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Iftikhar Ali* (iali@kfupm.edu.sa), King Fahd University of Petroleum and Mineral, Department of Mathematics and Statistics, KFUPM Box 5046, Dhahran, Eastern 31261, Saudi Arabia, and **Nadeem A Malik**, King Fahd University of Petroleum and Mineral, Department of Mathematics and Statistics, Dhahran, Eastern 31261, Saudi Arabia. *Numerical Investigation of Nonlinear Transport Models describing Gas Flow through Tight Porous Media.*

Mathematical modelling of gas flow through tight porous media results into time-dependent advection-diffusion equations, with highly nonlinear diffusion and advection coefficients. These coefficients depend on the unknown variable p and its spatial derivative, and also on the several reservoir parameters, such as, gas density, permeability, porosity, together with their compressibility coefficients. An accurate and precise determination of these coefficients play crucial role in the success of the mathematical model describing gas flow through reservoirs. In this study, we numerically investigate the effects of reservoir parameters and their compressibility coefficients on the model outcomes and also perform the sensitivity analysis with respect to several parameters. (Received September 21, 2015)