Investigating the improvement of Degradation Resistant with the Addition of SDBS Anionic Surfactant to PEO polymer

Sarmad K. Fakhruddin [1,2*], *Hayder A. Abdulbari* [1,3], *Ahmad Z. Sulaiman*[1] and *Hind A. Rafeeq*[2]

[1]Faculty of Chemical and Natural Resources Engineering, University Malaysia Pahang, Gambang 26300, Kuantan, Pahang, Malaysia

[2]Petroleum engineering department, Engineering College, University Kirkuk, Kirkuk 36001, Kirkuk, Iraq

[3]Centre of Excellence for Advanced Research in Fluid Flow, University Malaysia Pahang, Gambang 26300, Kuantan, Pahang, Malaysia

Abstract. Polyethylene Oxide (PEO) is one of the most common drag reduction agents. However, its ability to reduce drag in turbulent flow decreases with the time due to the degradation of its molecules. Thus, the enhancement of its degradation resistance by the addition of Anionic surfactant is presented. The Polyethylene oxide (PEO) was used in different concentration ranges from 10 to 60 ppm and with addition of sodium dodecyl benzene sulfonate (SDBS) as the anionic surfactant with five concentrations between 100 to 500 ppm. The degradation measurements were done using rotating disk apparatus (RDA). The RDA results have shown a considerable improvement in the degradation resistance of PEO with the addition of surfactant to the polymer solution. The interaction between the polymer and the surfactant results in transferring the polymer chain from coil to straight-like body. Thus, enhance the polymer degradation resistant ability.

1 Introduction

The drag reduction was discovered by Toms in 1948, which is probably the effect produced by polymer addiction in fluids which has attracted most of the attention, due to its relevance for several applications. While performing experiments on the degradation of polymers, Toms observed that the addition of few parts per million of long chain polymers in turbulent flow produces a dramatic reduction of the friction drag [1]. Lately, several researches rapidly developed in the field of polymers additive to reduce the drag.[2] Drag-reducing polymers solutions are usually shear thinning, viscoelastic and either strain thinning or strain thickening, and to varying degrees each of these characteristics is thought to influence the level of drag reduction [3]. Polymeric DRA is proved to reduce transverse flow gradient, and then effectively creating laminar flow in the pipe. This phenomenon is usually occurring close to the pipe wall where axial flow velocity profile has a very steep gradient in which significant pressure losses happen [4]. Janosi et al, 2004 investigated in dam break flows, where a finite volume of fluid is released from a compartment into a long, rectangular channel. The result reported drag reduction occurs in the present of a minute amount of PEO (polyethylene oxide in different time range). The result proved that flow is much faster in the present of PEO which one of the polymer chain which has high molecular weight [5].

Polymer is very effective DRA but it is easily degraded in short time of the additive period. The major problems exist in the polymer degradation is due to mechanical force in solvents flowing at high velocity. The shear force at the wall of the flow channel will degrade the polymer mechanically [6].This mechanical stress will break the linkage of polymer hence reduces its efficiency towards the solvent [7]. To solve these major problems, there are three ways to enhance polymer stability and mechanical strength. The first one is polymer grafting to improve its molecular weight [8]. Grafted polymer is the way to enhance the molecular weight of the polymer by increasing bonding between polymer and increase polymer molecular weight and increase withholding from shear force in flow [9]. However, this method is too costly and needs précises operation conduction which makes it less attractive. The second method to enhance the polymer is by reversible intermolecular association. The objective is to improve mechanical stability by increasing molecular weight. There is the also cross-linking method that joining the polymer by another polymer to become like- ladder structures, but this method is not really efficient on shear degradation. The third method which is the most effective method is by the molecular interaction between the polymer and the surfactant[10, 11].

The field of polymers-surfactant application still limited with counted numbers of researches. Nonetheless, the result of the studies, that has been introduced the implementation of drag reduction using the polymer-surfactant complex, showed the

* Corresponding author: sarmadfakhrulddin@gmail.com