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Optimization of Shale Gas Production by Advanced Hydraulic Fracturing

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Abstract : This paper shows a comprehensive learning focused on the optimization of gas production in shale gas reservoirs through hydraulic fracturing. Shale gas has emerged as an important unconventional vigor resource, necessitating innovative techniques to enhance its extraction. The key objective of this study is to examine the influence of fracture parameters on reservoir productivity and formulate strategies for production optimization. A sophisticated model integrating gas flow dynamics and real stress considerations is developed for hydraulic fracturing in multi-stage shale gas reservoirs. This model encompasses distinct zones: a single-porosity medium region, a dual-porosity average region, and a hydraulic fracture region. The apparent permeability of the matrix and fracture system is modeled using principles like effective stress mechanics, porous elastic medium theory, fractal dimension evolution, and fluid transport apparatuses. The developed model is then validated using field data from the Barnett and Marcellus formations, enhancing its reliability and accuracy. By solving the partial differential equation by means of COMSOL software, the research yields valuable insights into optimal fracture parameters. The findings reveal the influence of fracture length, diversion capacity, and width on gas production. For reservoirs with higher permeability, extending hydraulic fracture lengths proves beneficial, while complex fracture geometries offer potential for low-permeability reservoirs. Overall, this study contributes to a deeper understanding of hydraulic cracking dynamics in shale gas reservoirs and provides essential guidance for optimizing gas production. The research findings are instrumental for energy industry professionals, researchers, and policymakers alike, shaping the future of sustainable energy extraction from unconventional resources.

Keywords : fluid-solid coupling, apparent permeability, shale gas reservoir, fracture property, numerical simulation
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