

A Data-Driven Model to Determine the Injectivity of Highly Deviated Wells

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Abstract

Injection wells are utilized to increase production, different types of injectors can be used such as vertical, horizontal, and deviated wells. Using inclined wells can lead to increasing the well injectivity/productivity. Different methods can be used to estimate the injectivity of deviated wells, however, huge deviations were observed between the models' outcomes and the field-measured data. This work presents a new model to predict the injectivity of highly deviated injection wells. The proposed model can outperform the available models in predicting the well injectivity for highly deviated wells.

In this study, functional network (FN), adaptive neuro-fuzzy inference system (ANFIS), and artificial neural network (ANN) techniques were used to build a new data-driven model. The model inputs are reservoir permeability, layer thickness, and well deviation angle. Error metrics such as coefficient of determination (R^2), root square error (RMSE), and average percentage error (AAPE) were used to evaluate the prediction performance.

A comprehensive analysis was carried out to obtain the optimum prediction model. All models parameters such as learning rate, hidden layer, transfer function, number of neurons, and learning algorithm were examined to improve the prediction performance. Around 458 data sets were utilized for training, and 198 data sets were used for the testing.

The results indicate that the ANN technique outperforms all studied approaches, with an accuracy of 0.997 R^2 on testing. The RMSE was 0.016 Rb/day/psi and the AAPE was about 9.4% on testing.

In addition, a novel empirical correlation was developed based on the ANN technique, to predict the injectivity of the deviated well as a function of reservoir thickness (h), permeability (k), and inclination angle (θ), with an uncertainty of 0.016 Rb/day/psi on average.

Overall, this work can improve the performance of highly deviated wells by allowing fast and reliable determination of the well injectivity at different reservoirs and operational conditions. The developed correlation can be used to suggest the optimum range for the operational parameters which will lead to improving the well injectivity and reducing the total cost.