EFFICIENCY OF CBM (COMPLEX BENEFICIAL MICROBES) TO REDUCE RIVER POLLUTION OF MALACCA RIVER

Mohd Affandi Marjuni* and Normala Halimoon

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Introduction

River as main freshwater resource is one of country's assets and essentials to agriculture, industry and even human existence. However, those importance are incomparable to the present efforts of preserving and conserving its natural condition, sustain its quality for its usage and ironically the degree of water pollution nowadays and the near future are keep increasing and in asymmetric condition with those efforts. By maintaining and well managing the river, its aesthetic value may boost as well as the country's engine of economic growth and also improve the quality of life for its citizens by providing excellent quality and quantity of healthy water. Although rivers providing water resource for various sectors, those sectors in turns become major contributor to river and water pollution. In Malaysia, 91 river basins (64%) were classified as clean and 7 river basins (5%) classified as polluted from the total of 143 river basins monitored by Department of Environment (DOE) in 2007. Meanwhile, most of the point sources of river pollution were contributed by sewage treatment plant, followed by manufacturing and agro-based and notably animal farm (pig farm) (DOE, 2008).

Recently, effective or beneficial microorganisms technology has been widely applied as a mean of pollution control or bioremediation technology. It has been regard as the environmental solutions towards environmental problems that tackle the problem by manipulating, amplifying, and modifying the natural events and processes especially microbes to treat and degrade environmental pollutants. Thus this study is trying to discover the effectiveness of this technology by conducting an experiment to a beneficial microorganisms product developed by local company to treat river pollution.

Problem Statement and Significance of Study

Malacca is an urbanized town with mass anthropogenic activities and will unquestionably pose significant effects towards the environmental quality especially to Malacca River through point and non-point sources pollution mainly from industrial and domestic wastes and wastewater. In term of environmental monitoring and remediation, there are also several environmental analyses and river rehabilitation program have been conducted on it earlier.

Although the condition and status of the Malaysian rivers for example Malacca River is constantly being monitored and regulated there are few of river restoration and pollution control program are reported involving the use beneficial microorganisms product.

Thus, this study is conducted to determine the existing water quality status of Malacca River and the applicability and efficiency of CBM to treat or reduce river pollution into considerable level in a laboratory-scale as aligned by the existing guideline and standard established by Malaysian DOE.

Research Objectives

1. Determination of water quality status based on selected physicochemical, biological and nutrient parameters of Malacca River,

2. Evaluation of the optimum environmental condition and experimental variables that enhance or affects the performance of CBM to remediate river water pollution.

3. Determination of the CBM's efficiency and feasibility in laboratory scale to reduce river pollution level of Malacca River by comparing the results with existing guidelines.

Literature Review

Biodegradation is a term used to explain biological processes of breaking down organic compounds by living organisms resulting in the formation of CO_2 and water or CH_4. It is also can be defined as the disappearance of environmentally undesirable properties of a substance. Biodegradation is caused by microorganisms such as bacteria, fungi, and microfauna (e.g. protozoans, some worms and some insects) (Hamby, 1996).

Bacteria are natural degraders that can break up complex compounds into pieces for their growth and reproduction. Some bacteria use the carbohydrates and proteins found in the suspended solids, while others employ compounds most organisms cannot, such as, sulfide, ammonia and hydrocarbons (Jjemba, 2004). Combinations of species often provide a more powerful and complete degradation of specific pollutants than individual strains applied alone, because the by-products of one species often serve as another species' food. Only a correctly balanced formula of bacterial strain that was already altered and engineered can use this synergistic effect to completely breakdown pollutants to non-toxic by-products. Furthermore, degradation pathways are determined quite often by environmental condition such as pH, oxygen, and nutrient conditions (Timmis *et al*., 1994).

Thus, the potential of microorganism or bacteria to degrade environmental pollutants was quickly applied into various products and technology and termed as biochemical product, beneficial microorganisms or effective microorganisms. For example, the termed "effective microorganism" was first coined by Teruo Higa of the University of the Ryukyus in Japan in the 1980s to encompass those microorganisms that are effective and beneficial in a variety of settings and have been applied in agriculture, livestock production and recently in environmental remediation such as cleaning polluted waterways, lakes and lagoons, and septic tanks, as well as in wastewater treatment, landfills, and for water purification Teruo and James (1994) (Zhou *et al*., 2008). One of the examples is the use of biochemical products or effective microorganisms as a bioremediation technique to assist and improve the performance of domestic sewage treatment plants (Salmiati *et al*., 2007).

Material and Methodology

1) Materials

This study is conducted to evaluate the performance of Complex Beneficial Microorganisms (CBM) and as an environmental remediation product to treat or reduce Malacca River pollution level.

2) Research Design and Methodology

i) Preparation of Inoculum Stock Solution

The original CBM solution will be diluted with media in the ratios of 1:200, 1:300, 1:400 and 1:500 to attain several concentrations of CBM stock solution.

ii) River Water Sample Collection and Initial Analysis

River water will be analyzed to determine its current river water quality. The parameters of the analysis comprised of physicochemical, nutrient and biological parameters and will be measured *in-situ* and *ex-situ* for laboratory-scale treatment. *In-situ* parameters are pH, DO and Temperature meanwhile *ex-situ* parameters are BOD_5 Test, Suspended Solid, Total Nitrogen, NH_3-N, NO_3-N, NO_2-N and Chemical Oxygen Demand (COD). All of the parameters will be analyzed using HACH Method.

iii) Analytical Procedure

a) Experimental Conditions

Samples will be treated with all of the CBM concentrations with at least 4 replications for each concentration and tested into several experimental conditions such as:

- pH (e.g. 5, 6, 7 and pH 8)
- Agitation speed (e.g. 200, 250, 300 and 400 rpm)
- Temperature (e.g. 20, 25, 35, 40 and 45°C)
- Incubation period (e.g. 3, 4, 5, 6, and 7days)

b) Reanalysis of Samples

Samples will be reanalyzed for its water quality parameters after undergone all of the experimental conditions and data output will be compared with initial data for the determination of the CBM's performance.

iv) Data Analysis

The data will be statistically analyzed using Analysis of Variance (ANOVA) and other appropriate statistical method to determine the statistical significance of the performance of CBM under different concentrations and variables. The relationship between variables and also with CBM's concentration will be established for its optimum condition of CBM's performance and its kinetic modeling activity.

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