RESERVOIR SIMULATIONS OF SHALE GAS IN TIGHT ROCKS USING A NON-LINEAR TRANSPORT MODEL WITH FULLY PRESSURE DEPENDENT MODEL PARAMETERS

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A new source of energy has recently been discovered from unconventional hydrocarbon reservoirs, such as shale gas deposits. Shale gas is found in tight porous rocks which are characterised by nano-scale size porous networks with ultra-low permeability [1,2]. The modelling of transport through such tight porous media is very challenging because it is a relatively new discipline and not much is known but transport processes in them, and little data is available; but it is a growing sector and must be addressed. Here, we apply a recently developed non-linear gas transport model [3], to reservoir simulations of single-phase gas through homogeneous tight rocks. The transport model is an advection-diffusion partial differential equation for the pressure field, $p = p(x, t)$, in such reservoirs,

$$\frac{\partial p}{\partial t} + U\left(\frac{\partial p}{\partial x}\right) = D\frac{\partial^2 p}{\partial x^2}, \qquad t > 0,$$

with suitable initial and boundary conditions. In our new model, the apparent convection velocity, $U = U(p, p_x)$ and the apparent diffusivity, $D = D(p)$, are both highly non-linear functions of the pressure. The model incorporate various flow regimes (slip, surface diffusion, transition, continuum) based upon the Knudsen number, Kn, and also includes Forchchiemers turbulence correction terms. In application, the model parameters and associated compressibility factors are fully pressure dependent, giving the model more realism than previous models, see [4]. Given rock properties such as the intrinsic permeability, K, and porosity and tortuosity parameters, the system above is solved for future pressure distributions over a period of time. Details of the model and applications to various reservoir contexts will be presented at the conference.

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