Jason Chen
Chris Jensen
MSWI-270C EcoEnvAnthr
Term Proposal
21 March 2019

Mycelium: *An Alternative to Plastic Production*

A major contributor to anthropogenic change is that of single-use plastic goods. On the market today, many of the products are composed of synthetic plastics that are cheap to manufacture but detrimental to ecosystems and the environment. Plastic, from its production process to its disposal is contributing to major changes that affect both human health and ecosystem wellbeing. Plastics are constructed from fossil fuels that release excess carbon into the air and when incinerated during disposal, releases toxic gases into the environment which pose threats to human health [9]. As the effects of anthropogenic change from plastic are becoming more apparent, alternative production methods need to be explored and addressed to reduce the negative impact of humans on the environment. Mycelium, or fungi filaments combined with a substrate such as hemp to serve as a fabrication method for production is a topic I have chosen to explore in this term project as it is a material that can serve as an alternative to fossil fuel generated plastics, combating the plastic waste [6]. To showcase mycelium as a viable option to combat the anthropogenic effects of plastic I have created mycelium composite planters to serve as an alternative to single-use plastic planters. In my work, through the aid of illustrated packaging around my planters, I've explored and compared the effects of plastic on the ecosystem and addressed how mycelium may relieve the issues generated from synthetic plastic materials.

Plastic as a material is usually comprised of petroleum. The continual production of single-use plastic goods has depleted limited fossil fuel resources. The heating process in which plastics are created and oil is refined for plastic construction emit a variety of pollutants and release an abundance of carbon [7]. This manufacturing process is a major anthropogenic impact on the environment, as the byproducts of creating plastic are contaminating air sources and affecting air quality [1]. For many of the workers and employees working in the factories producing plastic, their health is dramatically affected. This is a major concern of plastic production, as individuals work more with such materials, the chemicals released continually affect the health of workers resulting in serious side effects and even cancer. In my term project, I demonstrated the anthropogenic effects of plastic production in a panel of the packaging on my mycelium planter. Surrounding the planter is packaging with four panels that illustrated in watercolor with various situations, one of which being the process of producing plastic. On this specific panel, I've included imagery from the oil being pumped out the earth to create plastic and the large refining factories that transform the oil into plastic. From these factories spews fumes of pollutants that are known to harm human health, causing cancer and having serious effects on those producing such products [3].

Transitioning from this panel is the continuation of a dreary and polluted landscape. After the production of single-use plastic comes its short consumer life but is then followed by its everlasting effects when disposed of. Unless incinerated, plastic products cannot be simply broken down in nature and many plastic goods make it to the ocean, like how 2.3 billion pieces

of plastic products were recovered from Southern California beaches in just over 72 hours [9]. This has ever lasting effects on the marine ecosystem and marine life, aiding to the ever increasing risk of extinction caused by anthropogenic change. Even when plastic is attempted to be disposed of through incineration, there are lasting effects on the environment and human health. In many third world countries such as India, plastic is burnt in landfills releasing toxic gases such as dioxins, furans, mercury, and polychlorinated biphenyls that increase risk of heart disease, aggravates respiratory ailments such as asthma and emphysema and cause rashes, nausea or headaches, and damages the nervous system [9].For my project I illustrated the panel following the production panel with the disposal process through a watercolor painting of sea life being trapped and affected by plastic garbage and waste.

On a panel leading from the disposal practices of plastic is a panel illustrating the process in which I took to construct mycelium planters. Mycelium uses a natural low-embodied energy production process which makes the costs competitive to traditional synthetic means of production. Mycelium relies on cultivation that can happen in a lab environment and does not require the extensive extraction process of petroleum that relies heavily on limited resources to produce most plastics. Using simple organic materials, lowers costs to grow and produce mycelium, making it a prime candidate for mass production, unlike the extensive process which goes into transforming crude oil into plastic, later used to create products [5]. The illustration for this panel shows how I grew mycelium in a container away from light for four days to mold the basic structure and to prevent the development of spores and to encourage growth [8]. It then shows how I dried the product just with the natural air quality and then baked the product to get its final form. Using natural materials that required no chemicals that produced off set gases, the illustration is in contrast to the polluted landscape of the production method of plastic that I illustrated prior. Arrows on the illustration show how the components lead to one another and transition to the next panel.

As a sustainable product and a product of biological origins, mycelium-based products are biodegradable and can break down naturally into the environment. In contrast to the single-use plastic planters that make their way into the ocean or sit in landfills, the mycelium planter will naturally begin to deteriorate with use. This is a key component to mycelium and a factor of its sustainability. As a product, its afterlife is beneficial to the environment as products constructed from it can be simply placed back into the natural world and be broken down by natural means [2]. This ability to naturally breakdown makes mycelium a great contender for single use items such as existing single use planters. These products are not degradable and are impossible to break down naturally. I've illustrated in watercolor an individual breaking down the planter to show users how to do so after their planter begins to show deterioration. The illustration then blends into a scene of growing plants highlighting how even the breakdown of mycelium is beneficial to the cultivation of crops, a stark contrast to how sealife was illustrated to be harmed by existing synthetic plastic goods.

Concerning the physical planter, it serves the purpose of actually showcasing the potential of mycelium to actually produce a physical product. Concepts and ideas are one thing but I wanted to create a physical planter to showcase that this technology is possible. Due to its moldable characteristics and ability to form into various shapes, it can very much be an alternative to rotationally molded plastics. Through the construction of my planter, I wanted to demonstrate the ability of mycelium to be molded and created into various products. The planter highlights how selecting which substrate to use will result in various strengths and density. A

stronger and denser mycelium by-product would result in a longer lasting product. On other hands, the weaker products would see perfect use in the packaging world as they would be able to be broken down and disposed of naturally [4]. This feature is becoming more and more explored, finding a sustainable substitute to single-use plastic products.

As for choosing to create the mycelium planter and the illustrating packaging, I wanted to provide individuals such as myself who are young slightly environmentally aware individuals the chance to buy plants and grow them without the thin single-use plastic planter. This is the group that will possibly make the greatest difference as they are the ones that will have the most impact on future generations, teaching them and influencing their decision making. I think many of today's generation are interested in living a more sustainable life by using fewer resources such as plastics. By giving them these options to buy biocomposite products from mycelium, it opens the market to innovation for alternatives to plastic. As the youth are very open-minded, it allows for the adaptation and acceptance for such experimental materials such as mycelium and perhaps will stimulate the growth of biological manufactured materials. I want my planter to give audiences a chance to also realize the benefits of sustainable sourcing in comparison to plastics and to have an understanding of how products are made and where they end up. It's important for me as an industrial designer to educate and promote awareness to develop growth in the sustainable material sector.

Works Cited with Annotations

1.
Allison , E, and B Mandler. “Air Quality Impacts of Oil and Gas.” *American Geosciences Institute*, 20 June 2018, www.americangeosciences.org/critical-issues/factsheet/pe/air-quality-impacts-oil-gas.

From this article I was introduced to the properties that make up plastic such as toxic materials like benzene and vinyl hydrochloride. During the manufacturing process, to when it is disposed of, plastic is noted to be toxic from birth to forever. These chemicals found in plastics are known to cause cancer, and the manufacturing byproducts contaminate water sources and the air.

2.
Arifin, Yusnani Hajar, and Yusri Yusuf. “Mycelium Fibers as New Resource for Environmental Sustainability.” *Procedia Engineering*, vol. 53, 2013, pp. 504–508. *Google Scholar* , doi:10.1016/j.proeng.2013.02.065.

The study takes into consideration how mycelium composite materials may act as a replacement for traditional polystyrene packaging methods such as styrofoam. The journal takes into consideration how the low cost of polystyrene make it unprofitable to attempt to reuse or recycle the packaging material. Instead a biodegradable alternative such as mycelium could reduce the amount of waste found in the ecosystems around the world. The use of Mycelium as a packaging material was tested through the calculation of density and porosity of certain combinations of substrates and fungal strands.

3.
Ecology Center. “PTF: ENVIRONMENTAL IMPACTS.” *Ecology Center*, 2018, ecologycenter.org/plastics/ptf/report3/.

This source was able to give insight in how damaging the production of plastic is to the environment in terms of atmospheric pollution and chemical release. It also noted the effects on workers who produced plastic and the side effects plastic had on the general population.

4.
Hobson, Ben. “Growing Products from Fungus Could Be the Start of a ‘Biotechnological Revolution.’” *Dezeen and Mini Frontiers* , 4 Nov. 2016, https://www.dezeen.com/2015/01/21/movie-officina-corpuscoli-growing-products-materials-fungus-biotechnological-revolution/

From this article I was able to use information concerning the hydropellent quality of mycelium regarding the how the thread-like filaments, after being beaked produced a strong waterproof material. This was explained comes with the membrane that fungal organism produce that allows for the creation of hydropellent raincoats and shoes.

5.

Jiang, Lai, et al. “MANUFACTURING OF MYCELIUM-BASED BIOCOMPOSITES.” *Manufacturing of Mycelium-Based Biocomposites*, 13 July 2016, pp. 1–14. *ResearchGate*, doi:10.3897/bdj.4.e7720.figure2f.

This journal takes into account how the low-embodied-energy production process for mycelium composite products makes them cost competitive to synthetic plastics. The sustainable factor regarding the biodegrading factor of mycelium is looked at and noted that it can be recycled back into feedstock, diverting waste from landfills.

6.

Karana , Elvin, et al. “When the Material Grows: A Case Study on Designing (with) Mycelium-Based Materials.” *International Journal of Design*, vol. 12, no. 2, ser. 119-136, 1 Aug. 2018, pp. 119–136. *Art & Architecture Source*,eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?vid=3&sid=98a286dd-d7eb-47b3-8944-15931f7aedd0%40sdc-v-sessmgr04.

This article highlights the process in which a substrate is selected and sterilized and combined with a fungi to produce mycelium composite fabrication materials. Along with showcasing the process needed to physically create the property, the article address how users may engage with such a new and unused material. It was noted that the roughness of the material caused users to associate a want to interact with it, touch a break it; which, would be helpful as the product lends itself to being a substitute for synthetic packaging and the want to break and disposal of it would be highlighted just by the physical characteristics.

7.

Knight, Geof. *Plastic Pollution*. Raintree, 2013.

From this book I was introduced to the compounds that made up plastic and how plastic is an outcome of petroleum production. I was able to relate back to how fossil fuels consumption is at an all time high and how it is being depleted as a resource. This also adds to the pollution in the production of plastic materials.

8.

Lelivelt, R, et al. “The Production Process and Compressive Strength of Mycelium-Based Materials.” *First International Conference on Bio-Based Building Materials*, 1 Jan. 2015, pp. 1–6. *Google Scholar* , pure.tue.nl/ws/portalfiles/portal/15138585/leliproduct2015.pdf.

This study follows the idea that a cellulose rich substrate will result in the strongest nd densest mycelium composite. The proposed reason for this is that the fundamental difference between fungi and other material is that fungi can break down cellulose into glucose; therefore, it is practical to use cellulose-rich substrates as it likely prevents contamination from other organisms and promotes strength. The test evaluates the qualities of various strand of mylcium along with varying substrates to determine that the combination of non woven hemp mats and Coriolus Versicolor presented the densest mycelial growth. In terms, this means that the compression tests revealed that the combination showcase the highest levels of strength and stiffness.

9.

Verma, Rinku, et al. “Toxic Pollutants from Plastic Waste- A Review .” *Procedia Environmental Sciences* , vol. 35, 2016, pp. 701–708. *Google Scholar* , doi:doi: 10.1016/j.proenv.2016.07.069 .

From this article I was able to see how landfills in India handled the incineration of plastic waste. I was able to note how damaging the incineration process is to the environment, affecting the ecosystem along with harming the inhabitants of the area due to the release of chemicals into the atmosphere.