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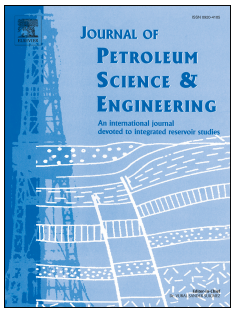

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Elastic, Viscoelastic, and Strength Properties of Marcellus Shale Specimens

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ABSTRACT

Shale gas rocks are characterized as clastic sedimentary rocks, with features such as obvious bedding planes, presence of micro-cracks, and high clay and organic content. These rocks are anisotropic, and inhomogeneous exhibiting a nonlinear response under loading. In order to optimize the required energy for hydraulic fracturing operation and production in shale gas reservoirs, and for constitutive and numerical modeling, it is important to characterize these shale gas rocks. In this study, the hysteresis, elastic-plastic, viscoelastic, and strength properties of Marcellus Shale specimens retrieved from a deep well located in West Virginia were evaluated through perforimg a series of creep, cyclic, and triaxial multi-stage failure tests on these specimens. The results suggest that both elastic moduli and plastic deformations show significant levels of pressure depednecy. Moreover, higher creep compliance and lower Young's modulus values were observed for clay-rich specimens. Both Power-Law and Burgers models were found to capture the creep response of these specimens reasonably well. The dynamic moduli estimated from the ultrasonic velocity measurements at different stress levels were found to be higher than static moduli estimations. In addition, the changes in the internal micro-structure of the specimens resulted from variations in the stress condition, were found to affect the ultrasonic velocity measurements. The strength properties of the calcite/quartz-rich specimen, using multi-stage triaxial failure test, were estimated through both Mohr-Coulomb and Hoek-Brown failure criteria.

KEYWORDS

Shale gas, failure strength, ultrasonic velocity, creep models, elastic moduli, viscoelastic, cyclic

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