



Microbial-derived bio-surfactant using neem oil as substrate and its suitability for enhanced oil recovery

Temitope Ogunkunle¹ · Adesina Fadairo^{1,2} · Vamegh Rasouli² · Kegang Ling² · Adebowale Oladepo¹ · Onyinyechi Chukwuma¹ · James Ayoo³

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Abstract

The limitation in the formulation and application of synthetic surfactants in petroleum industry is owing to their high cost of production or importation and their associated toxic effect which have been proven to be harmful to the environment. Hence it is vitally imperative to develop an optimum surfactant that is cost-effective, environmentally safe (biodegradable) and equally serves as surface acting agent. This study discusses the production of microbial produced bio-surfactant and its application in enhanced oil recovery. The bacteria *Pseudomonas* sp. were isolated from urine and allow to feed on neem seed oil as the major carbon source and energy. The crude bio-surfactant produced from the fermentation process was used to prepare three (3) solutions of bio-surfactants at different concentrations of 5 g/500 mL, 10 g/500 mL and 15 g/500 mL, and their suitability for enhanced oil recovery (EOR) was evaluated. Reservoir core samples and crude oil collected from the Niger Delta field were used to evaluate the EOR application of the microbial-derived surfactants. The sets of experimental samples were carried out using core flooding and permeability tester equipment, and the results obtained were compared with conventional waterflooding experiments. The three bio-surfactant concentrations were observed to recover more oil than the conventional waterflooding method for the two core samples used. Optimum performance of the produced microbial-derived surfactant on oil recovery based on the concentrations was observed to be 10 g/500 mL for the two samples used in this study. Therefore, eco-friendly bio-surfactant produced from neem seed oil using *Pseudomonas* sp. has shown to be a promising potential substance for enhanced oil recovery applications by incremental recoveries of 51.9%, 53.2%, and 29.5% at the concentration of 5, 10, and 15 g/500 mL and 24.7%, 28.7%, and 20.1% at concentration of 5, 10, and 15 g/500 mL for the two core samples, respectively.

Keywords Microbial derived bio-surfactant · Neem oil · Enhanced oil recovery · *Pseudomonas* sp. · Bio-degradable

Introduction

Crude oil as a major energy source continues to be highly demanding, and this necessitates the oil and gas industry to explore every possible technology that is economically feasible to maximize the recovery of the field and maintain a balance in oil price (Oladepo et al. 2017, Sandersen et al.

2012; Gao and Zekri 2011). This is because as more production is carried out as a result of the increasing demand for energy, the reservoir's primary energy is depleted having produced about 20–30% of the reserve leaving about 70% of the estimated oil recovery. Enhanced oil recovery method is a technology mostly employed in oilfields that have exhausted the primary (using the natural reservoir drive energy) and secondary recover method (waterflooding or gas flooding), to improve the productivity of the field. This technology over the years has been improved and can be realized using methods like microbial injection or thermal recovery, chemical injection, gas injection, and ultrasonic stimulation. Chemical enhanced oil recovery among others has received attention in the recent research because of its ability to improve the microscopic displacement efficiency through various mechanisms like

✉ Adesina Fadairo
adesinafadairo@yahoo.com

¹ Department of Petroleum Engineering, Covenant University, Ota, Nigeria

² Department of Petroleum Engineering, University of North Dakota, Grand Forks, USA

³ Chevron Nigeria Limited, Lagos, Nigeria