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PERFORMANCE OF PHB/PEG BLEND FOR POLYMER FLOODING IN ENHANCED OIL RECOVERY (EOR) APPLICATION

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ABSTRACT

Jatropha curcas plant has been known for significant benefits such as for house protection, medicinal uses, biodiesel substitution and many more. The *Jatropha* oil extracted from *Jatropha* seeds gained global attention mainly in packaging industries as this oil was used as carbon source for production of Polyhydroxybutyrate (PHB) due to non-edible food source thus mitigates the global food issue crisis. Besides that, previous study showed that PHB gave good result than Xanthan Gum (XG) as plugging agent for soil remediation and Enhanced Oil Recovery (EOR) application. In the meantime, polymer flooding (PF) one of method applied in (EOR) application need polymer which has good thermal stability when applied in high temperature reservoir. In PF, water-soluble polymer was used. Therefore, in this study, PHB extracted from dried weight (DW) of *Jatropha* was blended with water soluble polymer; Poly(Ethylene Glycol) (PEG) to improve the insolubility of PHB and the rheological properties of PHB/PEG blends were studied. The blend ratios of PHB/PEG are (0 %, 20 %, 40 %, 50 % and 80 %) by %v/v and were coding as (PHB 100, PHB 80, PHB 60, PHB 50 and PHB 20). All conducted tests of PHB/PEG blends were benchmarked with commercial (XG) as it is one of the commonly used polymer in PF. The rheological properties of PHB/PEG was investigated at different temperatures (30 °C, 50 °C, 70 °C, 90 °C, 110 °C and 130 °C), shear rates from (1 s^{-1} to 100 s^{-1}) and different PEG contents using Oscillating Disk Rheometer. This study began with study of chemical reaction in functional group of PHB/PEG blend using Fourier Transform Infrared spectroscopy (FTIR). Result showed that carbonyl absorption shifts to higher frequency and peaks became much broader with increased of PEG contents. For thermal stability study using Differential Scanning Calorimetry (DSC) showed the melting temperature of PHB/PEG reduced except PHB 80 and PHB 40. The Thermogravimetric Analysis (TGA) results showed poor miscibility as degradation temperature, T_{onset} for PHB 100 is higher than PHB/PEG blends. The PHB/PEG blends also displayed higher mass loss along the degradation temperature. The solubility test using Sartorius Moisture Analyser showed that PHB 50 have good solubility in NaCI solution. For rheological properties study showed that all polymer behaved as shear-thinning behaviour. The PHB 80 has higher value of viscosity when subjected to different temperatures, shear rates and PEG contents. In study of temperature effects, activation energy (E_a) decreased with increased PEG content. The PHB 50 and PHB 60 have small value of ($E_a = 4.744 - 2.756$) indicate less dependent on temperature compared to PHB 100 and PHB 80 ($E_a = 11.014 - 9.124$). On the other hand, the flow behavior was studied using curve fitting tool in Matlab software (version 7.12.0635 - R2011a) and best rheological model to present the experimental measurement was selected. During study of effect of shear rates and PEG contents, Ostwald-De-Waele model showed well describe of PHB/PEG blend flow behaviour with higher value of R-squared ($R^2 = 0.91<1$) and smaller values of Sum Square Error (SSE) and Root Mean Square Error (RMSE) although absence of yield stress measurement. Potential as displacement agent was studied in simulated sandpack flooding. During this test, PHB 50 was select due to higher solubility in NaCI solution (30,000 ppm). From this test, commercial XG achieved higher total oil recovered about 65.5 % compared to PHB 50 about 39.1 %.

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TABLE OF CONTENTS