BIOSOURCED POLYMERS: PROCESS DESIGN FOR THE LARGE-SCALE PRODUCTOIN OF POLY-4-HYDROXYBUTYRATE

RISE OF BIOPLASTICS: HUMAN AND EVNIORNMENTAL IMPACT OF PETEROLEUM PLASTICS

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SOCIOTECHNICAL SYNTHESIS

The essence of good engineering practice lies in the intentions of a product or system's end design. When considering the design of the human body, it is clear that plastics were not intended. The numerous effects that petroleum based plastics have on human life, animal life, and the environmemnt have only become more evident as time prevails. The emerging solution to these negative effects are the adoption of bioplastics that have been proven to be biodegradable and are not harmful to biological lifeforms. The technical portion of this thesis portfolio provides a design for the production of poly-4-hydroxybutyrate (P4HB). P4HB is a promising candidate for the further adoption of bioplastics, and its intended use will be for medical sutures, implants, and scaffolding sold for a reduced price relative to traditionally used plastics. The STS portion of this thesis breaks down and analyzes the current system in which plastics are currently produced and reveal the many reasons that bioplastics are becoming a popular alternative to petroleum. A large part of this analysis includes the environmental and public health concerns that are assoiated with soceiety's current production and use of plastics produced from petroleum. Not only would the technical portion's design make plastic surgery more affordable for those in need of it, but it is also a curcial step in proving that bioplastics are capable of replacing petroleum based plastics. The intention of the STS portion of this thesis is to motivate the use of P4HB in applications beyond medical use, especially applications that are disposable and likely will end up in a landfill.

The technical project includes product details and specifications, process design, equipment selection, and economic analysis. The general purpose of this portion is to express the feasibility of such a design by providing cost estimates to the production plant's construction and operation. This was achieved by using the methods taught in the chemical engineering

undergraduate curriculum. Monod kinetics and mass transfer concepts were used for modeling cell growth and productivity in a specificed bioreactor, and downstream unit operations are designed to purify the product to meet FDA specificiations. The result of this technical project yielded a final statement that suggests the proposed process is economically feasible and would profit from further research and continuation of the design process.

The STS research paper utilized the Actor Network Theory (ANT) framework to abstract society's use of plastics, and questions the extent of damage that petroleum-based plastics cause. With referneces to existing literature and the examination of case studies, the paper argues the dangers of continuinated use and dependence on petroleum. The surprisingly widespread effects of these plastics have been showcased by this research to persuade readers to cut out the use of petroleum based products from their lives. Moreover, the primary conclusion of this work is that bioplastics are a necessity in restoring a healthy society.

The widespread replacement of non-biodegradable plastics with biodegradable type plastics is the ultimate goal in eliminating the current harmful propogation of microplastics. Transitioning to a network that keeps manufacters and industrial processors of plastics more accountable of waste management of their products is essential to allevieating the current harm. With a technical report that provides evidence of an economically feasible process producing biodegradable plastics along with research that show benefit of its universal use, a future free of harmful plastic waste can be achieved.

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