

ABSTRAK

EVALUASI KINERJA POLIMER NONIONIK DAN ANIONIK PADA RESERVOIR KARBONAT DI BAWAH DEGRADASI TERMAL DAN EFEK IONIK

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Reservoir karbonat bertemperatur tinggi menghadapi tantangan dalam penerapan *polymer flooding* akibat degradasi termal dan interaksi ionik antara polimer dengan ion divalen seperti Ca^{2+} dan Mg^{2+} yang dapat menurunkan viskositas serta efektivitas pendesakan minyak. Penelitian ini bertujuan mengevaluasi dan membandingkan kinerja polimer anionik Hydrolyzed Polyacrylamide (HPAM) dan polimer nonionik Scleroglucan pada kondisi reservoir karbonat bertemperatur tinggi.

Penelitian dilakukan menggunakan model benchmark UNISIM-IV yang merepresentasikan reservoir karbonat Cekungan Santos, Brasil, dengan temperatur reservoir 212°F (100°C) dan OOIP sektoral sebesar 446 MMSTB. Simulasi reservoir dinamis dijalankan menggunakan perangkat lunak tNavigator dengan model Thermal Extended Black Oil. Empat skenario dievaluasi, yaitu *primary recovery*, *waterflooding*, *HPAM flooding*, dan *Scleroglucan flooding*. Degradasi termal dimodelkan menggunakan *half-life* polimer, sedangkan interaksi ionik dimodelkan menggunakan adsorpsi polimer.

Hasil simulasi menunjukkan perbedaan kinerja yang signifikan antara HPAM dan Scleroglucan. HPAM mengalami penurunan viskositas dari 0,97 cP menjadi 0,30 cP dan menghasilkan *mobility ratio* sebesar 1,97, sedangkan Scleroglucan mampu mempertahankan viskositas lebih baik dari 4,40 cP menjadi 0,98 cP dengan *mobility ratio* sebesar 0,43. Secara keseluruhan, injeksi Scleroglucan menghasilkan *incremental recovery factor* tertinggi sebesar 4,6% dibandingkan *primary recovery* yaitu 38% menjadi 42,6%, menunjukkan bahwa stabilitas termal dan kompatibilitas ionik merupakan faktor kunci dalam keberhasilan *polymer flooding* pada reservoir karbonat bertemperatur tinggi.

Kata kunci: Degradasi Termal, Injeksi Polimer, Polimer Nonionik, Reservoir Karbonat, Simulasi Reservoir.

ABSTRACT

EVALUATION OF NONIONIC AND ANIONIC POLYMER FLOODING IN CARBONATE RESERVOIRS UNDER THERMAL AND IONIC EFFECTS

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High-temperature carbonate reservoirs face significant challenges in polymer flooding applications due to thermal degradation and ionic interactions between polymers and divalent ions such as Ca^{2+} and Mg^{2+} , which can reduce polymer viscosity and displacement efficiency. This study aims to evaluate and compare the performance of the anionic polymer (HPAM) and the nonionic polymer (Scleroglucan) under high-temperature carbonate reservoir conditions.

The study was conducted using the UNISIM-IV benchmark model, representing a carbonate reservoir in the Santos Basin, Brazil, with a reservoir temperature of 212°F (100°C) and a sectoral OOIP of 446 MMSTB. Dynamic reservoir simulations were performed using tNavigator with the Thermal Extended Black Oil model. Four scenarios were evaluated: primary recovery, waterflooding, HPAM flooding, and Scleroglucan flooding. Thermal degradation was modeled using polymer half-life, while ionic interactions were represented through polymer rock adsorption.

Simulation results revealed a significant performance difference between HPAM and Scleroglucan. HPAM experienced a substantial viscosity reduction from 0,97 cP to 0,30 cP and resulted in an unfavorable mobility ratio of 1,97. In contrast, Scleroglucan maintained higher viscosity stability, decreasing from 4,40 cP to 0,98 cP, while achieving a favorable mobility ratio of 0,43. Overall, Scleroglucan flooding delivered the highest recovery factor incremental of 4,6% compared to the primary recovery from 38% to 42,6%, demonstrating that thermal stability and ionic compatibility are critical factors governing polymer flooding performance in high-temperature carbonate reservoirs.

Keywords: Carbonate Reservoirs, Nonionic Polymers, Polymer flooding, Thermal degradation, Reservoir Simulation.