EFFECTS OF MIXED BACTERIAL CONSORTIUM ON BIOREMEDIATION OF CRUDE PETROLEUM CONTAMINATED RIVER SEDIMENTS

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1. Letter of Report Submission

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Dear Professor,

FINAL RESEARCH REPORT "EFFECTS OF MIXED BACTERIAL CONSORTIUM ON BIOREMEDIATION OF CRUDE PETROLEUM CONTAMINATED RIVER SEDIMENTS"

With reference to the above-mentioned matter, I am pleased to submit two copies of the final report entitled "Effects of Mixed Bacterial Consortium on Bioremediation of Crude Petroleum Contaminated River Sediments".

Thank you.

Yours sincerely,

CINDY TAN SOO YUN
Project Leader

5. Report

5.1 Proposed Executive Summary

Petroleum exploration refining and related activities around Lutong River,Miri Sarawak have caused deterioration to the river quality and sediments around the area. The crude petroleum is a mixture of mostly alkanes, cycloalkanes and various aromatic hydrocarbons with some organic compounds that contain nitrogen, oxygen and sulphur and traces of metals. Bioremediation can be defined as the use of living organisms to remove environmental pollutants from soil, water and gases. It is a natural process which is safe with minimal exposure risks. In the bioremediation process, the waste is detoxified and mineralised where the waste materials are converted into inorganic compounds such as carbon dioxide, water and methane. Since biological processes are usually specific, the growth conditions of microorganisms in a biodegradation process must be maintained in optimum conditions throughout the treatment to ensure successful removal of pollutants. Controlling the microbial populations by providing suitable environmental growth conditions as well as appropriate type and level of nutrients is challenging and may be difficult as the conditions may vary from site to site, especially in an *ex-situ* treatment.

This study explores the usage of indigenous bacteria which will be isolated from the petroleum contaminated river sediment. These bacteria will be selected based on their characteristics to form the mixed bacteria consortium for the bioremediation process. Some pre-determined experimental conditions will be introduced on the selected microorganisms based previous related studies to study the ability of bacteria consortium to degrade hydrocarbons. Crude petroleum contaminated sediments from Lutong River bed will be excavated and used for trial bioremediation experiments in this study. There are four proposed steps in the research methodology as follows:

(i) Physicochemical characterisations of the contaminated soil samples, i.e. soil physical properties, heavy metals and nutrient analyses.

(ii) Microbial analyses including bacterial isolation, enrichment, identification and DNA sequencing.

(iii) Preliminary bioremediation screening on the contaminated sediments using mixed bacterial cultures.

(iv) Enhancement of bioremediation processes by alteration of the treatment conditions.

5.3 Introduction

Marine oil spills have become the primary public concern as it causes oil pollution over a large area and present severe environmental hazards. Major inputs of oil into seas are associated with accidents during transportation by tankers and pipelines (about 70 %) such as the incidents involving Exxon Valdez, Sea Empress and Torrey Canyon supertankers. Contributions from the offshore activities such as drilling and production are minimal, less than 1 %. On the contrary, oils spills on land usually are localised, hence their impact can be rid of easier, relatively. However, the occurrence of catastrophic spill which releases more than 30,000 tonnes of oil has decreased markedly (Patin, 2008).

In tandem with the population growth, Malaysia is experiencing a booming economic development in the areas of industrialization and urbanization. Owing to the aggressive developments, the country's environment is more exposed to threats and hazards from all kinds of pollutants. The concentration of petroleum hydrocarbons from point and non-point sources in Malaysia varies according to locations (Sakari et al., 2010), with the west coast of Peninsular Malaysia being reported to contain medium to high concentration of hydrocarbons from city source materials, industrial points, workshops and run offs (Zakaria et al., 2002). A slightly lower amount of these organic compounds is observed in the east coast of Peninsular Malaysia because there are lesser heavy industrial activities and usually the main contributors of the environmental contamination are the local boats and limited residential areas (Sakari et al., 2008). Similarly, the petroleum pollution in Sabah and Sarawak regions is more evident in the areas involved in the oil and gas exploration.

Petroleum hydrocarbons (TPHs) found in fuels and oils are complex mixtures composed of more than 250 compounds. The carbon numbers range from C_5 through C_{36}. It is very common that the compositions of these products are made up of several hundred hydrocarbon compounds (RISC, 2006). Petroleum hydrocarbons are considered as recalcitrant compounds which persist in the environment. Due to their highly hydrophobic nature accompanied by low volatility, they are hard to biodegrade and become a threat to the ecosystems. Among the most important groups of petroleum hydrocarbons studied widely covers the straight-chained alkanes, branched alkanes, aromatic hydrocarbons and some organosulphur compounds (Abed et al., 2002). Some even contain asphaltenes and the resins (Das and