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Application of Lightning Breakdown Simulation in Inversion of Induced Fracture Network Morphology in Stimulated Reservoirs

Tuesday, 1 June 2021 11:30 (15 minutes)

Accurately characterizing fracture network morphology is necessary for flow simulation and fracturing evaluation. The complex natural fractures and reservoir heterogeneity in shale gas reservoirs make the induced fracture network resulting from hydraulic fracturing more difficult to describe. Existing fracture propagation simulation and fracture network inversion techniques cannot accurately match actual fracture network morphology. Considering the process of lightning breakdown similar as fracture propagation, a new efficient approach for inversion of fracture network morphology is proposed. Based on the dielectric breakdown model (DBM) for lightning breakdown channel simulation and similarity principle, an induced fracture growth algorithm integrating reservoir in-situ stress, rock mechanical parameters, and stress shadow effect is proposed. The fractal index and random function are coupled to quantitatively characterize the probability distribution of induced fracture growth path. At the same time, a matching rate function is proposed to quantitatively evaluate the fitting between fracture network morphology and the micro seismic data. Combined with automatic history matching method, the actual fracture network morphology can be inverted with the matching rate as objective function. The proposed approach is applied to fracture network simulation of fractured horizontal wells of shale oil reservoir in the Lucaogou Formation in Xinjiang of China, and the fracture networks from inversion fit well with the micro seismic data. A simulation of 94 fractures in the 32 section of Well X2 in Xinjiang Oilfield shows that the well develops more obvious branch fractures. The single-wing fracture network communicates approximately 200m horizontally and approximately 10m vertically. When simulating a single fracture in a production well, it is necessary to consider the influence of complex fracture network morphology, but when simulating a single well or even a reservoir, only the main fracture needs to be considered. This paper proposes an induced fracture growth algorithm that integrates reservoir in-situ stress, rock mechanical parameters, and stress shadowing effects. This algorithm greatly improves the calculation efficiency on the premise of ensuring the accuracy of induced fracture network morphology. The approach in this paper provides a theoretical basis for flow simulation of fracturing reservoirs and optimization of fracture networks.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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Student Poster Award

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