Predicting Water In Crude Oil In Oil Plants Using Hybrid AI Modelling

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Abstract

Objectives/Scope: In conventional oil fields operations, crude quality monitoring in terms of water and salt content in crude generally do not receive attention commensurate with their economic importance. Operations and Engineering often rely on sampling data and in some cases on online Basic sediment and water (BS&W) and salt in crude analysers which are expensive. These analysers ignore the complex interplay of flow regimes, chemicals, and emulsions on water and salt content in crude production.

Methods, Procedures, Process: At Saudi Aramco, we build a multi-target time-series hybrid AI (physics based machine learning) model to evaluate the impact of water content in crude expressed as BS&W (vol%) on crude production over the operation of the facilities. We trained a decision tree-based algorithm to predict BS&W (vol%) using process parameters. We used data from the several Gas Oil Separation plants (GOSPs) processing Arab Light crude oil with gravities of 36-41 API, to the model, possessing information and production data to be used in the model. We split the data randomly into training & testing split. In order to understand the model predictions, we employ advanced machine learning techniques to reflect how each feature contributed to the water and salt in oil predictions.

Results, Observations, Conclusions: The model exhibited 90% on target results and reflected how each feature identified from process contributed to the water and salt in oil predictions. The model required monthly data update to improve reliability. The team also developed recommender system with instructions for operator response with changing process conditions. This was first of kind in the industry and will have several deployments across the Saudi Aramco in line with digitization in GOSPs.

Novel/Additive Information: As conventional fields mature and water handling & disposal continues to increase in importance, both operators and engineers must improve their water in oil (BS&W) predictions. This approach offers robust way of predicting water and salt in crude in real time and at augmenting the operator responses that impact crude quality remotely also supporting sustainability.