Biodegradation of Polyethylene by Microalgae *Anabaena* sp. and *Chlorococcum* sp.

Karthick Murugan Palanisamy [1,a)], Gaanty Pragas Maniam[1, b)], Mohd Hasbi Ab. Rahim[1, c)],and Natanamurugaraj Govindan[1,d)]

[1] *Algae Culture Collection Center & Laboratory, Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, Lebuh Persiaran Tun Khalil Yaakob 26300, Kuantan, Pahang, Malaysia*

[a)] *Corresponding author: karthickmurugan13395@gmail.com*
[b)] *gaanty@ump.edu.my*
[c)] *mohdhasbi@ump.edu.my*
[d)] *natanam@ump.edu.my*

Abstract. These accumulations of used plastics like high-density polyethylene (HDPE) and low-density polyethylene (LDPE) cause environmental pollution in various way. Biological treating method can be an alternative of solution for reducing the accumulation of plastics in our environment. In this study, Plastic samples were pre-treated by placing under exposure of ultraviolet (320 ± 10 nm) for 5 days continuously. Then, placed in the microalgae *Anabaena sp*. culture and *Chlorococcum sp*. culture for biological treatment for 21 days. FTIR and SEM been used and observed the functional group changes and surface changes on polyethylene. From the biological treatment between treated polyethylene and microalgae found that both microalgae shown well grown. In LDPE found greater growth of *Chlorococcum* sp. higher than *Anabaena* sp. HDPE does not shown any obvious changes in growth of microalgae. FTIR result shown the changes in mechanical structure of LDPE by reduction of ester groups -(C-C-O-C-C)- after biological treated with *Chlorococcum* sp. Visual changes as pattern of round rupture circle found on the surface of LDPE as compared HDPE which analyzed though FESEM result.

INTRODUCTION

Plastic waste disposal in the atmosphere is a major issue due to its very poor biodegradability and existence in large amounts. The amount of global plastic waste reached about 6.3 billion metric tons in 2015 [1]. And this number will rise to 12 billion metric tons by 2050. Usually, emerging Asian nations are the main importers of plastic waste, Especially Malaysia is the leading importer in 2018, which generally comes from developed countries [2].

Plastic recycling solves the environmental issues of landfilling and incineration however the process is relatively inefficient, and the consistency of the polymer generated is reduced [3]. Therefore, solution with less cost, effective and less incentive to invest in recycling facilities is consequently given. Microorganisms playing vital role in bioremediation and can grow well in various extreme conditions such as high salinity, nutrient stress, heavy metals, and temperature [4]. Consequently, evolving trend of microalgae in bioremediation of polyethylene due to abundance of binding and high binding affinity [5]. Marine photosynthetic microalgae single cell has the potential to grow at anywhere with minimum environmental conditions. Any changes in the polymer properties such as, mechanical strength alteration, molecular weight reduction and surface properties attributable by microbial actions are consider as polymer biodegradation [6]. They can extract both organic and inorganic contaminants from different ecosystems by collecting, adsorbing, or metabolizing them to relatively safer levels [7]. There is no protocol has been developed yet to feasibly degrade polyethylene on a commercial scale by biodegradation [8].

4th Symposium on Industrial Science and Technology (SISTEC2022)
AIP Conf. Proc. 3023, 020004-1–020004-7; https://doi.org/10.1063/5.0188313
Published by AIP Publishing. 978-0-7354-4800-1/$30.00