

PLANT-BASED SHOE (PbS)

Mohammad Fathullah bin Jameini and Leviana Andrew

Faculty of Business and Management, Universiti Teknologi MARA Cawangan Sarawak, Kampus Samarahan, MALAYSIA

E-mail: fathul1994@gmail.com

ABSTRACT

Shoes do not decompose easily and among the most difficult to recycle. Shoes made from leathers and cotton that cannot be recycled and rubber that cannot be decomposed. Currently, shoes are made at least with 35% PVC and EVA can take as much as 1,000 years to decompose. Shoe wastes produce chemical toxic and lead to contamination of soil and groundwater. As shoes take a very longtime to decompose, it takes up a lot of space in landfill. Hence, the Plant-based Shoe (PbS) is designed specifically using polyesters (Polyhydroxyalkanoates or PHAs) which are produced in nature by numerous microorganisms, including through bacterial fermentation of sugars or lipid and commonly found in palm oil. PHAs are widely used in biochemical application but it also can be used to produce biodegradable plastics. Using Plant-based Shoe will help promoting environmental-friendly practices and lifestyle, reducing pollution and contamination caused by improper waste management and utilizing the abundant amount of palm oil in Malaysia. What most unique about PbS is that the material is biodegradable, free from harmful chemical and can be incorporated into any type of shoe.

Keywords: polyhydroxyalkanoates, PHAs, bioplastics, sustainability

1. INTRODUCTION

In current society, the environmental awareness among people significantly growing compare to the last few decades. People start to think more about the environment and it is evident as we starting to see more product that are focused on environmental-friendly and produce less pollution to the environment in today market such as food produce and products, electronic devices, packaging, apparels and many more. The environmental friendly movement or more commonly known as the green movement have been widely adopted by many companies in their products to cater the need of those who preferred to opted for environmental-friendly product or simply “green product”. Therefore, a new kind of shoe is designed which is a plant-based shoe made from material or plastic that is made from palm oil, biodegradable and could be decomposed without polluting the environment.

Everyone wears shoes. Shoes exist in the market ranging from the cheapest could we found to the top elite expensive shoes. But what happen when the shoes we wear worn-out, damaged to the point we could not longer wear it? The common option is to throw it out. It will end up in the landfill and as it not made from biodegradable material, it will take a long time to decompose. In United States alone, U.S. Department of the Interior report that Americans throw “away” over 300 million pairs of shoes each year and mostly end up in landfill or waste dump [1]. Normal shoes do not decompose easily and among the most difficult to recycle as the materials used in making the shoes are mixed up and had to be separated apart manually. Type of shoes that are made from leathers and cotton cannot be recycled and shoes made up from rubber cannot be decompose [2]. Shoes are commonly made from or by mixing Ethylene Vinyl Acetate (EVA)

and Polyvinyl Chloride (PVC). Shoes that are made up at least with 35% PVC and EVA could take as much or at least as 1000 years to decompose [3]. As the shoes take a very long time to decompose, it takes up a lot of space in landfill as caused space problem or crisis in waste management. Furthermore, shoe waste produces chemical toxic, leading to contamination of soil and groundwater as the chemicals used in manufacturing the shoe start leaking after being left in the landfill for a long time. Therefore, there is a need to produce a more sustainable solution to these problems.

The objectives of this design are:

- 1.1 To create shoes that environmental-friendly and biodegradable.
- 1.2 To reduce non-biodegradable waste in the landfill.
- 1.3 To replace the usage of plastic with bio-plastic from palm oil.
- 1.4 To reduce the pollution and contamination caused by improper waste management.
- 1.5 To help promote and encourage recycling habits and environmental-friendly practices in the society.

2. POLYHYDROXYALKANOATES OR PHAS

Polyhydroxyalkanoates or PHAs are linear polyesters produced in nature by bacterial fermentation of sugar or lipids. These plastics are biodegradeable and are used in the production of bioplastics. They can be either thermoplastic or elastomeric materials, with melting points ranging from 40 to 180 °C. Plant oils such as palm oil, soybean oil and corn oil are desirable raw materials for the production of bioplastics as they are relatively cheaper than most sugar [4]. Plant oils can provide higher cell biomass and PHA production (0.6 to 0.8g of PHA per g of oil) due to their higher carbon content per weigh as compared to sugars [5]. Several bacteria are known to product PHA from plant oils like Burkholderia cepacia, Pseudomonas aeruginosa, Comamonas testosterone and Cupriavidus necator [6,7]

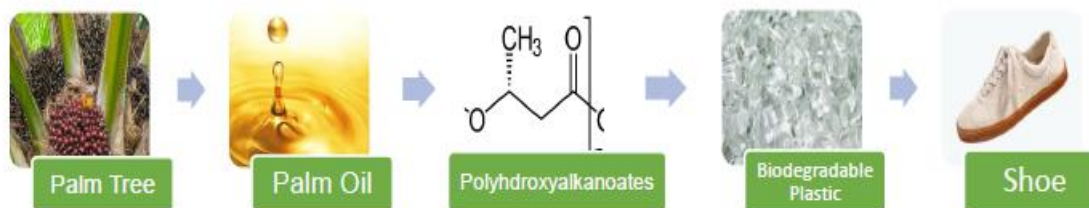


Figure 1. Process of creating plant based shoe

2.1. Novelty

The material (PHAs) is made from palm oil which is abundant in Malaysia which is fully decomposable material, free from harmful chemical, animal-cruelty free, suitable for vegetarian and can be incorporated in any type of shoe.

2.1.1. Benefit

This design will help promoting environmental-friendly practices and lifestyle through participation from the shoe industry in reducing potential pollution and contamination.

2.1.2. Commercialization Potential

The current trend is customers are now more environmental conscious and prefer to buy environmental-friendly product. Potential cooperation establishment between shoe industry and palm oil industry. This could be a potentially easier market entry as many well-known brands started to support the environmental-friendly movement. As Malaysia is among the top produce of palm oil in Asia, easy access to resources will never be a problem to produce plant-based shoe thus improving Malaysia's economy as a whole. Not to mention this will bring positive impact to palm oil plantations and palm oil farmers, create more jobs in the plantation that will overcome poverty and unemployment.

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