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Crucial effect of system compliance on the maximum stress estimation in hydrofracturing method: Theoretical consideration and field-test verification

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Why are the data of field hydrofracturing tests so far indicate that the measured reopening pressure lies close to the shut-in pressure far more numerous than can reasonably be expected ? In order to explain such a strange phenomenon, it is necessary to take into consideration two additional factors of (i) a residual aperture of fracture and (ii) hydraulic compliance of a test equipment, which are ignored in the conventional theory of hydraulic fracturing. The residual aperture causes pressure penetration into the fracture prior to opening, and its effect is to reduce the reopening pressure by a factor of two from the value expected using the conventional theory. This implies that the fracture always begins to open at the borehole pressure less than the shut-in pressure. However, due to the effect of large hydraulic compliance, there opening pressure measured in the conventional manner becomes larger than the true reopening pressure and approaches the shut-in pressure. Contrary to this, there opening pressure measured by using the test equipment with sufficiently small compliance represents a good estimate of the true reopening pressure. This pressure is related to the maximum horizontal stress SH and its measured value allows us to estimate the value of SH.