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EVALUATION OF THE EFFECTS OF KAOLINITE ON THE EFFICIENCY OF OIL RECOVERY BY RADIOACTIVE-ASSISTED LOW SALINITY WATERFLOOD

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ABSTRACT

Recently, extensive researches are being done on low salinity waterflooding (LSW) as a mean to enhance oil recovery. This study focuses on the impact of kaolinite concentration on the oil recovery by means of radioactive assisted LSW. The LSW experiments conducted were divided into two categories. Firstly, 3 sets (A, B, C) of experiment were conducted using sandpack with varying concentration of kaolin clay (5wt%, 10wt% and 15wt%). The second part of the study include, the use of a radiotracer to help evaluate the sandpack condition during LSW. Kerosene were used as the oil phase of the experiment. Varying results were obtained from each sets of experiments most likely due to the difference in method of preparation of the sandpack prior to LSW. Set A and B showed an increase of recovery with increasing kaolinite concentration. Meanwhile set C and the radiotracers discerned no real correlation between an increase in kaolinite concentration. Highest oil recovery was obtained at 85% of OOIP while the lowest was observed at 51% of OOIP. During experimentation, low initial oil saturation was achieved with the kerosene. Water breakthrough occurred much faster in higher concentration kaolinite sandpack. The increase in pH and MIE mechanisms were evaluated based on the pH values and final Mg2+ and Ca2+ concentration of the produced water. The effect of pH increase was only observed in set C experiment. Concentrations of the Mg2+ and Ca2+ showed a decrease as compared to the initial formation water and low salinity brine in all experiments. Radiotracers experiment produced two RTD models associated with the sandpacks. Kaolinite containing sandpack were shown to be best fitted with the Perfect mixer in parallel RTD model, while clean sandpack showed more alignment with the perfect mixer in series with exchange.

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TABLE OF CONTENT

CHAPTER ONE
INTRODUCTION

1.1 Oil Supply and Demand

Oil has remained as the world's energy source for almost 6 decades and the demand for energy has never been higher. However, as fields mature, oil production will gravitate towards an eventual decline. This occurrence can be linked to several reasons; reserve depletion, pressure decrease and ineffective production techniques (Shiran, 2014). Since exploration and development of new fields are highly cost intensive, companies will try to look at ways to maximize production from their existing assets (Lake, 1996). Therefore, the notion of deploying secondary recovery and EOR technique such as waterflooding, surfactant flooding, polymer flooding or chemical flooding is an attractive alternative and is almost a necessity in every modern producing oil fields (Craig, 1975). These methods are more energy efficient and utilize existing installations and facilities of the developed fields.

1.2 Research Background

Oil is primarily recovered by the reservoir natural drive mechanism which are; solution gas, water influx, gas cap drives and/or gravity drainage. However, to further improve production, secondary or tertiary recovery mechanisms tend to be applied. The primary aim of secondary recovery is to increase or maintain the depleted reservoir pressure. This recovery method includes techniques such as gas or water injection. Tertiary recovery however, is any recovery technique applied after the secondary recovery (Lake, 1996). These classifications for oil recovery are illustrated in Figure 1.1. For the sake of simplicity, this literature will refer to the tertiary recovery process as the Enhanced Oil Recovery (EOR) process.

One of the most common method for oil recovery in the world is waterflooding. The attractiveness of waterflood stems from the general availability of water, relative simplicity of the injection, good spreading in the oil reservoir and its high displacement efficiency (Craig, 1975). Waterflood has been practiced in the oil and gas industry over a millennium. It is a secondary recovery technique as the process yields a second batch