

CHAPTER-9

CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusion:

In present thesis, a three dimensional multi-phase dual porosity shale gas reservoir model has been developed. In this model, different fluid flow mechanisms like Darcy's Flow, Non Darcy Flow and Gas adsorption and desorption were considered for generating three nonlinear PDE's which represent the single phase gas flow in the matrix and the dual phase (Gas + Water) flow in the induced or hydraulic fractures. Also, a multi-stage hydraulically fractured horizontal wellbore is considered in the 5th layer of the 9*9*9 block reservoir model.

First, the developed model was verified by using a commercial CMG-IMEX Simulator. From this it is proven that the effect of natural fractures on gas production is very low and it will not have high impact on the long period gas production reservoirs.

Secondly, the effect of different reservoir and hydraulic fracture parameters on cumulative gas production, rate of gas production and average reservoir pressure has been studied. Reservoir parameters like matrix porosity, matrix permeability, formation thickness, Langmuir volume and Langmuir Pressure and Hydraulic or induced fracture properties like fracture width, no of hydraulic fractures, fracture permeability have been studied separately using a GEM commercial simulator of Computer Modeling Group.

Hydraulic fracture parameters like number of hydraulic fractures, fracture width and fracture permeability will have maximum impact on gas production at the initial stage of production, but as the production life increases the effect of hydraulic fracture parameters will decrease relatively.

During long term production, the effect of reservoir parameters will play an important role in shale gas production. Parameters like matrix porosity, matrix permeability, Langmuir volume and Langmuir pressure have a great effect on gas flow from matrix to hydraulic fracture. Natural fracture porosity does not have greater effect on shale gas production for shorter or longer period of times.

9.2 Recommendations:

Some recommendations for future scope of work in shale gas reservoir modeling are given below:

- Flow of gas in the matrix can also be considered as a multi-phase flow.
- A similar fracture treatment but with different fracture dimensions can be considered.
- Most of the investigations were carried out on reservoir properties relevant to North American Shale Gas Reservoirs; therefore, further research can be done on other shale gas reservoirs like European Shale reservoirs and Indian Shale Reservoirs.
- Shale gas wells produce loads of condensate along with gas. In future work, the modeling of condensate production can be included.

9.3 Futuristic Scope:

World Energy demand is projected to increase by 40 percent by 2030, adding another United States of America and another China to demand. Meeting energy demand on this scale will require all forms of energy: Coal, Oil, Gas and alternatives. Drastic changes are being seen in energy supply and consumption.

Due to drastic changes in the geographies and geologies, China, India and Middle East have emerged as key demand centers, contributing more than 80% of incremental consumption. Moreover, oil and gas supply pattern have also been shifted- Share of North America and Asia Pacific is increasing while the supply from Europe and Latin America is declining.

In order to meet the present energy demands globally, new oil and gas production is focused in more remote, challenging and expensive-to-operate locations. Deep-water, Ultra deep-water, tight oil and shale gas are best examples.

India needs to choose the best energy resource which can meet the current energy demands. One of those resources is the Shale Gas, which has around 63 Tcf recoverable reserves

by which the overall energy requirements in India will be met for next 25 Years. So, extraction of shale gas is a must for the present energy requirements.

Between oil and gas, gas has the potential for finding large domestic reserves. As a cleaner fuel, it promotes a better quality of life. Most significantly if promoted around a national gas grid, it can help India to jump across many years to become an economic 'Power House' as we set up different infrastructures with the help of gas.