ABSTRACT

The demand of unconventional resources like shale gas and tight oil has increased in recent years due to two crucial empowering different horizontal drilling technologies and multistage induced fracturing. The productivity of gas from shale reservoirs depends upon the reservoir parameters and the hydraulic fracture properties. For producing shale gas from the complex matrix and fracture network, an efficient model has to be developed. In addition, the distribution of pore sizes in shale gas reservoirs and conventional gas reservoirs are relatively different. As the major portion of gas is in adsorbed state, the diffusivity equation of conventional gas reservoirs is not suitable to define the gas flow in shale reservoirs. So, a new diffusivity relation, which includes the different transport mechanisms like gas slippage, gas diffusion and gas desorption, has to be developed to model a gas flow in shale reservoirs. Moreover, there is high cost and huge uncertainty in the development of shale gas reservoirs because of several uncertain reservoir and fracture parameters. Therefore, an efficient approach to perform sensitivity analysis in respect of Langmuir volume, Langmuir pressure, matrix porosity and matrix permeability for the development of shale gas reservoirs is desirable.

In this research, an efficient analytical model has been developed by dividing the entire shale reservoir into number of blocks, which described matrix and hydraulic fractures. A set of non-linear partial differential equations (PDE'S) has been developed for both matrix and fractures, which represents the fluid flow in the matrix and the fracture. In matrix, the important flow mechanisms like gas slippage, gas diffusion and gas desorption have been included in the mass balance equation while developing nonlinear PDE. In fracture, the flow is considered as dual phase 2-D flow for developing a nonlinear PDE. A horizontal wellbore is considered in which the gas from matrix and fracture will flow into the wellbore. The well performance has been investigated by varying the reservoir properties like Matrix porosity, permeability, Matrix adsorption properties and induced fracture properties like natural fracture porosity, permeability, fracture half length, fracture spacing and number of fractures.

For this work, several presented shale gas modeling and simulation models were studied for determining the extents of different reservoir and fracture properties. CMG-IMEX Simulator has

been engaged to study the horizontal well bore performance of water-gas system i.e. shale gas reservoir. CMG-GEM Simulator has been used to finish the reservoir simulation work and to perform sensitivity analysis.

A 3-Dimensional multi-phase dual permeability model has been developed to describe the gas flow in reservoir. Mainly flow mechanisms like Darcy, Non Darcy flow, and Gas diffusion and in addition gas desorption and gas adsorption mechanisms were also considered in this model. Sensitivity analysis for different reservoir and fracture parameters has been done to study the effect of parameters on production estimation of shale gas reservoir. Also, the effect of these parameters has been computed in 1^{st}, 2^{nd} and 3^{rd} Year by simulation study.