

## **Thesis Portfolio**

### **Scale-Up Design for Biodegradable Vanillin-Based Polymer Production**

(Technical Report)

### **Characterization of the Relationship Between Media Technology and Development of the Anti-Vaccination Movement**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree  
Bachelor of Science, School of Engineering

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## **Sociotechnical Synthesis**

Though there is no direct relationship between the Technical Capstone and STS Thesis, they both examine complex issues that affect public health and environmental sustainability on a global scale. The technical capstone projects focuses on the scale-up of a biodegradable polymer manufacturing process, while the STS Thesis studies the growth of the anti-vaccination movement. The research conducted for the Technical and STS Theses has afforded valuable insights into divergent issues in current global politics- public health and plastic waste.

Vaccination is only effective when the proportion of vaccinated individuals in a population lies above the threshold for herd immunity, which varies between individual pathogens. The costs of maintaining public health through mass vaccination, however, are the copious amounts of biohazardous waste generated from unrecycled plastics required to prevent contamination throughout the infrastructure of vaccine manufacture and delivery. While plastics have made huge advancements in medical technology and disease eradication possible, the human race cannot persist if the land and marine ecosystems it relies on are completely destroyed by its own creations.

The technical capstone project aims to research scaleup of an environmentally sustainable manufacturing process for a biologically-sourced polymer with properties that make it a suitable substitute for PET plastic. The primary deliverable of the technical project is the design of a fully-operational plant to mass-produce a bioplastic, poly-dihydroferulic acid (PHFA), using the vanillin synthetic scheme described by Mialon et al., and the corresponding patent of Mialon and Miller (2010; 2015). By transitioning the synthesis from a laboratory-scale batch to an industrial-scale continuous process while optimizing issues of energy efficiency, operational safety, and waste abatement, the design allows for profitable production of the bioplastic in quantities

required for commercial applications. In addition to producing a sustainable product, the environmental sustainability of the process design itself has been a crucial component of the project to ensure that the environmental benefit of the PHFA polymer is not diminished by its manufacture.

Opposition and hesitancy towards vaccination in the United States has surged in the past two decades. The unofficially named ‘anti-vaccination movement’ propagates dangerous misinformation about the safety and efficacy of vaccines, the intentions of healthcare professionals, and the ramifications of disease. As advancements in media technology such as the Internet and social media have reconfigured how people disseminate and receive information, so too has the propagation of anti-vaccine rhetoric. The STS Thesis investigates the relationship between the development of media and communications technology and growth of the anti-vaccination movement after 1998 through the lens of Actor-Network Theory. Research methods include documentary research, historical case studies, policy analysis, discourse analysis, network analysis, and wicked problem framing. Due to the youth of the modern anti-vaccine movement and social media, there is a severe lack of research investigating their societal implications. The objective of the Thesis is to piece together the findings of previous works published at various dates after 1998 in order to synthesize a body of comprehensive research spanning the entire relevant timeline of the movement.