Pemanfaatan Metoda Capacitance Resistance Model dan Analisis Ketidakpastian Statistik Bayesian secara Simultan dalam Menunjang Evaluasi Performa Waterflood = Utilization of the Capacitance Resistance Model Method and Bayesian Statistical Uncertainty Analysis Simultaneously in Supporting Waterflood Performance Evaluation

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Abstrak

Waterflood berperan penting sebagai strategi pemberdayaan sumur minyak tua guna mencegah penurunan tekanan dan meningkatkan produksi minyak. Teknik streamline serta teknik tracer test adalah metode umum untuk mengevaluasi performa waterflood. Namun, kedua metode tersebut memiliki kekurangan akibat kebutuhan data geologis dengan ketidakpastian yang tinggi. Capacitance Resistence Model (CRM) diusulkan sebagai alternatif karena hanya memerlukan data historis debit sumur untuk memetakan kekuatan interkonektivitas antar sumur. Penelitian ini menggunakan data sintesis dan data lapangan X. Pada data sintesis, model CRMP dan CRMIP tervalidasi melalui history matching dengan R-square>0,9 dan MAPE<10%. Pada data lapangan X, ketidaklengkapan metode matematis menyebabkan hasil history matching menjadi belum optimal dengan nilai R-square 0,79-0,88 dan MAPE 127-185%. Analisis ketidakpastian dari model CRMP dan CRMIP dilakukan melalui metode Bayesian dengan luaran berupa prediction interval pada parameter hasil model CRM dan prediction band profil produksi fluida. Data sintesis memiliki prediction interval yang sedikit berbeda, dengan rata-rata coefficient of variations model CRMP yang lebih rendah dari model CRMIP. Data lapangan X memiliki nilai ketidakpastian pada model CRMP dan CRMIP yang lebih tinggi dibandingkan dengan dataset sintesis. Profil produksi fluida pada semua data yang digunakan menunjukkan hasil yang konsisten, dimana overall relative precision (%) model CRMP lebih rendah daripada model CRMIP.

.....Waterflood plays an important role as a strategy for empowering old oil wells to prevent pressure drops and increase oil production. The streamline technique as well as the tracer test technique are common methods for evaluating waterflood performance. However, both methods have drawbacks due to the need for geological data with high uncertainty. The Capacitance Resistance Model (CRM) is proposed as an alternative because it only requires historical well discharge data to map the strength of interconnectivity between wells. This study uses synthesis data and X field data. In the synthesis data, the CRMP and CRMIP models are validated through history matching with R-square>0.9 and MAPE<10%. In field data X, the incompleteness of the mathematical method causes the results of history matching to be not optimal with R-square values of 0.79-0.88 and MAPE 127-185%. Uncertainty analysis of the CRMP and CRMIP models was carried out using the Bayesian method with outputs in the form of prediction intervals on the results parameters of the CRM model and prediction bands of fluid production profiles. The synthesis data has slightly different prediction intervals, with an average coefficient of variation for the CRMP model which is lower than the CRMIP model. Field X data has a higher uncertainty value in the CRMP and CRMIP models compared to the synthesis dataset. The fluid production profile for all data used shows consistent results, where the overall relative precision (%) of the CRMP model is lower than the CRMIP model.