UNIVERSITI TEKNOLOGI MARA

MONITORING SWEEP EFFICIENCY OF LOW SALINITY WATERFLOODING IN SANDSTONE RESERVOIR USING RADIOACTIVE TRACER

ZAFIRAH BINTI ZAIDI

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ABSTRACT

Waterflooding is a common secondary recovery oil extraction method that can enhance oil recovery up to 45 percent overall recovery factor. Waterflooding is commonly used due to its availability, cost effectiveness and simplicity. Sweep efficiency is to determine the effectiveness of oil recovery. Sweep efficiency studies for carbonates had been found using substitution index, coreflooding, simulation and analytical model. But there is limited number of studies using sand pack column for sandstone reservoir. Radioactive tracer was introduced to get the optimum RTD model which indicate the mechanism of the system. Sweep efficiency were believed to increase its value when low salinity brine is used as compared to seawater injection due to capillary pressure, interfacial tension and wettability. In this study, low salinity brine with value of 500 ppm, 1000 ppm and 1500 ppm were injected into packed column. Sample of sandstone were analysed using FESEM to verify for chemical composition of rock. Sweep efficiency was analysed with and without the use of radioactive tracer. Technetium-99m (Tc-99m) radioisotope with half-life of 6 hours was injected into the column. Results from radioactive tracer test showed that the optimum RTD model for this system is perfect mixer in series with exchange model which indicate the mobilization of oil from attached fine particle. The percent oil recovery decreased with increasing brine salinity. Sweep efficiency monitored using radioactive tracer increase for lower salinity solution, LSW and 500 ppm, 39.49% and 41.36% respectively. Volumetric sweep efficiency decreases as salinity increase. This study can conclude that low salinity NaCl brine gives higher volumetric sweep efficiency.

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TABLE OF CONTENT

CHAPTER 1
INTRODUCTION

1.1 Research Background

In recovering oil from reservoir, there are several ways used in petroleum industry. The ways are such as primary recovery, secondary recovery and tertiary recovery or also known as enhanced oil recovery (EOR). Natural mechanism or primary recovery will only use pressure from reservoir to push the oil to surface, while for secondary recovery, water or gas will be injected from injection well towards production well to give energy for the oil to be produced. One of the methods in secondary recovery that use water is called waterflooding, where water will drive the oil that cannot be recovered in primary recovery.

Waterflooding is widely used compared to other fluid such as gas. The use of waterflooding within U.S. and Canada had been proven with high level of producing rate and reserves. Common accessibility of water, ease of connection with water, retention of hydraulic head in injection well, water that able to move through an oil-bearing formation, and efficiency of water in sweeping the oil can be counted as the factors of popularity for waterflooding (Forrest F. Craig, 1971) .

The efficiency of waterflood recovery can be evaluated from few factors including efficiency of primary recovery, connate water saturation, sweep efficiency, saturation of residual oil and crude shrinkage. The efficiency may differ between sandstone and carbonate reservoir. Carbonate reservoir seems to have more complicated structure compared to sandstone reservoir. Hence, by studying the effect of those factors, efficiency of waterflooding for both reservoirs can be improved from time to time depending on reservoir conditions.

In this study, several factors will be discussed to investigate the sweep efficiency of waterflooding. Sweep efficiency is important to indicate whether trapped oil from primary recovery is displaced by the injected water or not. If the sweep efficiency for waterflooding is low, it means that the water injected to reservoir is insufficient to drive the oil towards production well.