

UNIVERSITI TEKNOLOGI MARA

**SYNTHESIS OF ZNO FOR WAX DEPOSITION
CONTROL AND OIL UPGRADING: EFFECT OF
PH**

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ABSTRACT

Waxes and asphaltene depositions are one of the major problem happened during oil and gas operation. Deposition of asphaltene in pipes and pipelines may cause damages to the equipment and increase the maintenance cost. To overcome this problem, several methods are invented in the industries. One of the methods is by using nanoparticles as an agent in controlling wax deposition in crude oil because of their applicable characteristics. At some point, to maximize the outcome of the method, an optimum pH of nanoparticles is vital because the higher the pH, nano-size of nanoparticles become smaller. To get the best viscosity reduction and wax deposition control, uses nanoparticles at optimum pH is important. So, objectives of this study are to synthesize and characterize zinc oxide, ZnO nanoparticles by using sol – gel method in the effect of pH and to run performance study of zinc oxide in-situ addition to heavy crude oil. Firstly, heavy crude oil is characterized to obtain physical properties and rheology characteristics. Secondly, synthesis of ZnO nanoparticles by using sol-gel method in variations of pH values (pH 2, pH 3, pH 4 and pH 5). Thirdly, the ZnO nanoparticles is characterized using X-ray diffraction (XRD) to analyze crystal structure and crystallite size of ZnO nanoparticle. Energy Dispersive X-ray (EDX) and Field Emission Scanning Electron Microscope (FE-SEM) also used to observe morphology and final composition of ZnO nanoparticles. Lastly, performance studies of in-situ addition of ZnO nanoparticle to heavy crude oil by using Electronic Rheometer and cold finger method. The result showed that high pH values will produce smaller crystallites size of ZnO nanoparticles when checked by using X-ray diffraction (XRD). Performance study result showed that optimum pH for wax deposition control is at pH 2. On the other hand, pH 4 ZnO nanoparticle give the best result for viscosity reduction of the heavy crude oil. When shear rate increases, the viscosity reduction decreases. In conclusion, this study will provide the best option of pH for ZnO nanoparticle that can be used to overcome the wax and asphaltene problems and oil upgrading in industries.

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TABLE OF CONTENT

	Page
AUTHOR'S DECLARATION.....	II
ABSTRACT.....	III
ACKNOWLEDGEMENT.....	IV
TABLE OF CONTENT.....	V
LIST OF TABLES	IX
LIST OF FIGURES	X
LIST OF ABBREVIATIONS	XII
CHAPTER 1: INTRODUCTION.....	1
1.1 Research Background.....	1
1.2 Problem Statement.....	2
1.3 Research Objectives.....	3
1.4 Research Scope.....	3
CHAPTER 2: LITERATURE REVIEW.....	4
2.1 Introduction.....	4
2.2 Crude Oil.....	4
2.2.1 Characterization of Crude Oil.....	4
2.2.2 Saturate, Aromatic, Resin, and Asphaltene (SARA) Analysis.....	5
2.2.3 Asphaltene.....	5
2.3 Wax Deposition Problem.....	5

CHAPTER 1

INTRODUCTION

1.1 RESEARCH BACKGROUND

Nowadays, oil and gas industry is a very important source of economic incomes for many countries all over the world. According to US Energy Information Administration, it is almost 100 countries that already have their own reserves of oil in all over the world. That is including their hydrocarbon exploration, production and processing facilities equipped with advanced technologies and expertise such as unconventional drilling, seismic logging systems, hydraulic fracturing systems and others for heavy crude oil extraction.

Heavy crude oil are very viscous crude oil that have large amount of Sulphur composition inside it, usually dark green to black in color, API ° ranging between less than 13°, and have very low specific gravity (Alberto & Acevedo, 2017). Heavy crude oil are transported by pipelines from the producing well into processing facilities. At certain point, temperature of crude oil will decrease and crystal solid substances called wax start to appear. At certain time, large amount of wax deposited inside the pipe line and block the flow inside the pipe. It will cause damages and economic problem (Salimi, Salimi, & Abdollahifar, 2016).

Waxes and asphaltenes are the most important elements of the crude oil as they influence the oil properties. Waxes are complex mixture of solid hydrocarbons which consist of paraffin with a small amount of naphthenic and aromatic hydrocarbon at ambient temperature (Ganeeva, Yusupova, & Romanov, 2016). Asphaltenes can dissolve in crude oil under reservoir conditions, while in production process, the stable state of colloidal system of crude oil will be disrupted due to changes in external temperature and pressure and resulting in deposition of asphaltenes. During wax or asphaltene deposition in crude oil pipelines, oil can be trapped in the deposit.

Current development of technologies has resulted in some new solutions that can be used in oil and gas industries to overcome some problems appeared in the operations. According to Thota & Onyeonuna, in their research paper, they stated that there are three categories for wax