

Modeling Natural Gas Flow Behaviors in Unconventional, UHPHT Reservoirs with Nanoporous Media

Dr. Anita Jobbik and Patrik Pusztai; University of Miskolc, Research Institute of Applied Earth Sciences

The growing requirement for energy and decreasing quantity of fossil fuels are forced the present engineers to find alternative solutions. This phenomenon is valid in case of hydrocarbons too, where the role of unconventional reservoirs is getting more significant at recent times. Natural gas production from these types of reservoirs has been developed remarkably in the past few decades thanks to the technology advancement.

These types of reservoirs (tight gas; shale gas) usually have pore size distribution in the range of micro- to nanometers and the reservoirs are placed in extreme conditions, which influence the equations describing the gas flow and the material balance equations. Appropriate description and modeling of these mechanisms are indispensable for economic exploitation of unconventional natural gas reservoirs.

Conventional continuum-flow equations, such as the well-known Darcy's law, greatly underestimate the fluid-flow rate when applied on nanopore-bearing reservoirs. This paper concentrates on the collection, interpretation and presentation of different flow models which can be used in such conditions. They are utilized on core samples which are originated in a Hungarian reservoir under extreme pressure and temperature (over 1100 bar and 200 °C). As only limited literatures are available which can describe the exact flow behavior of natural gas in these conditions, comparison of the different models under these conditions can provide information for a wider understanding of these types of reservoirs.

Several factors influence gas production from these unconventional formations, so the creation of an adequate material balance equation was necessary to describe pressure depletion and original gas in-place. Integration of this novel material balance equation with the different flow models results a calculation algorithm which enables to investigate the reservoir behavior during production. Through this calculation procedure a simple economic analysis can be performed. Finally the adaptability of this model to real production data is investigated.