

**UNIVERSITI TEKNOLOGI MARA**

**DEMULSIFICATION AND  
RHEOLOGICAL  
CHARACTERIZATION OF LIGHT  
MALAYSIAN CRUDE OIL  
EMULSIONS USING  
ELECTROCOAGULATION  
PROCESS**

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**MSc**

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## AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

To date, most of the world's ongoing demand for crude has focused on lighter grades. However, creation of oil emulsion due to mechanical strength and natural surfactant during production are undesirable. The challenges associated with transportation and refining posed by world's oil produces lead the researchers to probe into practical demulsification methods. A great understanding of crude oil rheology and operating condition to treat emulsion is necessary. The research deals with water-in-oil (W/O) emulsion with API gravity of 38.98. The objectives of this research are to study the rheological behaviour and demulsification rate of emulsion. The rheological behaviour of crude oil emulsion has been studied by manipulating the temperature, shear rate and water volume fraction. The rheological study was conducted within a range of temperature (30 – 90°C), shear rates (0.1 – 100 s<sup>-1</sup>) and volume water fraction (20%, 30% and 40%). For emulsion with different water content, the rheological studies follow non-Newtonian shear thinning behaviour and were described in better way by Herschel – Bulky model. Besides that, experimental results indicated that measured viscosity of emulsion decreases significantly with temperature (dropped from 41.0 cP to 27.9 cP) while increasing water volume fraction resulted in increase in viscosity (raised from 6.14 cP to 103 cP). The increasing of temperature cause the molecules loss the chance to agglomerate and thereby breaking the ordered structure thus reduce the viscosity. Meanwhile, higher water fraction of emulsion characterizes higher elastic behaviour, subsequently increase resistance to flow then resulted in higher viscosity. The demulsification rates of water in crude oil emulsion in direct current fields were investigated under various conditions by using electrochemical cell. The separation rate of water increased along with the applied field, water content and salt concentration. The results showed that emulsion separation was governed by the applied electric field, which yield high separation efficiency up to 85.75% at 30V. Moreover, as the salt concentration reached 40000 ppm, the separation percentage achieved 88.75% with shorter time by using copper as electrode. On the other hand, the highest separation achieved by using aluminium was 62.5%. Copper showed a better performance than aluminium. This is because, copper is good electricity conductor, thus it can produced more ions during electrolysis and enhanced the separation efficiency. The findings obtained from this study proved that the demulsification process of crude oil emulsion under electric field can have a high efficiency of separation when the water-in-oil emulsions have high water volume fraction (40%) and salt concentration (40 000ppm) by using copper electrode with 30V applied voltage.

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