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MONTHLY REPORT (OCTOBER 1977)

GAS STIMULATION PROGRAM AT LLL

TO: Don Ward, DOE

FROM: Merle E. Hanson, LLL

This letter discusses the progress and activities of the LLL Gas Stimulation program during the month of October 1977. During the month, a paper discussing the past year's activities of the LLL Program was presented at the 1st Eastern Gas Shales Symposium at Morgantown, West Virginia.

Theoretical Model Development and Application

Application of both theoretical models has indicated that the boundary conditions applied to the finite size continuum simulated with the codes can cause some problems. Several techniques have been assessed to reduce the effect of these boundaries. The most promising technique which is now being pursued is to enlarge the zonal sizes along the boundaries thereby extending the boundary without increasing grid size. This technique has been applied with other finite element codes for this same purpose.

The theoretical model which includes pore-pressure effects has been used to analyze the effect of changes in pore-pressure on the stress intensification factor. The fluid which is used to drive a hydraulic fracture can propagate into the surrounding reservoir material and thereby increase the pressure of the fluids near the fracture. The analysis indicates that the fracture stress intensification factor decreases as the pressure in the surrounding pore spaces increases. The stress intensification factor is believed to be a measure of the onset of fracture propagation from a stable or quasi-stable state.

We have continued to apply the other theoretical model to analyze the effects of layering near a hydrofracture on the surface deformations. Preliminary indications are that changes in the Young's modulus from layer to layer and changes in layer geometry can cause some change in the position of the maximum surface deflection or slope. The boundaries still cause some problems with the solutions, but as indicated above, we are working on "fixes" for these boundary problems and these modifications will be incorporated into both of the models.

Experimental Model

The effects of interfaces on fracture characteristics have received much of our attention in the experimental effort this month. We have experimentally studied unbonded interfaces between limestone test specimens. For example, with a given surface roughness, a hydraulically driven fracture will not cross the unbonded interface when a normal compressive stress of 1000 psi is imposed across the interface. However, when the normal stress is increased to 1500 psi, the hydraulic fractures propagated across the interface. Other experimental measurements were performed to determine the effect of the vertical stress on the hydraulic fracture orientation. Here a triaxial cell was applied which allowed us to impose a horizontal stress field which had a different value in each direction. Although the data has not been fully analyzed, we note that for ratios of σ_v/σ_{Hmin} smaller than one, the initial vertically created fractures turned and became horizontal. For this ratio greater than one, the fractures remained vertical.

EOS Measurements

The equation of state measurements of the Devonian shale cores has continued. We have completed the remaining tests to define the one-dimensional loading path and have finished all of the planned extension tests.

Geology and Geophysics

During the past month the report discussing the available knowledge of the rock geometry and rock mechanics of the Western tight gas sands was completed. The report is in editing and drafting prior to publishing.

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