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An Experiment-based Study on Bioplastic Applied to Fashion and Textile Design

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Abstract

Fast fashion has sped up the practice of weaving non-degradable petrochemical textiles into their chic and cheap garments. This has caused environmental damages from production, manufacture, and landfilling. Bioplastic is a bio-polymers combined material supposed to be either biobased, biodegradable, or features both properties. Bioplastic-based textile with enhanced performance of degradability, lower carbon footprint and multi-functions is gradually drawing attention from the industry. In recent years, the increasing cooperation between biotechnology start-up companies and fashion brands have also proved that bio-fashion would be a driving force to reduce pollution and build a sustainable fashion system in the future. This essay aims to translate the term sustainability into bioplastic-based material innovation and explore its potential application to fashion and textile design. Through a series of experiments on the formula, texture and design of bioplastics, the study demonstrates a guideline to designers on innovating bioplastic materials and seeks potential application in the fashion and textile design contexts.

Keywords: Bioplastic; Sustainability; Fashion; Textile Innovation

1 Introduction

In the past decades, the fast fashion sector has ramped up production of plastic-infused clothes with quick turnaround of new styles, increased number of collections, and lower prices [1]. Oil-based plastic fiber creates pollution along its entire supply chain, from the production, use and end-of-life phases. This has polluted the quality of land, water and air, as well as destroying ecosystems and endangering human health. From the ocean to the land, the equator to the poles, micro polyesters are everywhere [2]. All of the above are attributed to the linear mode of the

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fashion and textile system: non-renewable and non-degradable resources are extracted to produce garments for short-term usage, whereby the materials are mostly sent to landfills or incinerated.

To reduce the negative impact of petroleum-based textiles on the environment and enhance the sustainable capacity of the fashion and textile industry, biotechnology can now make degradable, low carbon, and safe textiles. A long list of recent collaborations between fashion houses and biotechnology companies, such as Hermès × MycoWorks, indicates that bio-textile is no longer a fantasy but a megatrend worthy of attention. Bioplastic is a general term for biomaterials commonly adopted in the fashion industry with a variety bio-based, bio-sourced and plant-based classifications [3]. Crops, bacteria, fungi, spider silk, seaweed, agar and gelatin have been tested to be the next generation of sources for eco-friendly, degradable and innovative materials.

The term "sustainability" has been in vogue since the 1990s [4] among academic and policy agendas on a global scale and gradually became part of research in various fields, such as natural sciences, economics, art and design [5]. According to the research on the three-pillar conception of sustainability [6], social, economic and environmental factors are commonly represented by three intersecting circles with overall sustainability at the centre. Bioplastic based textiles are classified as sustainable because they follow sustainable social production processes, help enterprises enhance competitiveness and promote environmental friendliness. Most previous academic research theoretically explores bioplastics' properties from the molecular structure, but few discuss it from the design angle and its possible scenarios. This article illustrates the classification, characterization and application cases of bioplastic in the context of contemporary fashion and textile industry, seeks potential application of biomaterial through a series of bioplastic experiments, and finally broadly provides a reference to designers on how to use biotechnology to generate sustainable design ideas with more creativity, diversity and possibility.

2 Literature Review

2.1 Environmental Impact of Petroleum Based Textile

According to the report on Pulse of the Fashion Industry proposed by the Global Fashion Agenda 2017 [7], more than 62 million tons of global apparel are consumed per year, and the figure is projected to see a rise from 63% to 103 million by 2030. More than 26 million tons of old clothes are thrown away per year in China and less than 1% are reused or recycled [8]. As one of the most polluted industries globally, second to the petrochemical industry, the prosperity of the fashion industry has led to serious environmental damages stemming from the stages of production, manufacture and disposal [9]. Many researches have mentioned that fast fashion is mainly responsible for this situation because fast fashion has overwhelmingly produced products for consumers with various styles, excess choices, and induced price with cheap plastic-based textiles [10]. There is increasing evidence showing that the fashion industry relies heavily on cheap petroleum-based textile, particularly polyester, whose production has grown ninefold during the past 50 years [11].

First, the production of petroleum-based textiles are energy intensive. Sourced from oil, gas, and coal, it directly links to carbon emissions and can be attributed to oil spills, methane emission, water pollution and biodiversity loss. The carbon footprint of a single polyester shirt is 5.5kg compared to 2.1kg for a cotton shirt [12]. According to the Ellen MacArthur Foundation (EMF),