

FORMULATION OF A BACTERIAL-SILT MIXTURE  
FOR DEGRADING HYDROCARBONS IN  
CRUDE OIL-CONTAMINATED SEDIMENTS

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TERENGGANU

1999



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**BY**

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**This project report is submitted in partial fulfillment of  
the requirements for the Degree of  
Bachelor of Science (Marine Science)**

**Faculty of Applied Science and Technology  
UNIVERSITY PUTRA MALAYSIA TERENGGANU**

**1999**

**1100024132**

## ACKNOWLEDGEMENTS

I am fortunate in having the invaluable advice, comments and guidance of Prof. Dr. Law Ah Theem of University Putra Malaysia as principal supervisor of this project. I am indebted to his kind assistance and supervision. Without him, this project would not have been carrying out.

No undertaking of this magnitude can be accomplished alone. It is with grateful appreciation that I acknowledge the assistance of Dr Kamil for his generosity in lending me set of nitrogen gas; and the following FSGT's (Faculty of Applied Science and Technology) staff: Hj. Hosni Jalaludin, Pn. Karitini Mohamad, Hj. Sukiman Sengat, Mr. Ismail Nordin, Mr. Sidek, and Mr. Muhammad Embong.

My deepest heartfelt thankfulness goes out to my parents, brothers, sister-in-law and Miss Hiew Yeh Yuen for their endless love and moral support during my day in University.

I would like to extent my gratitude appreciation to Mr. Zulkamal, Miss Salmah, Miss Hing Lee Siang, Mr. Wong Yip Hing and Miss Low Siew Kim for their help in many aspects. Thanks also to a very good friend of mine; Miss Ong Pei Thing, my house-mates of 414 (Travis, See ien, Tiing Siik), Yee Lerk, Jillian, Morgan, Jenny Bong, Elvis, my course-mates and friends for their support and encouragement.



## ABSTRAK

Bauran bakteria-selut telah dirumuskan dengan tujuan untuk mengurai petroleum hidrokarbon yang terkandung dalam tanah yang tercemar oleh minyak mentah. Perumusan bakteria-selut adalah dengan inokulat bakteria yang dipencil daripada persekitaran marin Malaysia ke dalam medium jenis selut yang telah diperkayakan dengan nutrien. Bakteria yang diinokulat ke dalam medium akan membentuk spora apabila keadaannya kurang baik. Bauran bakteria-selut telah berjaya dirumuskan. Kecekapan bauran untuk menghuraikan hidrokarbon telah diuji dari segi masa penyimpanan, kesan suhu dan keberkesanan bauran dalam pelbagai jenis tanah yang tercemar (1500 mg/kg Petronas Tapis A minyak mentah). Hasil daripada uji kaji ini, bio-penghuraian optima bagi bauran ini adalah 0.5515  $\mu\text{g}/\text{kg}/\text{hari}/\text{sel}$ ; kadar pertumbuhan spesifik maksimum bagi bakteria ialah 0.1350  $\text{j}^{-1}$  (Pada tanah jenis selut, 30°C). Suhu merupakan salah satu faktor yang mempengaruhi keberkesanan bauran ini. Bio-penghuraian adalah sangat rendah pada 4°C. Pada 20°C, kadar bio-penghuraian adalah 0.0551  $\mu\text{g}/\text{kg}/\text{hari}/\text{sel}$  (dengan kadar pertumbuhan spesifik yang maksimum; 0.0837  $\text{j}^{-1}$ ). Kadar bio-penghuraian dan kadar pertumbuhan spesifik secara maksimum pada suhu 50°C adalah 0.0502  $\mu\text{g}/\text{kg}/\text{hari}/\text{sel}$  dan 0.0563  $\text{j}^{-1}$  masing-masing. Jenis tanah yang berlainan juga akan mempengaruhi proses bio-penghuraian. Kadar bio-penghuraian hidrokarbon dalam tanah jenis selut, lumpur dan pasir adalah 0.5515  $\mu\text{g}/\text{kg}/\text{hari}/\text{sel}$ , 0.2492  $\mu\text{g}/\text{kg}/\text{hari}/\text{sel}$  dan 0.1292  $\mu\text{g}/\text{kg}/\text{hari}/\text{sel}$  masing-masing.

Untuk memperolehi data bio-jisim mikrob dalam tanah yang lebih menyeluruh, kedua-dua kaedah penentuan secara langsung (APHA, 1989) dan tidak langsung (Findlay et al., 1989) telah diuji. Keputusan eksperimen menunjukkan bahawa, terdapat perhubungan yang rapat antara bilangan sel dan kandungan phospholipids dalam sel. Maka, kaedah penentuan mikrob dalam sedimen secara tidak langsung dengan menggunakan phospholipid telah digunakan.

## ABSTRACT

Bacterial-silt mixture has been formulated to degrade hydrocarbons in crude oil contaminated sediments (1500 mg/kg Petronas Tapis A crude oil). The bacterial-silt mixture was formulated by inoculating an active oil degrading bacteria isolated from Malaysia marine environment into enriched marine silt. The spores forming characteristic of this active oil degrading bacteria has made the formulated mixture a success. Efficiency of the formulated bacterial-silt mixture has been assessed in terms of survival rate, temperature effect, periods of storage and the efficacy of hydrocarbons degradation in different types of crude oil contaminated sediments (1500 mg/kg Petronas Tapis A crude oil). Assessments of the formulated bacterial-silt mixture reveal that, the optimum biodegradation rate of this formulated mixture was 0.5515  $\mu\text{g/kg/day/cell}$  with a maximum specific growth rate of 0.1350  $\text{hr}^{-1}$  (silt type of sediments, at 30°C). Temperature was one of the factors that alter the biodegradation of the mixture. Biodegradation rate of the hydrocarbons in crude oil contaminated sediments was extremely low at 4°C. At 20°C, the biodegradation rate was 0.0551  $\mu\text{g/kg/day/cell}$  (Maximum specific growth rate; 0.0837  $\text{hr}^{-1}$ ). Where as, the biodegradation rate and the maximum specific growth rate at 50°C were 0.0502  $\mu\text{g/kg/day/cell}$  and 0.0563  $\text{hr}^{-1}$ . Different types of sediments will also affect the efficiency of the bacterial-silt mixture. The biodegradation rate in silt, clay and sand type of sediments were 0.5155  $\mu\text{g/kg/day/cell}$ , 0.2492  $\mu\text{g/kg/day/cell}$  and 0.1292  $\mu\text{g/kg/day/cell}$  respectively.



In order to obtain a more representative data on sediment microbial biomass, both direct (APHA,1989) and indirect (Findlay et al., 1989) sediment microbial enumeration techniques were conducted. The results reveal that there was a very close relationship between the cell counts and the phospholipids content in the cells. Thus, this technique was selected for the determination of bacteria biomass in the sediments.