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A New Approach to Optimizing Recovery PRTISP Process

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LifeView

Abstract

Results

Field, lab, and modeling efforts have validated the existence and validity of seismic stimulation. Stimulation has been shown to work in a wide variety of formations where seismic attenuation is relatively low. It does not appear to be effective in highly attenuative formations.

Benefits

Seismic wave stimulation technology has the potential to provide a low-cost procedure for enhancing oil recovery in mature fields and making it economically feasible to return abandoned wells to production as well as increase production in currently producing fields. Tests of the technology indicate that seismic stimulation technology potential is greatest in fields with a high water cut and large amounts of immobile oil, making the technology exceptionally suitable for mature domestic oil fields. This work, coupled with lab and theory, will allow producers to make intelligent choices of stimulation procedures.

Background

At the present time a variety of mechanisms has been pro-posed for the effect, but there is not a clear understanding of the phenomenon. Needed are controlled field tests that measure the seismic energy of the sources at the depth of stimulation and tight monitoring on changes in production fluids. Coupled with the lab and theory efforts, a comprehensive understanding of the technology can be achieved.

Summary

During the last year several critical results were obtained that indicate that seismic stimulation may be a viable technology in providing increased production. This was achieved through actual measurements in the field during stimulation with pressurepulsing technology and through improved modeling and theory. This is supported by observation of actual production increases of 10 - 15 percent that can be correlated with stimulation. Also, as the technology is being implemented by more and more companies, researchers are learning why it is working and at which frequencies it will work as a function of rock type.

From a theoretical formulation of deformation and wave propagation in elastic porous media containing two immiscible fluids, including the effect of inertial coupling, a dispersion equation for the dilatational waves in multi-fluid porous media was derived to describe how wave natural frequency depends on wave number. To gain insight into the fluid-dependent nature of these three waves, numerical simulations were performed to investigate the effect of fluid saturation and natural frequency on the phase velocity and attenuation coefficients containing either water and gas or water and oil. The attenuation behavior of the P-wave was found to be sensitive to the presence of different pore fluids.
The laboratory experiments in the Dynamic Stress Stimulation Laboratory (DSSL) at LANL have demonstrated at least four types of stimulated flow behavior. Qualitative agreement also has been confirmed between the lab/theoretical parameters and those of several field stimulation tests performed under this project. In addition to the experiments listed here, project efforts also have focused on modifications to the DSSL apparatus, refinements to the experimental procedures, and improvements to the fluid delivery and stress/strain measurement systems.