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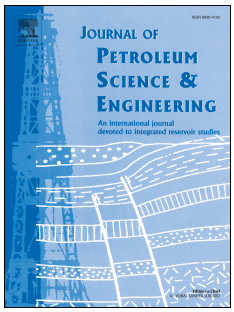

Prediction of productivity of high energy gas-fractured oil wells

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Prediction of Productivity of High Energy Gas-Fractured Oil Wells

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Abstract

The use of fresh water as a fracturing fluid has limitations such as limited water availability in arid areas and negative impacts of water on oil and gas production in formations with high clay content. Alternatives to water for well fracturing include tailored energetic materials such as novel explosives. High energy gas fracturing (HEGF) creates radial fractures with fracture-orientations independent of formation stress anisotropy and heterogeneity. This eliminates the requirement of in-situ stress orientation for designing multi-hydraulic water-fracturing horizontal wells. Assuming uniformly distributed radial fractures around wellbore, an analytical well productivity model was derived in this study to predict productivity of HEGF-completed oil wells under pseudo steady state flow condition. Field case studies and sensitivity analyses were performed with the analytical model. Result of field case studies indicates that the analytical model over-predicts productivity of HEGF-completed wells by about 10%. Sensitivity analysis with the analytical model shows that the productivity of HEGF-completed wells reaches a maximum value at an optimal number of radial fractures around the wellbore. The productivity of the HEGF-completed wells increases non-linearly with fracture conductivity. But the benefit of increasing fracture conductivity levels out beyond fracture conductivity 2000 md-inch for the typical case investigated in this study.

Keywords: HEGF, Water-free, Fracturing, Oil, Well, Productivity

Introduction

Water is widely used in hydraulic fracturing processes to improve productivity and injectivity of oil and gas wells in the petroleum industry. In addition to its limited availability in some regions, it can damage oil and gas reservoirs if clay materials present and thus reduce wells' potential for oil and gas production. To replace water entirely, CO2, ammonia or hydrocarbons have been used in recent years. Other alternatives to fracturing include using high energetic materials such as novel high explosives, deflagrating solid propellants and liquid or gaseous propellant. Depending upon the energy level and its release time of different materials, the processes involving high energy material are further classified as blast fracturing and high energy gas fracturing (HEGF) as shown in Figure 1 (Jaimes et al., 2012). For simplicity of expression, the term HEGF is used for all types of explosive-related fracturing processes in this paper.