

Thesis Portfolio

Hydrothermal synthesis of crystalline calcium silicate hydrate phases from combustion waste feedstocks

(Technical Report)

Perception of the Environmental Impact of the Fast Fashion Industry Among Generation Z

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Thesis Prospectus

Sociotechnical Synthesis

As a member of Generation Z, I have grown up with the ever-present reality of climate change. I learned about the Intergovernmental Panel on Climate Change (IPCC) before I could legally buy alcohol. I have witnessed the non-stop debates of what humans should do to combat rising CO₂ levels and ocean levels, as well as debates questioning whether any of the changing climate is a result of human activity and whether humans should do anything to tackle the climate crisis. However, these debates are all looking for one solution when many will be needed. The current paradigm of how humans interact with the environment has proven to be unsustainable and many parts of normal life will need to change to maintain a livable Earth. These changes will need to come from a variety of sources, from governmental regulation to personal lifestyle change to technological advancements.

My technical capstone project was focused on a technological advancement aiming to decrease the environmental footprint of cement and concrete. Concrete is the most commonly used construction material and is responsible for an estimated 5-10% of all anthropogenic CO₂ emissions. I have been working in the UVA Reinventing Cement lab studying a new class of pseudowollastonite (pwol) based cements since the beginning of summer 2021. Much of this research has been focused on understanding how these cements strengthen through mineral carbonation and the chemical conditions required to form crystalline calcium silicate hydrate (CCSH) phases from pwol, a high-temperature polymorph of wollastonite (CaSiO₃). Pwol has been used as a model calcium silicate feedstock in the laboratory environment, but it is energetically expensive to produce. My capstone project was to analyze the potential to form tobermorite, a CCSH phase, out of various combustion waste feedstocks, such as calcia-rich slags and silica-rich fly ashes or silica fumes. Three binary mixes were made using a calcia-source and a silica-source and combined to meet one of two masses depending on the condition and a Ca:Si molar ratio of 5:6. These mixes were reacted for 1, 3, and 7 days at 150°C. CCSH phases were generated in the 7 day samples.

My STS thesis investigated how college-aged members of Generation Z perceive the environmental impact of fast fashion using the Actor-Network Theory (ANT) framework, which associates different actors in an industry or group by the networks that connect them. I chose to investigate this age group as I feel that we have an increased stake in the issues associated with climate change and rising CO₂ emissions. Additionally, the purchasing power of Generation Z is increasing everyday. I interviewed 8 people to gauge how they participate in the fashion industry, how they perceive the effects of their actions, and how social media has changed the social pressure of clothing, from fears about repeating outfits to pressure to inform people when one is wearing a “green” article of clothing. Through these interviews, the topic of social media was a common theme that had both positively and negatively affected how people viewed the fast fashion industry, as social media, especially Instagram and TikTok, is rife with advertisements promoting fast fashion but also full of informative posts educating consumers of the harmful social and environmental effects of the industry. Based on this, I concluded that the producers and consumers of fast fashion are interconnected most in a digital network including producers

advertising to consumers and consumers educating other consumers about the negative impacts of their actions.

Both of these projects are important, as it will take changing technology and personal choices to promote a balanced relationship between humans and the Earth that we live on. I have hope after creating favorable phases out of waste materials and furthering the science of cleaner concrete and speaking to young people that are aware of the issues posed by their consumption and either taking steps to reduce the negative effects of their consumption by thrifting or shopping for eco-friendly, ethically made “slow fashion” or eager to reach a point where they have the money and time to shop their values.