COMPOSTABILITY OF DEGRADABLE PLASTICS AND ITS USE IN SOLID WASTE DISPOSAL

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ABSTRACT

Plastic waste generation and quantity generated is a growing concern in many countries including Malaysia. Plastic waste contributes the third highest waste volume in Malaysian municipal solid waste (MSW) next to putrecible waste and paper. In the year 2000, plastic waste in MSW of Kuala Lumpur was 24.4% by weight from the MSW and most of the plastic waste was dumped into landfills. Landfills in Malaysia are reducing in its useful life as the amount of waste generated is growing every year by 2% and they have become an undesirable option of getting rid of plastic waste because of the properties of plastics. Thus, efforts are being made to divert some plastic wastes from landfills, or to use degradable plastics.

In this study a set of experiments was done to check on the compostability of polyethylene and prooxidant additive based environmentally biodegradable plastics under various conditions. The plastic samples were given by EPI Environmental Plastics Inc. The samples were exposed hydrolytically or oxidatively at a temperature similar to composting environment, which is 60°C. This was done to determine the abiotic degradation path, that is, hydrolysis or oxidative. The next experiment was to carry out the composting of the plastic samples through a 45 days-composting period. The degradation of the polyethylene and prooxidant additive based environmentally degradable plastics in these two experiments was determined by monitoring physical and chemical properties, such as, weight lost, percentage elongation and Fourier Transform Infra Red (FTIR) spectrum. Finally, degradable samples were exposed to *Pseudomonas aeruginosa* on carbon free media for 28 days in microbiological exposure experiment. Methods of determining the biodegradability of the plastic

samples were checking: on weight loss of plastic samples and sign of bacterium growth.

Plastic samples showed evidence of degradation in oxidative environment rather than hydrolytic environment as shown by the physical appearance of linear low density polyethylene (LLDPE) samples. The samples were brittle and changed colour from pinkish to light brown. In addition to that, the samples also experienced a significant weight loss of 8% and have been oxidised as shown by the addition of carbonyl groups in the FTIR spectrum. The high density polyethylene (HDPE) samples did not show any significant changes in weight loss, physical appearance and in FTIR spectrum. However, the changes in percentage elongation for HDPE samples were significant, for example McD, samples showed a reduction of 23.5% and TDP samples experienced a 60% reduction. Thus, this proves that oxidative environment is the optimum environment for degradation. There are various factors that influenced the rate of oxidative degradation. Among these are the amount of prooxidant additive, the chemical structure and morphology of the plastic samples. By right HDPE samples should degrade faster than LLPDE because its tendency to undergo chemicrystallisation faster. However, in this study LLDPE samples degraded faster than HDPE. Perhaps the amount of prooxidant additive Totally Degradable Plastic Additives (TDPA^{TM}) for LLDPE samples, which was 4% higher than HDPE samples, affects the degradation rate. In addition to that, LLDPE structure has higher amorphous regions that allowed oxidation to take place within the polymer structure. Another factor that influenced the rate of degradation of plastic samples was the surface area. The higher the surface area, the faster the plastic samples degraded.

In the composting environment, percentage elongation for all samples showed significant results of 20% reduction for McD samples and LL samples and 18% reduction for TDP samples. Lastly, the microbiological trial exposure showed a positive growth of bacteria and a weight loss of 2.2% for degraded polyethylene samples. This is very encouraging, as this proved that the organisms were able to utilise plastic samples as sole carbon source and thus confirming the biodegradability of the EPI Environmental Plastics Inc. plastic samples.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES