Contribution ID: **357** Type: **Poster Presentation**

Three-dimensional fractal model of hydraulically fractured horizontal wells in anisotropic naturally fractured reservoirs

Thursday, 2 June 2022 15:15 (1h 10m)

A 3D numerical model is presented to analyze the behavior of gas flow in hydraulically fractured horizontal wells in anisotropic heterogeneous naturally fractured reservoirs with triple porosity (organic and inorganic matrix, and natural fracture network). This model generalizes the models proposed presented previously in the technical literature so far in relation to the combined of the effects of fractality, present in the stimulated reservoir volume (SRV), triple-porosity, slip and viscous flow, Knudsen diffusion, and kerogen adsorption/desorption from the organic pore walls, geomechanics, anisotropy, and anomalous diffusion.
The proposed model considers the presence of a SRV due to the improvement of the original petrophysical properties of the natural fractures network caused by hydraulic fracturing process generating an anisotropic and heterogeneous distribution of properties around each one of the hydraulic fractures. As a result of the fractal distribution of properties, a consistent matrix shape factor distribution is obtained in this SRV. The model also includes the presence of anomalous diffusion both in the natural fracture network and in the organic and inorganic matrix matrices through the Caputo's fractional derivative, geomechanically effects of production on the petrophysical properties, correction in the apparent permeability with slip and viscous flow, Knudsen diffusion and the adsorption-desorption process of kerogen from the walls of organic pores, and high-speed flow in the hydraulic fractures.
In this work, the functionality/benefit of implementing the proposed model with triple porosity, anisotropic fractal geometry, anomalous diffusion and different transport mechanisms is are analyzed in detail.
The accuracy of the proposed model is verified using approximate analytical solutions, previously presented in the literature, and asymptotic cases by means of a commercial simulator. The different flow periods are identified in the numerical solutions determined.
The results indicate that the shape of the pressure and rate decline curves are causally related to the anisotropic fractal exponents and the order of the fractional derivatives, which represent the density and connectivity of the natural fractures within the SRV and the degree of anomalous diffusion, respectively.
At long times the decrease in gas pressure produces an improvement in apparent permeability due to the sliding effect of the organic and inorganic matrices. In these times the desorption of gas from the organic walls also contributes to production.
The gas depletion process triggers the compaction of hydraulic and natural fractures, reducing the permeability and porosity of these media. This work shows the effect of the effective stress dependence of these properties.
This model allows the generation of well performance scenarios that are closer to reality and make decisions with less uncertainty.
The proposed model is presents for the first time production predictions which take into account the anisotropic permeability behavior of the SRV through the use of the fractal geometry, with associated distributions of porosity and matrix shape factor, and combines these petrophysical properties with the effects of triple-porosity, different scale-dependent transport mechanisms, geomechanics, and anisotropic anomalous diffusion.
The practicality of using these features together for reservoir simulation is evaluated against the benefits of more realistic production scenarios.

Acceptance of the Terms & Conditions

Click here to agree

MDPI Energies Student Poster Award

Yes, I would like to submit this presentation into the student poster award.

Country

México

References

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

Unsure

Primary authors: MARISCAL ROMERO, Rosa María (Universidad Nacional Autónoma de México); Dr CAMACHO VELÁZQUEZ, Rodolfo Gabriel (Universidad Nacional Autónoma de México)

Presenter: MARISCAL ROMERO, Rosa María (Universidad Nacional Autónoma de México)

Session Classification: Poster

Track Classification: (MS07) Mathematical and numerical methods for multi-scale multi-physics, nonlinear coupled processes