UNIVERSITI TEKNOLOGI MARA

SURFACTANT POLYMER FLOODING ENHANCED OIL RECOVERY: OPTIMUM POLYMER INJECTION RATE

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ABSTRACT

SP flooding (SP) is one of the most promising EOR techniques after primary and secondary recovery are no longer economical. However, polymer flooding can cause to formation damage due to irreversible polymer adsorption. Meanwhile, surfactant flooding is sensitive to temperature where degradation and precipitation can occur. This research was conducted to study the effectiveness of industrial water treatment Sulfocat BK80 in EOR process and to determine the optimum injection rate of Xanthan gum polymer from 0.25ml/min to 0.55ml/min in the sandpack flooding. Sixteen different SP formulations were designed at using different concentration of Xanthan gum and Sulfocat BK80. These formulations were characterized in terms of density, viscosity, shear rate and solubility in order to identify the optimum SP formulations. From the screening result, Sulfocat BK80-Xanthan gum exhibit non-Newtonian behaviour and Winsor Type II. The optimum concentration of Sulfocat BK80 and Xanthan gum were 3000ppm and 400ppm. The optimum SP formulations were applied in sandpack flooding experiment afterward. In the aspect of Xanthan gum injection rate, the result showed that the lowest and highest injection rate were not suitable in sandpack flooding. Intermediate Xanthan gum injection rate (0.40ml/min) was the optimum injection rate which produced the highest incremental oil recovery up to 7.7% and has better displacement effect. The highest the injection rate of polymer has a better displacement effect, however it contributes to fingering process.

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CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

In general, oil extraction method can divide into three types which are primary, secondary and tertiary method. Primary oil recovery happens at the beginning of oil production stage where the oil is extracted by displacement energy that occurs naturally in a reservoir. The primary oil recovery includes depletion drive, gas cap drive, water drive and combination drive (Khaled *et al*., 2017). Secondary oil recovery involves inject of water and gas in order to pressurize oil from the reservoir to the production well. Usually, secondary oil recovery takes place when the natural driving mechanism has depleted and the oil recovery started to plunge. The average recovery factor from primary and secondary recovery are about 20%-40% from original oil in place (OOIP)(Khaled *et al*., 2017).

When the production of oil is no longer economical and started to reduce, the tertiary method or known as enhanced oil recovery (EOR) is applied. EOR will take place after the secondary oil recovery. Usually, this tertiary method become economical viable in the late stage of development and the oil recovery can increase up to 30-60% (Liu *et al*.,2016). According to Tunio (2011), this recovery can be applied on mature and depleted reservoir which has been widely used on China. By injecting the chemical fluids in the reservoir, it can reduce interfacial tension (IFT) between oil and chemical fluid, thus it displace and mobilize oil effectively (Khaled *et al*.,2017). One of the EOR methods is chemical flooding. Polymer, surfactant, alkaline flooding or their combination are the example of chemical flooding.

One of promising chemical injection process is SP flooding. SP flooding (surfactant-polymer) is a combination of both polymer and surfactant flooding. It is originally derives from ASP flooding, where the alkaline flooding was eliminated from the ASP combination (Liu *et al*.,2016). This is because, alkaline polymer can cause few problems during the flooding such as scaling and fluid emulsification (Liu *et al*.,2016).