

**The study of the Potential of Nano-Scale Biopolymer Extracted from Coconut Husk as Drag Reducing Agent (DRA) in Water Injection Well**

by

Muhamad Hibri Hafiz bin Hazli

15366

Dissertation submitted in partial fulfilment of

the requirements for the

Bachelor of Engineering (Hons)

(Petroleum)

FYP II - MAY 2015

Universiti Teknologi PETRONAS

Bandar Seri Iskandar,

31750 Tronoh,

Perak Darul Ridzuan

**CERTIFICATION OF APPROVAL**

**The study of the Potential of Nano-Scale Biopolymer Extracted from Coconut Husk as Drag Reducing Agent (DRA) in Water Injection Well**

by

Muhamad Hibri Hafiz bin Hazli

15366

A project dissertation submitted to the

Petroleum Engineering Programme

Universiti Teknologi PETRONAS

in partial fulfilment of the requirement for the

BACHELOR OF ENGINEERING (Hons)

(PETROLEUM)

Approved by,

Approved by,

\_\_\_\_\_

\_\_\_\_\_

(Siti Sarah Bt Salehudin)

(Asif Zamir)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

MAY 2015

## **CERTIFICATION OF ORIGINALITY**

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

---

Muhamad Hibri Hafiz B. Hazli

## ABSTRACT

Drag reducing agent (DRA) is widely used as an additive to reduce the pressure drop in the pipeline system, thus will increase the fluid flow capacity. Whereas, water injection system is a secondary recovery method used to increase the reservoir pressure by injecting water into the reservoir through a number of injection wells. The DRA can be used to increase the performance of water injection system by reducing the pressure drop along injection wells. The synthetic polymer is widely used in the industry have raised an environment concern as it biodegrade very slowly, consequently it will bring harm if the usage is in excess. Hence, this project focuses on using environmentally friendly polymer DRA extracted from organic materials. In this study, grated coconut residue (CR) is used as biopolymer such as Carboxymethylcellulose (CMC) to produce the DRA. The CMC will be extracted from CR by synthesizing the cellulose under the alkali-catalysed reaction with monochloroacetic acid. The CMC will be divides into original scale which is CMC powder produced from the synthesization and the nano scale CMC obtained from grinding the original scale CMC into nano scale using Pulverisette 5 planetary Mill Machine. The objective of this research is to compare performance of the extracted CMC as DRA at different particle scale (nano-scale and original-scale) based on drag reduction percentage (%) in a fluid friction experimental setup. Based on conducted experiment in this research, the nano-scale particle size has better performance than the original-scale on drag reduction percentage resulted from fluid friction experiment.

## **ACKNOWLEDGEMENT**

First and foremost, the author would like to express my gratitude to Almighty God, Allah for the guidance, strength and grace that have been given to help the author undergo and complete this Final Year Project with Allah blessing.

The author would also like to express gratitude and a lot of appreciation to supervisor Mdm Siti Sarah Bt Salehudin for her continuous effort, supervision, advice and guidance throughout completing this report and all the knowledge given.

Apart from that, the author would like to express sincere appreciation and thanks to all the lab technologist Universiti Teknologi PETRONAS (UTP) that involve and guides the author to use and handle all of equipment that were used in this project. And also to all lecturers in Petroleum Engineering Department that have given the author knowledge and assistance in any kind throughout the author study in UTP.

Finally, deepest thanks to all those individuals who have involved directly or indirectly, lecturers, families, colleagues, friends for their kindness and advice throughout completing this project.

# TABLE OF CONTENTS

<b>CERTIFICATION OF APPROVAL</b> .....	i
<b>CERTIFICATION OF ORIGINALITY</b> .....	ii
<b>ABSTRACT</b> .....	iii
<b>TABLE OF CONTENTS</b> .....	v
<b>LIST OF FIGURES</b> .....	vii
<b>LIST OF TABLES</b> .....	viii
<b>CHAPTER 1: INTRODUCTION</b> .....	1
1.1 Project Background .....	1
1.2 Problem Statement .....	2
1.3 Objectives and Scope of Study .....	4
<b>CHAPTER 2: LITERATURE REVIEW</b> .....	5
2.1 Drag .....	5
2.2 Drag Reducing Agent (DRA) .....	6
2.3 Polymer as Drag Reducing Agent .....	7
2.4 Carboxymethylcellulose (CMC) .....	8
2.5 Nano-scale Drag Reducing Agent .....	8
2.6 Coconut Residue .....	9
<b>CHAPTER 3: METHODOLOGY</b> .....	10
3.1 Project Methodology .....	10
3.2 Project Experiments .....	11
3.2.1 Biopolymer Synthesization .....	11
3.2.2 CMC Grinding Process .....	17
3.2.3 Fluid Friction Experiments .....	22
3.3 Experimental Designs .....	24
3.4 Gantt Chart .....	25
<b>CHAPTER 4: RESULTS AND DISCUSSION</b> .....	27
4.1 CMC Synthesization .....	27
4.2 CMC Grinding Process .....	28

<b>CHAPTER5:</b>	<b>CONCLUSION AND RECOMMENDATIONS</b>	.....34
5.1	Conclusion	.....34
5.2	Recommendation	.....35
<b>REFERENCES</b>		.....36

## LIST OF FIGURES

Figure 1:	Water Injection System .....	1
Figure 2:	Segments of Turbulent Flow in Straight Pipeline [13] .....	5
Figure 3:	Project Workflow .....	10
Figure 4:	Washed coconut residue was oven-dried for 24 hours .....	12
Figure 5:	Cooked CR with 1M of NaOH solution at 100 °C for 1 hour .....	12
Figure 6:	CR after being wash with water .....	13
Figure 7:	Solution of 100 ml of 60% NaOH, 15 g of cellulose powder and 900 ml of isopropanol .....	14
Figure 8:	Solution of 100 ml of 60% NaOH, 15 g of cellulose powder, and 900ml of isopropanol added with 36 g of chloroacetic acid .....	14
Figure 9:	The solution after heated for 4 hours at 60 °C .....	15
Figure 10:	Washing process, left washed with ethanol and right washed with methanol .....	16
Figure 11:	CMC obtained .....	16
Figure 12:	The sample preparation according to the ratio .....	18
Figure 13:	The grinding jar tightened lock in the designated arms and the parameters were set in the control panel .....	19
Figure 14:	The grinding product after 30 hours .....	20
Figure 15:	Particle Size Analyzer equipment set up .....	20
Figure 16:	CMC powder inside the Particle Size Analyzer equipment set up ....	21
Figure 17:	Fluid friction equipment set up .....	23
Figure 18:	First test, particle size vs volume .....	29
Figure 19:	Second test, particle size vs volume.....	30



Figure 20:	Comparison of drag reduction performance with different particle size and flow rate.....	33
------------	--	----

## LIST OF TABLES

Table 1:	Most Widely Used Drag Reducing Polymer agents [10].....	8
Table 2:	Planetary Mill test parameters .....	17
Table 3:	Grinding ball diameter size and weight .....	18
Table 4:	Grinding ball calculation .....	18
Table 5:	Experimental Design Parameters .....	24
Table 6:	FYP I Gantt Chart .....	25
Table 7:	FYP II Gantt Chart .....	26
Table 8:	Mass of produced CMC .....	28
Table 9:	Mass of CMC before and after the grinding .....	29
Table 10:	First test, data of the smallest particle to the biggest particle and the volume .....	30
Table 11:	Second test, data of the smallest particle to the biggest particle and the volume .....	31
Table 12:	Summary of both test result .....	31
Table 13:	Summary of test result from original CMC synthesise.....	32
Table 14:	Summary of fluid friction result.....	33