Thesis Portfolio

Investigation into Polyhydroxybutyrate and Bacterial Nanocellulose Composites for Single-Use Paper Packaging

(Technical Report)

Bioplastics as a Solution for Plastic Medical Waste

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Socio-Technical Synthesis

In the medical field, there is an overwhelming emphasis on safety to prevent cross-contamination between patients. To do this, medical care in the United States has heavily relied on sterile single-use plastic medical equipment to ensure that each procedure can be carried out without fear of infection. However, after the procedure, almost all of the equipment used in the procedure is thrown away or incinerated because of its classification as a biohazard. This leads to plastic waste contributing to damage to the environment. Landfilling leads to the leaching of harmful compounds into the soil and when incinerated, the air. To combat this, the project focuses on developing a novel, hybrid bioplastic that can both meet the sterile and physical requirements of single-use plastics and degrade non-toxically back into the environment. The hybrid materials consist of a bacterial cellulose (BC) paper derived from the culture used to brew kombucha, a wellness drink. This paper is then coated with Polyhydroxy butyrate (PHB), a plastic that can biodegrade. This produces a flexible sheet that could be molded into different shapes. This material could be used to make hospital equipment and its respective packaging.

This project explores the ethics of how to balance human health and environmental preservation. With single-use plastics being the gold standard, is there any reason for the switch in the first place? Interactive sociotechnical analysis (ISTA) can be used to identify the unintended consequences of bioplastic implementation in hospitals. This will help identify whether this emergent technology can be successful in the medical market and what can be done to curb medical waste. To flush out the ISTA interviews of people in the medical and sustainability fields will be conducted. This research will hopefully uncover the viability of bioplastics as replacements for single-use plastics. As well as the protocols, training, and changes to system infrastructure that will be needed to enable success. The project will aim to figure out if the medical sector is ready for this type of emergent technology at this time. What it means to be sustainable and what factors need to be met for this technology to fall under that category will also be explored. The overall implication of this project will be to look at society’s outlook on recycling as a whole and how that spills over to the medical realm. Hopefully, this exploration could be used as a stencil to identify potential pitfalls of implementation of bioplastics in other industries before they happen to allow for greater success down the road.