

Isolasi Bertahap Bakteri Hidrokarbonoklastik Termofilik dari Ladang Minyak Bumi Suratmi di Utara Kepulauan Seribu dan Pengaruhnya terhadap Karakter Fisik Minyak Bumi

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Abstrak

Microbial Enhanced Oil Recovery (MEOR) merupakan teknologi untuk meningkatkan perolehan minyak bumi dengan cara menginjeksikan mikroba ke dalam reservoir minyak bumi. Teknologi ini memanfaatkan bioproduk yang dihasilkan mikroba seperti gas, *bioacid* dan biosurfaktan, yang dapat mengubah karakter minyak bumi sehingga lebih mudah diproduksi. Bakteri indigen umumnya berpotensi untuk digunakan dalam MEOR. Pada penelitian ini telah dilakukan isolasi bertahap bakteri hidrokarbonoklastik termofilik dari ladang minyak bumi Suratmi di Utara Kepulauan Seribu. Isolasi bertahap bakteri hidrokarbonoklastik dilakukan pada suhu 70°C dalam medium *Stone Mineral Salt Solution* yang ditambah 0,01% ekstrak ragi (SMSSe) + 2% minyak bumi (isolasi tahap 1) dan 2 % minyak sisa degradasi (isolasi tahap 2) dengan pengocokan 120 rpm. Tujuh isolat bakteri berhasil diisolasi dari tahap 1 dan dua isolat bakteri diperoleh dari tahap 2. Kesembilan isolat bakteri diuji kemampuan hidupnya dalam medium SMSSe dengan konsentrasi minyak bumi meningkat (2%, 5%, 10%). Empat isolat bakteri hasil isolasi tahap 1 (S17, S20, *B. fastidiosus*, *B. circulans*) dan dua isolat bakteri hasil isolasi tahap 2 (*Bacillus* sp.1, *Bacillus* sp.2) dapat bertahan hidup dan beradaptasi dengan baik dalam medium SMSSe + 5% minyak bumi. Kemudian kurva pertumbuhan dibuat untuk menentukan umur inkulum terbaik. Kultur campuran isolat tahap 1, tahap 2 dan gabungan keduanya selanjutnya digunakan dalam uji karakterisasi minyak bumi. Karakter fisik yang diuji adalah viskositas, densitas, tegangan antar muka, produksi gas. Uji kromatografi gas dilakukan pula untuk mengetahui perubahan komposisi minyak bumi setelah penambahan inkulum. Hasil perlakuan menunjukkan terjadinya penurunan viskositas, densitas dan tegangan antar muka oleh kultur campuran tahap 1, 2 dan gabungan keduanya. Persentase penurunan viskositas dan tegangan antar muka tertinggi dihasilkan oleh gabungan kultur campuran tahap 1&2, berturut-turut sebesar 13.33% dan 26.93%. Penurunan densitas tertinggi oleh kultur campuran tahap 1 sebesar 1.86% dan dihasilkan produksi gas tertinggi oleh kultur campuran tahap 1 sebesar 0.615%. Perubahan komposisi minyak bumi dengan uji kromatografi gas menunjukkan adanya degradasi minyak bumi pada n-alkana rantai panjang oleh ketiga kultur campuran bakteri. Kultur campuran isolat tahap 1 dapat mendegradasi rantai n-alkana C25, C28, C30-C32,

C34, C35. Kultur campuran isolat tahap 2 mendegradasi rantai n-alkana C28, C30, C32, C34, C35, C37 dan gabungan kultur campuran tahap 1&2 mendegradasi rantai n-alkana C28-C32, C34, C35, C37. Hasil uji karakterisasi menunjukkan bahwa kultur campuran bakteri hasil isolasi bertahap berpotensi untuk digunakan dalam MEOR pada skala laboratorium.

Kata Kunci:

Isolasi bertahap, *Microbial Enhanced Oil Recovery*, kultur campuran bakteri, viskositas, densitas, tegangan antar muka

Sequential Isolation of Hydrocarbonoclastic Thermophilic Bacteria from Suratmi Field in The North of Kepulauan Seribu and Its Effects on Oil Physical Character

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Abstract

Microbial Enhanced Oil Recovery (MEOR) is one of the technologies used to increase oil reservoir recovery by injecting microbes into reservoir. This technology is applied by using bioproduct which are produced by microbial metabolism, such as gas, bioacid and biosurfactant. Indigenous bacteria are generally potential for MEOR. A study on isolation of thermophilic oil-degrading bacteria from the crude oil of Suratmi Field had been conducted in a sequential way. The first isolation phase was done directly from the crude oil sample by using *Stone Mineral Salt Solution* plus yeast extract (SMSSe) medium + 2% crude oil at 70°C. The second phase isolation used the same source at the same condition and the same kind of medium but enriched with 2% residual oil degradation by the mixed culture bacteria phase 1. Four bacterial isolates were able to adapt in SMSSe medium + 5% crude oil obtained from the first isolation stage and identified as *Bacillus fastidiosus*, *Bacillus circulans*, S17 and S20. The second stage gave another two different bacterial isolates which were identified as *Bacillus* sp.1 and *Bacillus* sp.2. The bacterial growth curve was made after that to determine the optimum time of the bacteria which can be used as the inoculum. The physical oil characterization was conducted using mixed culture bacteria phase 1, phase 2 and combination bacteria from phases 1&2. Viscosity, density, interfacial tension were measured after seven day incubation. The highest decrease in viscosity and interfacial tension was by the combination of bacteria from phases 1&2 (13.33% and 26.93%). The highest decrease in density was by phase 1 mixed culture bacteria (1.86%). The highest gas production 0.615%, was by the mixed culture bacteria of phase 1. The change in oil composition analysed by gas chromatography showed that the crude oil had been degraded by bacteria. Phase 1 and phase 2 mixed culture bacteria degraded chain of long n-alkanes. Phase 1 mixed culture bacteria degraded C25, C28, C30-C32, C34, C35 n-alkanes. Phase 2 mixed culture bacteria degraded C28, C30, C32, C34, C35, C37 n-alkanes and the combination of phase 1&2 mixed culture bacteria degraded C28-C32, C34, C35, C37 n-alkanes. Results of the study showed that indigenous bacteria isolated from crude oil of Suratmi were potential for MEOR on laboratory scale.

Key words:

Sequential isolation, microbial enhanced oil recovery, mixed culture bacteria, viscosity, density, interfacial tension