Neural Network Based Fractal Models for Predicting Petrophysical Properties of the Sandstone in Northern Coal Mines of China

Zhenxue Dai (1), Lulu Xu (1), Bin Xu (2), Xiaoying Zhang (1), and MohamadReza Soltanian (3)
(1) Jilin University, College of Construction Engineering，Changchun 130026，China, (2) Xi'an Research Institute of China Coal Technology & Engineering Group Corp, Xian 70054, China, (3) Department of Geology, University of Cincinnati, USA

This study develops fractal models to incorporate with the empirical Posenille's formula and Darcy's law for deriving a novel relationship between permeability and porosity that includes fractal dimensions. To test this relationship, we performed scanning electron microscopy (SEM) on sandstone samples collected from Xingtai coal mines in Northern China. The image processing software was applied for estimating different statistical parameters (e.g., fractal dimensions) and geometrical parameters. An automated porosimeter-permeameter was developed to measure porosity and permeability of samples. We compared the estimated permeability with the measured permeability data to test the derived relationship. We also developed a neural network model, parametrized by fractal dimensions and porosity data, to estimate permeability. The estimated permeability and the measured ones were compared to assess the accuracy of the neural network model. The results from this study provide substantial insights for understanding the petrophysical properties of the sandstone and other porous rocks.