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MODELING OF HYDROCARBON AND NON-HYDROCARBON GASES VISCOSITY BY USING AN ARTIFICAL NEURAL NETWORKS MODEL

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ABSTRACT

The viscosity of gas mixtures is one of the most crucial governing parameters, which affect oil and natural gas flow in reservoirs and exploitation equipment. Ideally, viscosity must be determined experimentally in a laboratory on actual fluid samples. However, in the absence of experimentally measured data, due to its difficulty or when invalid samples are available, parameters would be simulated by different mathematical models. Existing models need experimentally obtained gas components' mole fraction. This study presents an artificial neural network model that predicts the hydrocarbon and non-hydrocarbon gases viscosity by only three input parameters: temperature, pressure, and gas molecular weight, which are easier to find compared to gas components' mole fraction. The prediction procedure in this study was carried out using a large database containing 2445 experimental data in a wide range of temperatures (100-460 °F), pressure (14.7- 10000 psi) and molecular weights (16.04-53.92 Ib/Ib- mole). To develop a suitable model, a multi-layer feed-forward neural network with a back propagation learning algorithm is used. 70 percent of data points were used to train the network. 15 percent were used to validate along the training process and finally, 15 percent were used for blind testing of the network. To find the optimized structure of the network a MATLAB code is written. This code searches through different networks to find the optimal number of hidden layers, number of hidden neurons, the activation function of the hidden layer and the activation function of the output layer. In this study up to two hidden layers, 25 neurons in the first hidden layer and 20 neurons in the second hidden were evaluated. Also, sigmoid and tangent sigmoid activation functions were tested for the hidden layer and sigmoid, tangent sigmoid and linear activation functions were tested for the output layer. As a result, an investigation is made through a vast number of networks. A network with two hidden layers including 12 neurons in the first hidden layer and 10 neurons in the second hidden layer showed the least error. Activation functions of this network are the sigmoid function. The average absolute relative error of the network for test data is 3.27%. A comparison study between this model and five other models is done. Not only the input parameters of this new model are easier to be obtained, but also the proposed artificial neural network model can predict gas viscosity more accurately.

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