Thesis Project Portfolio

Producing a Bioplastic from Biodiesel Waste: Polyhydroxybutyrate Using Crude Glycerol

(Technical Report)

Covering Up the PFAS Poisoning of Parkersburg

(STS Research Paper)

An Undergraduate Thesis

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In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Isabelle Deadman

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Department of Chemical Engineering

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Sociotechnical Synthesis

Chemical and manufacturing plants serve the public by providing a product, but they also have a duty to keep the public safe from any potential negative impacts of their operation as well as their products. Sustainability, safety, and human and environmental health must be considered in any process. For my technical project, my capstone team designed a process to develop a sustainable material with minimal environmental impact. For my STS research, I studied a case in which a chemical company knowingly allowed an entire community to be directly harmed by the company's actions and its product. While my technical project and STS research are on two ends of a spectrum, they both illustrate the importance of considering the well-being of the public when operating a chemical or manufacturing process.

The primary motivation behind my technical project was the plastic waste crisis, particularly the vast amounts of plastic waste that ends up in the ocean. Traditional plastics take hundreds of years to break down in the ocean, and even some "biodegradable" plastics will not break down without an industrial composting facility. My capstone team designed a sustainable process for the production of a naturally biodegradable polymer, polyhydroxybutyrate (PHB). Our process utilizes crude glycerol, a waste product of biodiesel production, as the carbon feedstock for bacteria that naturally accumulate PHB in response to nitrogen limitation. After accumulating in the bacteria during fermentation, the PHB is isolated from the cells and formed into pellets, where it can be sold to plastics manufacturers for single-use consumer applications. If PHB products end up in the ocean instead of being properly disposed of, they will fully biodegrade in a matter of weeks or months.

My STS research centers on a chemical company that did not abide by a moral obligation to keep the environment and the public safe. My research focuses on the C8 poisoning of Parkersburg, West Virginia by the chemical company DuPont. DuPont continued to manufacture

Teflon, which required the chemical C8, and release the chemical waste into the water supply despite individuals at DuPont being aware of the hazards to human and environmental health. Using actor network theory and the conditions of responsibility, I argue that there are identifiable individuals who are morally responsible for the harm caused to the Parkersburg community and ecosystem. Assigning the blame to a faceless entity (the company as a whole) obscures those who are truly responsible.

By working on both projects simultaneously, I gained a better understanding of how a manufacturing facility can impact a community. Researching the DuPont case and learning how people at the company purposely hid the fact that their chemicals were causing birth defects and health problems made me more conscious of any potential dangers of the process that I was designing. I knew I would be designing a material that would have minimal environmental impact since it naturally biodegrades and is biocompatible, but I had not yet considered the environmental or health impacts of the process itself. My capstone team abided by inherently safer design in our process, including minimizing the use of chemicals when possible, minimizing transportation of chemicals, and properly disposing of any waste. In turn, working on my technical project provided insight into the inner workings of a chemical plant, which improved my understanding of the DuPont case. The quality of each of these projects was enriched by the other.