BIOPILE FOR REMOVAL OF SOIL CONTAMINANTS FROM PETROLEUM PRODUCTION

CHRISTOFEL H. SIRAIT

MASTER OF SCIENCE
IN ENVIRONMENTAL SCIENCE

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่ Copyright © by Chiang Mai University All rights reserved

GRADUATE SCHOOL
CHIANG MAI UNIVERSITY
SEPTEMBER 2005
ISBN 974-9888-00-6

BIOPILE FOR REMOVAL OF SOIL CONTAMINANTS FROM PETROLEUM PRODUCTION

CHRISTOFEL H. SIRAIT

A THESIS SUBMITTEED TO THE GRADUATE SCHOOL IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE
IN ENVIRONMENTAL SCIENCE

Copyright C by Chiang Mai University
GRADUATE SCHOOL
CHIANG MAI UNIVERSITY C IT V C d
SEPTEMBER 2005

ISBN 974-9888-00-6

BIOPILE FOR REMOVAL OF SOIL CONTAMINANTS FROM PETROLEUM PRODUCTION

CHRISTOFEL H. SIRAIT

THIS THESIS HAS BEEN APPROVED

TO BE A PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF SCIENCE

IN ENVIRONMENTAL SCIENCE

SXAMINING COMMITTEE	
Dr.' Jitthep Prasityousil	CHAIRPERSON
Dr. Sakunnee Bovonsombut	MEMBER
Dr. Somporn Chantara	MEMBER
Sittisin Bovensom but Asst. Prof. Dr. Sittisin Bovonsombut	UniversityMEMBER

13 September 2005 © Copyright by Chiang Mai University

ACKNOWLEGEMENTS

The author would like to express his sincere appreciation to Dr. Jitthep Prasityousil, a chairman of supervisory committee members, for his interest, assistance, and guidance in this research effort and to Dr. Sakunnee Bovonsombut and Dr. Somporn Chantara, supervisory committee members, for their invaluable suggestions and constructive comments. The author also is also particularly grateful to Asst. Prof. Dr. Sittisin Bovonsombut for his feedback, correction and helpful comments of the manuscript of this thesis.

Various persons at Chiang Mai University have contributed to the development of this research and their help is greatly appreciated. Special thanks to Ms. Siriluck for extending knowledge and time to teach and guide on the microbiology laboratory and to Mr. Pisan, Mr. Jane in the faculty of chemistry and Mr. Suriya in the faculty of agriculture for their assistance in data analyzing.

Financial support was came from a scholarship Royal Thai Government,
Thailand through Department of Technical and Economic Cooperation (DTEC).
Without money and supporting, this thesis could not have been completed.

Acknowledgements are due to the Ministry of Environment through Assistant Deputy of Manufacture, Infrastructure and Service Affairs, Indonesia for providing facilities and some financial assistance during the experiment period.

Finally, the great thanks must go to my wife, my son, my father and mother for their loving support and encouragement throughout the experiment period and have been waiting for my success.

Christofel Hamonangan Sirait

"The LORD is my shepherd, I shall not be in want.

He makes me lie down in green pastures,

he leads me beside quiet waters,

he restores my soul.

He guides me in paths of righteousness

for his name's sake.

Even though I walk through

the valley of the shadow of death,

I will fear no evil,

for you are with me;

your rod and your staff,

they comfort me.

You prepare a table before me

in the presence of my enemies.

You anoint my head with oil;

my cup overflows.

Surely goodness and love will follow me

all the days of my life,

and I will dwell in the house of the LORD

forever.'

Psalm 23

Old Testament

The Holy Bible