

**CHARACTERIZATION AND BIOAUGMENTATION  
OF STRANDED TAR BALLS IN SUBTIDAL  
SEDIMENTS OF MARINTAMAN BEACH SIPITANG  
SABAH BY USING CONSORTIA OF LOCALLY  
ISOLATED BENEFICIAL MICROORGANISMS  
(LIBeM)**



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**FACULTY OF SCIENCE AND NATURAL RESOURCES  
UNIVERSITI MALAYSIA SABAH  
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**THESIS SUBMITTED IN FULFILLMENT FOR THE  
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**FACULTY OF SCIENCE AND NATURAL RESOURCES  
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2020**

**UNIVERSITI MALAYSIA SABAH**

**BORANG PENGESAHAN STATUS TESIS**

JUDUL : **CHARACTERIZATION AND BIOAUGMENTATION OF STRANDED TAR BALLS IN SUBTIDAL SEDIMENTS OF MARINTAMAN BEACH SIPI TANG SABAH BY USING CONSORTIA OF LOCALLY ISOLATED BENEFICIAL MICROORGANISMS (LIBeM)**

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Tarikh : 9 Jun 2020

(Prof. Madya. Dr. Piakong Mohd Tuah)  
Penyelia

## **DECLARATION**

I hereby declare that the material in this thesis is of my own except for the quotations, equations, references and summaries which have been duly acknowledged.

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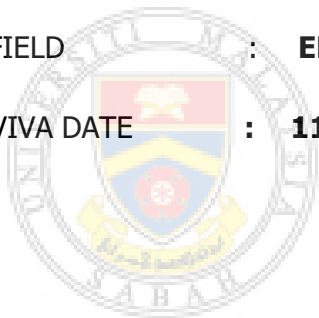


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## CERTIFICATION

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DEGREE : MASTER OF SCIENCE  
FIELD : ENVIRONMENTAL SCIENCE  
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Assoc. Prof. Dr. Piakong Mohd Tuah

\_\_\_\_\_

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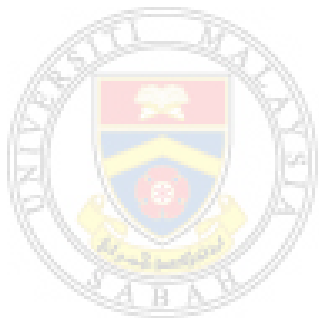
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ERMA HANI BINTI BAHARUDZAMAN

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## ABSTRACT

Oil spill is one of the environmental pollutions that commonly occurs along the coastal area. Tar-balls are one of the products come from the oil spill pollution. Tar-balls pollution was monitored at 10 points along the coastline of Marintaman Beach at Sipitang, Sabah were observed weekly in February 2016. This study is aimed to determine the physical characteristics, composition and concentration of Polycyclic Aromatic Hydrocarbons (PAHs) of the existence of tar balls in that monitored week. The total of tar-balls collected were 227 pieces (n=227). The shape of collected tar-balls was not irregular shape and the sizes of the tar-balls in range of 0.1 cm to 6.9 cm. The composition and concentration of PAHs in outer and inner layer of tar-ball was determined, top three compounds are benzo [g,h,i] perylene (196.58 ppm), flourene (141.8 ppm), dibenzo [a,h] anthracene (101.95 ppm), and indeno [1,2,3-c,d] pyrene (85.49 ppm) and they are highly found in the inner layers of the sample. The biodegradation efficiency, rate and environmental parameters were determined during the biodegradation of tar-balls by LIBeM in liquid formulation. The biodegradation Consortia LIBeM (*C. tropicalis*-RETL-Cr1 + *C. violaceum*-MAB- Cr1 + *P. aeruginosa*-BAS-Cr1) showed the degradation of TPH of natural attenuation were 81%-fold with 83.36% and 19.11% respectively after 84-day periods. For CFU, the range of cell counts that suit the treatment was exceeding to  $10^4$  with maximum value recorded  $5.0 \times 10^7$  CFU/mL . For pH, it was observed that the tar-balls treated well with consortia LIBeM and recorded an average pH was 6.00 to 6.86 respectively during the treatment. The treatment of tar-balls that treated with LIBeM consortia were recorded the soil moisture was below the range with 8% to 9%. For temperature the trends of temperature in tar-balls treatment with consortia LIBeM not showed a large deviation in the range 28-34°C. The biodegradation profile and ratio were monitored using the Gas Chromatography-Mass Spectrometry (GC-MS). The ratio shows that the biodegradation of treatment tar-balls had taken place during the specified biodegradation study. ASP-Biodegradation by LIBeM-LIQ formulation of *C. tropicalis* RETL-Cr1, *P. aeruginosa* BAS-Cr1 and *C. valaceum* MAB-Cr1 has a great potential as an integrated approach for treatment of tar-balls after oil-spill in marine ecosystem.

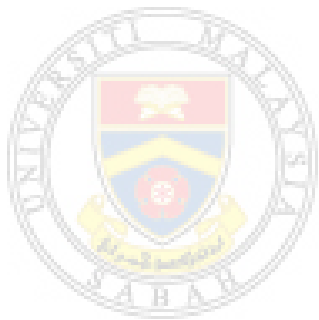


## **ABSTRAK**

### **KARAKTERASI DAN BIOAUGMENTASI TERHADAP BEBOLA TAR YANG TERDAMPAR DI PANTAI MARINTAMAN SIPITANG SABAH DENGAN MENGGUNAKAN KELEBIHAN MIKROORGANISMA ISOLASI TEMPATAN (LIBeM)**

Tumpahan minyak merupakan salah satu pencemaran alam sekitar yang sering terjadi di sepanjang kawasan pantai. Bebola tar adalah satu produk yang terjadi dari tumpahan minyak. Pencemaran bebola tar telah di kaji pada 10 lokasi penyelidikan sepanjang pantai Pantai Marintaman di Sipitang, Sabah dan di kaji pada setiap minggu dalam bulan Februari 2016. Kajian ini bertujuan untuk menentukan ciri-ciri fizikal, komposisi serta kepekatan hidrokarbon aromatic polisiklik (PAHs) dan kewujudan bebola tar dalam minggu yang dipantau. Jumlah bebola tar yang dikumpul adalah 227 biji bebola tar ( $n = 227$ ). Bentuk bebola tar yang terkumpul mempunyai bentuk yang tidak teratur dan saiz bebola tar adalah dalam jarak antara 0.1 cm hingga 6.9 cm. Komposisi dan kepekatan PAH dalam lapisan luar dan dalam bebola tar telah di analisis, terdapat tiga kompaun utama iaitu benzo [g, h, i] perilene (196.58 ppm), flourene (141.8 ppm), dibenzo [a, h] anthracene 101.95 ppm), dan indeno [1,2,3-c, d] pyrene (85.49 ppm) dan didapati compound tersebut mempunyai jumlah yang tinggi dalam lapisan dalam sampel. Kecekapan biodegradasi, kadar dan parameter alam sekitar juga di analisis semasa biodegradasi bebola tar oleh LIBeM dalam formulasi cair. Biodegradasi campuran LIBeM (*C. tropicalis*-RETL-Cr1 + *C. violaceum*-MAB-Cr1 + *P. aeruginosa*-BAS-Cr1) menunjukkan kemerosotan TPH adalah 81% kali ganda dengan pelemahan semulajadi dengan 83.36% dan 19.11% tempoh masa. Bagi CFU, julat jumlah sel yang sesuai dengan rawatan melebihi  $10^4$  dengan nilai maksimum yang direkodkan  $5.0 \times 10^7$  CFU / mL. Untuk pH, diperhatikan bahawa bebola tar yang dirawat baik dengan campuran LIBeM dan mencatat pH purata adalah 6.00 hingga 6.86 masing-masing semasa rawatan. Rawatan bebola tar yang dirawat dengan campuran LIBeM dicatatkan kelembapan tanah berada di bawah julat dengan 8% hingga 9%. Untuk suhu trend suhu dalam rawatan bebola tar dengan campuran LIBeM tidak menunjukkan sisihan besar dalam julat 28-34 ° C. Profil dan nisbah biodegradasi dipantau dengan menggunakan Gas Chromatography-Mass Spectrometry (GC-MS). Nisbah biodegradasi menunjukkan telah berlaku sepanjang tempoh degradasi. ASP-

Biodegradasi oleh penggubalan LIBeM-LIQ *C. tropical* RETL-Cr1, *P. aeruginosa* BAS-Cr1 dan *C. valaceum* MAB-Cr1 mempunyai potensi yang besar sebagai pendekatan bersepadu untuk rawatan bola tar selepas tumpahan minyak dalam ekosistem laut.



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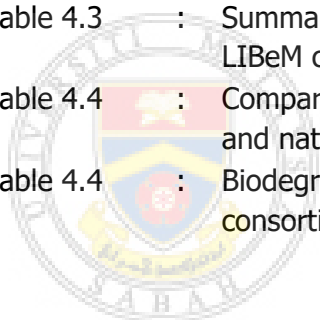
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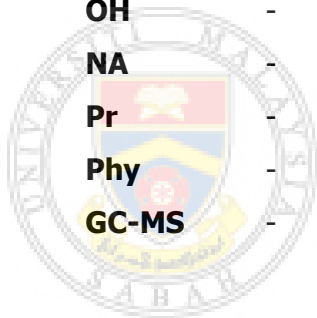
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## LIST OF ABBREVIATIONS

<b>LIBeM</b>	-	Locally Isolated Beneficial Microorganisms
<b>PAHs</b>	-	Polycyclic aromatic hydrocarbons
<b>LIBeM-LIQ</b>	-	Locally isolated beneficial microorganisms Liquid
<b>GMOs</b>	-	Genetic modified microorganisms
<b>SVOCs</b>	-	Semi Volatile Organic Carbon
<b>C<sub>20</sub>-C<sub>40</sub></b>	-	Aliphatic hydrocarbons with larger chain length
<b>PCSS</b>	-	Petroleum Coke–Sludge Slurry
<b>PCWS</b>	-	Petroleum Coke–Water Slurry
<b>OGPW</b>	-	Oil Gas Production Wastewater
<b>OPC</b>	-	Portland cement
<b>OH</b>	-	Hydroxyl Radicals
<b>NA</b>	-	Natural attenuation
<b>Pr</b>	-	Pristane
<b>Phy</b>	-	Phytane
<b>GC-MS</b>	-	Gas Chromatography-Mass Spectrophotometry



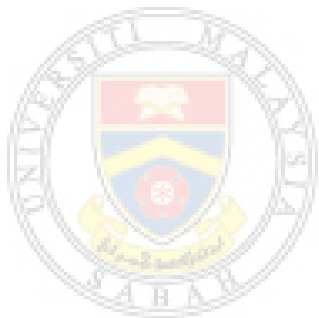
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## LIST OF SYMBOLS

<b>%</b>	-	Percentage
<b>µm</b>	-	Micrometer
<b>°C</b>	-	Degree Celsius
<b>&gt;</b>	-	Larger than
<b>&lt;</b>	-	Smaller than
<b>g</b>	-	Gram
<b>g/kg</b>	-	Gram per kilogram
<b>g/kg/d</b>	-	Gram per kilogram per day
<b>L</b>	-	Liter
<b>mg/kg</b>	-	Milligram per kilogram
<b>mL</b>	-	Milliliter
<b>mM</b>	-	Millimolar
<b>nm</b>	-	Nanometer
<b>OD</b>	-	Optical Density
<b>OD<sub>600</sub></b>	-	Optical density at wavelength of 600 nm
<b>v/v</b>	-	Volume per volume
<b>v/w</b>	-	Volume per weight
<b>% per day</b>	-	Percentage per day
<b>-ve</b>	-	Negative
<b>+ve</b>	-	Positive
<b>(*g)</b>	-	Gas production
<b>k</b>	-	Constant
<b>SD</b>	-	Standard Deviation
<b>Kg</b>	-	Kilogram
<b>K</b>	-	The biodegradation rate constant
<b>Rt</b>	-	Retention Time

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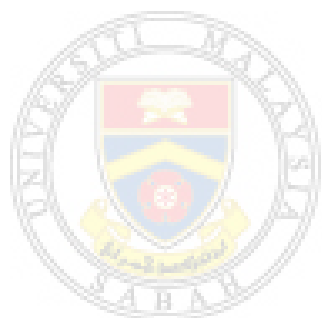
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