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New Method for Viscosity Estimation of Waxy Lube Oil/MEK-Toluene Solvent Composition

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Abstract: This study presents a newly developed method to estimate the dynamic viscosity of lubricating oil feedstock/solvent composition in solvent dewaxing process, where the high normal paraffin components are to be extracted from the mixture. A reliable technique to determine the flow properties in the complex multi-component mixture depends on selecting high carbon number, from the C_{20} to C_{40} chain, as a solute and light one, bellow C_{20}, as a liquid that matches the wax mass fraction in the light portion of the oil. The study focuses on the viscosity in the dissolution region (liquid phase) to characterize the feedstock/solvent composition behavior. The tested feedstock is ASE30 and the solvent is MEK-Toluene. The selected high carbon numbers are C_{33}, C_{34} and C_{45}, while the light one is C_{10}. The obtained viscosity results by the proposed method were found to be in good agreement with the predicted viscosities of multi mixture components using the available mixed rules procedure reported in the literature. It can be concluded that the linkage between the solubility model and the carbon number selection could govern the characteristics of the waxy lube oil/MEK-Toluene solution.

Key words: Carbon number, crystallization, dewaxing, feed stock, lube oil, multi components dynamic viscosity, oil and gas, solvent dewaxing process, waxing

INTRODUCTION

The lube oil base stocks are prepared from selected crude oils by distillation and special processing in order to meet the desired qualifications (Sequerira, 1994). These petroleum products possess high viscosity that they become sticky at low temperatures. The main reason is due to longer chain length of paraffinic hydrocarbons in those products, which restrict the flow (Thomas, 2008). The solvent which are normally used to ease the flow of the lube oil are Methyl Ethyl Ketone (MEK) combined with aromatic component, such as toluene. The major steps in preparing the feedstock charging with MEK dewaxing unit can be broken down into two processes, namely premixing the feed with a reasonable ratio of MEK and toluene to avoid oil immiscibility and heating the feed/solvent mixture above the cloud point to dissolve any wax microcrystals (Thomas, 2008). The lube oil feedstocks consist of multi component mixture of cycloparaffins, linear paraffins and a small amount of aromatics components. However, most crystallization leading to solidification is attributed to the linear paraffins (n-alkanes) because these components have higher pour points than the other components, (Taylor and McCormack, 1992). Therefore, the solvent dewaxing process is only used to remove the heavier normal paraffins. The experimental methods used for determination of lube oil feedstock characteristics in solvent dewaxing process are very limited, because these processes are confidential to the petroleum industries. The published studies that are related to the phenomena of this work have investigated the viscosity of the oil-MEK-toluene mixture by experimental measurements. Gureev *et al.* (1980) experimentally investigated the relative viscosity (ratio of suspension viscosity to the liquid phase viscosity) of three samples of residual raffinates (SAE, motor oil and MS-20) miscible with different solvent (MEK/toluene) volume ratio. Their experimental analysis led to an approximation expression for SAE and motor oils data in a third degree polynomial equation connected to the relative viscosity as a function to the solid wax suspension. The polynomials coefficients differ from each other were depending on the dilution ratio and the raffinates structural nature. The experimental results showed a Newtonian liquids behavior of these samples diluted with solvent volume ratio extended from 2:1 to 5:1.

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