Machine Learning Algorithms for Predicting Liquid Loading in Gas Wells

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Abstract

Liquid loading is a term used to describe the situation where the gas produced from a well is unable to carry the liquid that is also produced along with it. As a result, the liquid starts to accumulate in the wellbore. This accumulation of liquid can cause a decrease in gas production and in severe cases, it may even lead to a complete stoppage of production. The phenomenon of liquid loading in gas wells occurs when the critical gas velocity is less than a certain value, leading to a decrease in gas flow rate and ultimately a decrease in production. To simulate this phenomenon and study it in detail, we conducted experiments in a multiphase flow loop. We aimed to compare the results of the experiment with machine learning algorithms to predict the loading and unloading of the well. The purpose of this experiment was to examine the start of liquid accumulation in a gas well using a 2.4 meter vertical rigid pipe system with a 0.0508 meter (2 inch) internal diameter. The study analyzed the flow of gas and liquid in a vertical direction to gain insight into how liquid builds up in a vertical tube as gas flow decreases. The investigation included observing the movement of liquid and the different two-phase flow patterns, as well as measuring pressure, temperature, and the amount of liquid present at various points along the vertical tube. We varied the gas and liquid flow rates to simulate different conditions and recorded the pressure and flow rate data. We used this data to train machine learning algorithms such as Support Vector Machines (SVMs), Random Forests, XGBoost, and Neural Networks, to predict whether the well is loaded or unloaded. We then compared the predictions of the machine learning algorithms with the experimental data. Our results showed that the machine learning algorithms were able to predict the well's loading and unloading conditions with high accuracy. The accuracy was highest when using Random Forest, achieving an accuracy of over 90%. In conclusion, our experiment in the multiphase flow loop successfully simulated the phenomenon of liquid loading in gas wells, and we were able to use machine learning algorithms to accurately predict the loading and unloading of the well. These findings could help improve the efficiency of gas well production by providing an early warning system to prevent liquid loading and increase gas flow rates.