ABSTRAK

OPTIMASI *RATE OF PENETRATION* (ROP) MENGGUNAKAN ALGORITMA KLASIFIKASI *MACHINE LEARNING* PADA SUMUR A-3, A-4, DAN A-5 LAPANGAN "AFMH"

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Sumur A-3, A-4, dan A-5 merupakan sumur vertikal *onshore* di Lapangan "AFMH" dengan perbedaan nilai ROP yang signifikan berdasarkan data *mud logging*, walaupun menembus formasi yang sama. Untuk meningkatkan efisiensi pemboran di masa mendatang, dilakukan optimasi ROP menggunakan algoritma klasifikasi *machine learning* yang dapat mempelajari pola yang kompleks dalam data.

Proses optimasi ROP diawali dengan pengumpulan data yang dibutuhkan, seperti rekaman *mud logging* dan desain sumur. Tahapan optimasi ini mencakup pengolahan data mentah hingga siap digunakan, pengembangan model *machine learning*, serta prediksi dan visualisasi rentang parameter pemboran yang direkomendasikan untuk mencapai ROP optimal.

Pengolahan data dilakukan melalui tahap *data preprocessing* dan *feature engineering*, dilanjutkan pemodelan menggunakan algoritma *Random Forest* untuk *section* 8 ½", *Logistic Regression* untuk *section* 17 ½" dan 12 ¼", dan *Support Vector Machine* (SVM) untuk *section* 26". Model *Random Forest*, *Logistic Regression*, dan *Support Vector Machine* (SVM) menunjukkan selisih nilai *accuracy* yang kecil antara *train data* dan *test data*, masing-masing sebesar 0,71-0,68; 0,72-0,67; dan 0,76-0,71. Fitur utama yang dipilih untuk diprediksi adalah WOB, TRPM, dan *Flow Rate*. Rentang parameter pemboran hasil prediksi *machine learning* pada *section* 26": WOB 5 - 6 klbs, TRPM 5 - 71, *flow rate* 541 – 570 gpm; *section* 17 ½": WOB 5 - 23 klbs, TRPM 173 - 199, *flow rate* 701 - 810 gpm; *section* 12 ¼": WOB 5 - 25 klbs, TRPM 113 - 128, *flow rate* 810 - 821 gpm; *section* 8 ½": WOB 5 – 13 klbs, TRPM 261 - 312, *flow rate* 585 - 601 gpm. Berdasarkan pengembangan dan prediksi model, dapat diambil kesimpulan bahwa *machine learning* mampu memberikan rekomendasi parameter pemboran yang dapat diterapkan untuk mengoptimalkan ROP.

Kata kunci: *machine learning*, optimasi ROP, parameter pemboran

ABSTRACT

RATE OF PENETRATION (ROP) OPTIMIZATION USING MACHINE LEARNING CLASSIFICATION ALGORITHMS ON WELLS A-3, A-4, AND A-5 IN "AFMH" FIELD

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Wells A-3, A-4, and A-5 are vertical onshore wells located in the "AFMH" Field, each showing significant differences in Rate of Penetration (ROP) based on mud logging data, despite penetrating the same formation. To improve drilling efficiency in the future, ROP optimization is performed using machine learning classification algorithms that can learn complex patterns in data.

The optimization process began with the collection of relevant data, including mud logging records and well design. This was followed by several steps such as preprocessing raw data, applying feature engineering techniques, building machine learning models, and generating predictions and visualizations of the recommended drilling parameter ranges to achieve optimal ROP.

Data processing was carried out through preprocessing and feature engineering stages, followed by modeling using the Random Forest algorithm for the 8 ½" section, Logistic Regression for the 17 ½" and 12 ¼" sections, and Support Vector Machine (SVM) for the 26" section. The Random Forest, Logistic Regression, and SVM models showed small differences in accuracy between training and test data, which were 0.71–0.68, 0.72–0.67, and 0.76–0.71, respectively. The main features selected for prediction were WOB, TRPM, and Flow Rate. The recommended parameter ranges based on the machine learning predictions are as follows, for the 26" section: WOB 5 - 6 klbs, TRPM 5 - 71, flow rate 541 – 570 gpm; for the 17 ½" section: WOB 5 - 23 klbs, TRPM 173 - 199, flow rate 701 - 810 gpm; for the 12 ¼" section: WOB 5 - 25 klbs, TRPM 113 - 128, flow rate 810 - 821 gpm; and for the 8 ½" section: WOB 5 – 13 klbs, TRPM 261 - 312, flow rate 585 - 601 gpm. Based on the model development and prediction results, it can be concluded that machine learning is capable of providing drilling parameter recommendations that can be applied to optimize ROP.

Keywords: machine learning, ROP optimization, drilling parameters