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Evaluation of Emulsified Acrylate Polymer and Its Pour Point Depressant Performance

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Abstract

A traditional pour point depressant (PPD) of acrylate polymer is in solid form at room temperature. The costing for preheating and dilution is a prerequisite to be considered for its utilization in a crude oil industry. Hence, this PPD was improvised as an emulsion system in order to increase its flow ability. Evaluation of the emulsion system has been elucidated and its PPD performance has also been studied. The emulsified PPD could flow as low as -20 ^{o}C. The viscosity of emulsified PPD is much lower which is about 16 cP while traditional PPD solid at room temperature. The particle size of the sample increased by freeze thawed activities, but does not affect the stability of the emulsion. The zeta potential is about -43 mV showing that the emulsion is in the stable range. The pour point performance of emulsified product is better compared to traditional PPD. The increasing trends of performance by increasing the injection showing that the polymer content is the most influenced factor that increased pour point performance of emulsified PPD.

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Keywords: Emulsified PPD; emulsion evaluation; PPD performance

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1. Introduction

PPDs have been used greatly as crude oil flow improver for several decade. Crude oils contain of waxes which is tend to crystallize to produce cage-like structures such that traps the movement of crude oil[1]. PPDs improve the flow of crude oil by inhibit the crystallization growth of wax. PPDs are usually formulated with active compounds (crystal modifiers) dissolved in organic (aromatic) solvents for oilfield use[2]. However a traditional PPDs are waxy materials that tend to solidified at room temperature. Crude oil producers need to heat up the PPDs or diluted with solvent before being able to pump into down hole of production site. These methods create additional costing for the refiners. A PPD of acrylate polymer (Trade name: PD90) is solvent based PPD. It has strong polymer-solvent interaction. It has low melting point of around 45 ºC which will make it solidify at room temperature. To utilize this chemical additive in crude oil's well, preheating is required to make sure that this material is pump able. The introduction of an emulsion system to PD90 would produce a flow able material at room temperature such that the preheating cost would be discarded. Emulsion technique was used to create emulsified PD90 to form fine droplets of PPD in a free polymer-solvent interaction medium. The emulsion has two different phases in which the water-based will form a continuous phase to act as a carrier for the oil polymer-based hence give a better flow ability to PD90[3]. As an emulsion system is being introduced for this PD90, it has a tendency to break and the mixture becomes separated at elevated temperature. In considering that factor, freeze thaw test has been conducted for emulsified product followed by particle size evaluation. Particle size is important parameter that indicates the stability of an emulsion[4]. However, the knowledge on the emulsion state of the acrylate polymer after being emulsified is still scarce in the literature. Hence, the present study aims to prepare emulsified PD90 by emulsion technique and to investigate the emulsion behaviour such as freezing point, viscosity at room temperature, particle size and zeta potential of the emulsified products as well as to evaluate its performance as PPD towards synthetic crude oil/paraffin wax solution after being emulsified.

Nomenclature

PPD	pour point depressant
PD90	pour point depressant of acrylic polymer

2. Material and method

2.1 Materials

PD 90, emulsifier (MWV) and Solvesso 150 were supplied by ACME Chemicals (Malaysia) Sdn. Bhd. Xylene, diethanolamine and ethylene glycol were purchased from Merck Sdn. Bhd. PD90 consist of 40 to 60 wt. % of acrylate polymer in xylene.

2.2 Preparation of emulsified PD90

Emulsified PD90 was prepared by mixing PD90, xylene, Solvesso 150, MWV, diethanolamine, ethylene glycol and distilled water at 50 ºC and stirred at 500 rpm for 1 hour. The mixture was sonicated at 70 Hz until the mixture reach 60 ºC. The mixture was left to cool down to ambient temperature.

2.3 Rheology evaluation

2.3.1 Flow ability

The thermal properties were determined by using Mettler Toledo DSC1-Differential Scanning Calorimetry (DSC), United States system apparatus with nitrogen as purge gas. Starting from 30 ◦C, sample with the range of 6-10 miligram was first cooled until reaching -60 ºC, held isothermally and then heated to 70 ºC at a pre-defined rate of 10 ºC/minute. So, the first cycle or scan was completed. In order to delete any thermal history effects, two