ULTRASONIC ASSISTED WATER FLOODING

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“To my parents, my sister and my love Niloofar.
Your love and support represents the main motivation
To face new challenges and achieving my goals”
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ABSTRACT

Waterflooding being the most frequently used improved oil recovery methods fails to produce more than 30% of OOIP due to high viscosity of oil and/or high interfacial tension. Therefore chemicals or miscible flooding methods are required to improve the recovery of waterflooding. Another alternative and yet unconventional method is application of ultrasonic waves to waterflooding. Despite more than 40 years of experimental studies, there is lack of fundamental understanding about mechanisms and factors controlling the efficiency of ultrasonic assisted water flooding.

Series of displacement experiments were conducted on unconsolidated sand pack, using kerosene, vaseline and engine oil as non wet phase in the system. 2-16% increase in the recovery was observed as a consequence of sonication. In order to enhance the understanding about contributing mechanisms a series of supplementary (static) experiments were conducted by using ultrasonic bath, including: temperature experiments, emulsification experiment and one phase flow experiment. From the results of those experiments, emulsification and viscosity reduction were identified as main mechanisms contributing in improving the recovery of waterflooding. The outcome of this research is expected to enhance the insight about application of high frequency waves and reducing ambiguities about the mechanisms involved.
ABSTRAK

Banjiran air sebagai kaedah meningkatkan penghasilan minyak yang paling banyak digunakan telah gagal menghasilkan lebih daripada 30% kandungan minyak asal disebabkan kelikatan minyak yang tinggi dan/atau tegangan permukaan (interfacial tension) yang tinggi. Oleh itu kaedah banjir menggunakan bahan kimia adalah diperlukan untuk meningkatkan penghasilan minyak. Pilihan lain yang ada tetapi tidak biasa digunakan adalah aplikasi gelombang ultrasonik bersama banjiran air. Walaupun telah lebih 40 tahun kajian dan eksperimen dijalankan, masih terdapat kekurangan pemahaman asas tentang mekanisma dan faktor-faktor yang mengawal keberkesanan banjiran air diperkuatkan ultrasonik.

Beberapa siri eksperimen penyesaran telah dijalankan di dalam pek pasir menggunakan minyak tanah, vaseline dan minyak enjin sebagai fasa tidak basah (non wet phase) di dalam sistem. Kenaikan 2-16% dalam perolehan minyak telah diperolehi kesan daripada penggunaan sonik. Untuk mempertingkatkan lagi pemahaman tentang mekanisma yang terbabit, satu siri eksperimen statik telah dilakukan menggunakan mandian ultrasonik, termasuk: eksperimen suhu, eksperimen emulsi dan daneksperimen satu fasa. Daripada keputusan yang diperolehi, emulsi dan penurunan kelikatan telah dikenalpasti sebagai mekanisma utama menyumbang kepada peningkatan perolehan minyak. Hasil kajian ini dijangka akan menambah pengetahuan dalam aplikasi gelombang berfrekuensi tinggi dan menurunkan keraguan tentang mekanisma yang terbabit.