Analysis of crack formation in model specimens during hydraulic fracturing in holes

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This study relates to the technological aspect of hydraulic fracturing stress measurement technique increasingly wider applied at the present time for stress assessment in rocks. The physical modeling data on hydraulic fracturing of measurement hole walls are presented. The experiments were carried out on polymethacrylate cubes with faces 200×200 mm. In the specimens, either open-end or blind holes with a diameter of 12 mm were drilled at the center of one of the faces. In some specimens, in preset sections of the holes, longitudinal (along generatrix, to 30 mm long) and transverse (annular) slots up to 3 mm deep were cut. These slots acted as stress raisers governing initiation and growth direction of fractures. The hydraulic fracturing tests were implemented using a prototype probe representing a hollow bar with polyurethane packers and structural elements meant to compress packers axially in order to ensure sealing of the selected section in the hole. Hydraulic fracturing was executed under pressure feed of a working fluid (glycerin) through the axial channel of the bar into the interval between the packers.

During the test hydraulic fracturing, the specimens were subjected to loading conditions. To this effect, a triaxial compression test bench was used; the test bench was equipped with five hydraulic jacks (DN10P10, capacity of 10 tnf) and with a pressure feed and distribution system for applying unequal compression to different faces of the specimens. The behavior of hydraulic fractures was studied on 12 model specimens. The experimental results are compiled in the form of tables and contain some canonical information on the nature and features of initiation of hydraulic fractures in the vicinity of measurement holes under different stress state of the host medium. The analysis of the case studies of hydraulic fracture growth in the model specimens shows that the longitudinal hydraulic fracturing of the hole walls has, as a rule, one-sided direction relative to the axis of the measurement hole, and the presence of the initiating slots on the hole surface ensures the pre-set path of the fractures not in every case, which means that additional research in the matter is required.

The physical simulation results can be used in formulation and solution of analytical problems in the field of hydraulic fracturing stress measurement, or for advancement in the technology of the in-situ directional hydraulic fracturing and stress measurement.