considered. A model of a crack propagation taking account of the loss of liquid on seepage into a porous medium and the sedimentation of suspended particles under the action of gravity is developed. Detailed analysis of the sedimentation growth caused by leakage of hydraulic fracturing fluid into a porous medium is carried out. It is shown that the presence of particles has a significant effect on the process of crack opening. The crack growth in the presence of particles is limited, its final state depends on the composition of the mixture, injection method, inlet pressure, the volume content of the particles, the volume of the rim (pure fracturing fluid without admixture). All these factors are taken into consideration in the proposed model based on special dimensionless forms of the equations of motion. The results make it possible to estimate the crack residual and choose the technological parameters to provide the desired state of the ruptured formation.

Key words: hydraulic fracture, porous medium, viscous liquid.

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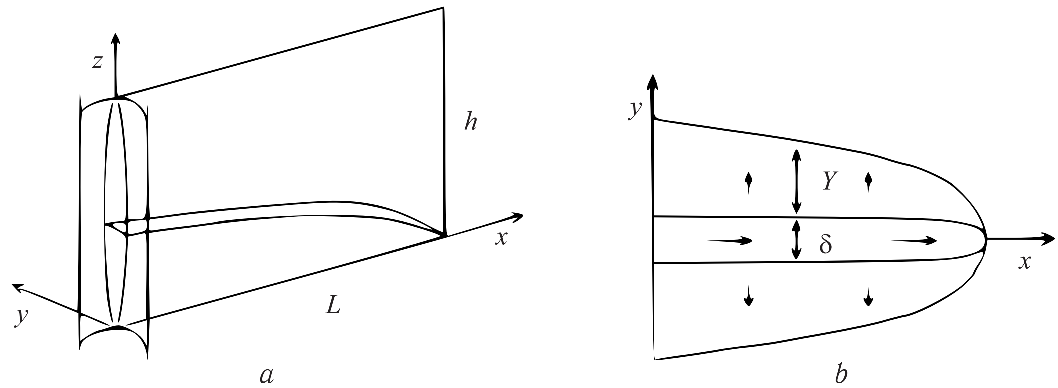

Fig. 1. Schematic representation of a vertical crack (a); cross-section in the horizontal plane (Khristianovicha) (b)

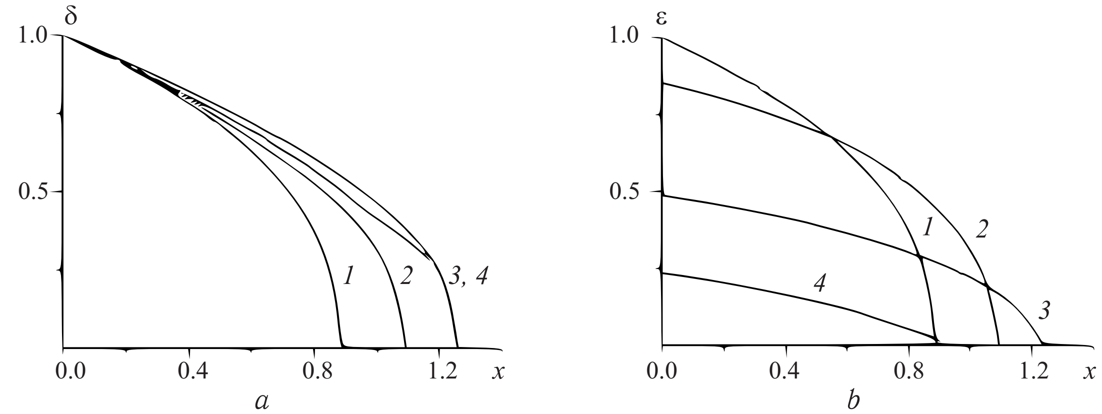

Fig. 2. The distribution of the dimensionless quantities δ (a) and ε (b) along the length of the crack at the instants $t = 1, 2, 6, 10$ are, respectively, curves *1–4*; $A = 0.2$, $\tau_1 = 1$

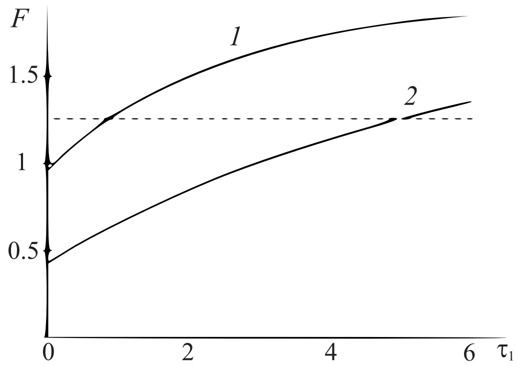

Fig. 3. Dependence of the limiting length of the crack, the time of the mixture feeding and the stopping time of growth from the duration of pumping of the rim: *1* — L_m, *2* — 0.05τ, dotted line — $0.5\tau/t_m$, $A = 0.2$

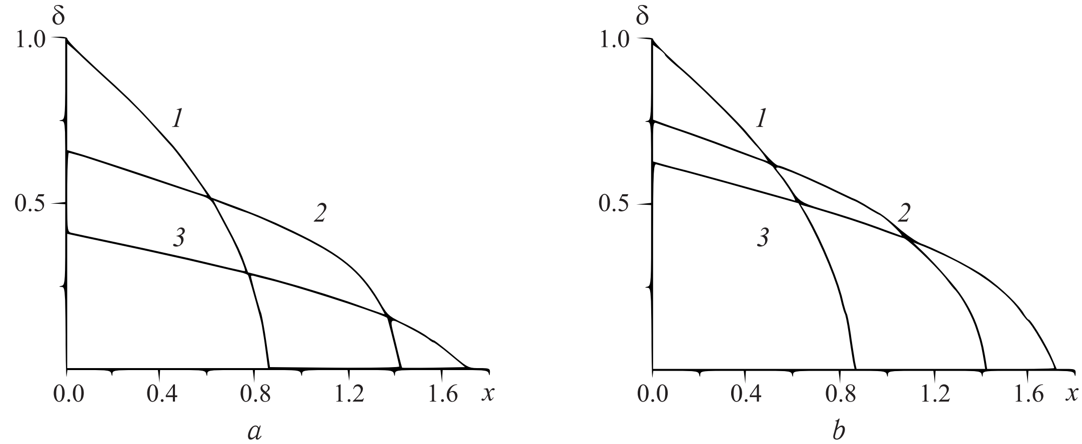

Fig. 4. The final shape of the crack with stopping proppant flow; The values $\tau_1 = 0, 2, 5$ correspond to the curves *1–3*, $A = 0.2$, $\tau = \text{const} = 10$ (*a*), $\tau_2 = \text{const} = 10$ (*b*)

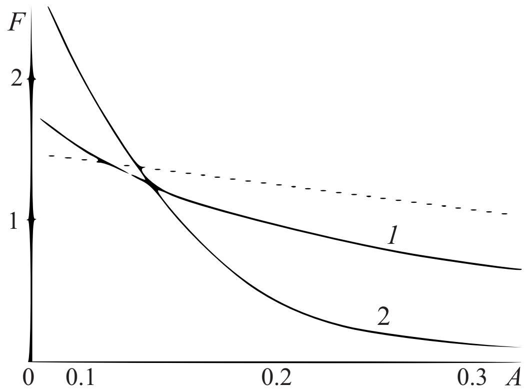

Fig. 5. Dependence of the limiting length of the crack, the time of the mixture feeding and the stopping time of growth on the volume content of the particles: *1* — L_m, *2* — 0.05τ, dotted line — $0.5\tau/t_m$, $\tau_1 = 0$

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