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FINAL YEAR PROJECT (THESIS) – CRITICAL REVIEW

PROPERTIES OF BIOPLASTICS AS GREEN PACKAGING MATERIALS: A REVIEW

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Faculty of Applied Sciences
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PROPERTIES OF BIOPLASTICS AS GREEN PACKAGING MATERIALS

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ABSTRACT

Petroleum-based plastics have been widely used in packaging applications due to their strong mechanical strength and low-cost production, but they have raised several environmental concerns, such as plastic pollution and greenhouse gas emissions. Bioplastics have been introduced as sustainable alternatives to petroleum-based plastics due to their renewable sources and environmental friendliness. However, their performance is heavily dependent on their sources, modification methods, and compound compositions and formulations. Plus, their performance is limited by their mechanical, biological, and thermal properties, which will be a critical challenge for applications of bioplastics in green packaging materials.

This study will investigate the role of each bioplastic's properties, which is how the bioplastic behaves under stress and forces for mechanical properties, how the environment will interact with the bioplastic, especially in terms of biodegradability and water absorption for biological properties, and how bioplastics behave when exposed to heat for thermal properties. This study provides valuable insights for researchers and manufacturers in developing high-performance, sustainable packaging materials by comparing the benefits and drawbacks of bioplastics to conventional plastics. It also contributes to efforts to reduce environmental pollution and dependence on petroleum-based plastics.

CHAPTER 1

INTRODUCTION

1.1 Background of study

Plastics have been an essential part of the market industry. Tons of plastic products are produced by thousands of plastic companies and are widely used due to their light weight and durability (Filiciotto et al., 2021). Most plastics come from fossil feedstocks such as crude oil or natural gas. These raw materials are first refined, and one of the primary products is naphtha (from crude oil) or light hydrocarbons from natural gas. These monomers are polymerized through chemical reactions that bind thousands of monomer units into long chains, resulting in polymers such as polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), polyethylene-terephthalate (PET), and others (Ibrahim et al., 2021). Petrochemical-based plastics have several advantages, including their mechanical strength and durability make them ideal for demanding applications, including automobile parts, building materials, and high-performance packaging. Furthermore, their low production costs are attributed to sophisticated, large-scale manufacturing infrastructure, which enables mass production with consistent quality (Stanley et al., 2025).

However, petrochemical-based plastics are not sustainable due to their substantial carbon footprint and harmful environmental impacts. Their manufacturing to disposal, contributes significantly to greenhouse gas emissions and climate change; increased production of plastics disturbs the global carbon cycle and exacerbates the carbon budget imbalance (Yao et al., 2025). Plus, the plastic production process requires significant energy and takes years to decompose (Atiwesh et al., 2021). Waste-management systems are frequently insufficient or overwhelmed, and most petrochemical plastics are not efficiently recycled, resulting in widespread pollution.