Environmental vs. Traditional: The Study of Sustainability in the Industry

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ENVIRONMENTAL VS. TRADITIONAL

The Study of Sustainability in the Fashion Industry

CAMILLE FULLER

SENIOR THESIS

Intro

Fabric manufacturers are utilizing harmful methods to produce and dye materials in the fabric production process, turning a blind eye to the harm being caused. There are eco-friendly and safe ways to dye and manufacture fabrics that provide economic and financial benefits. These methods are economical and safe while also providing fashionable designs and materials. The main purpose is to provide companies alternative methods; to make a change.

During my spring semester of junior year, I viewed the documentary *Manufactured Landscapes* by photographer Edward Burtynski, in my Photography II course. Burtynski examined different types of pollutants and explored the affects it had on various parts of the world. While the images he is able to produce are truly amazing, it left me feeling remorseful about the terrible conditions people are living in because of manufacturing. On another occasion, I viewed the documentary *The True Cost*, which details the fashion industries largely growing carbon footprint. It was disheartening to think that something as exciting as fashion could be doing so much harm. The semester prior, I had the opportunity to study abroad in South Korea at Sookmyung University. While enhancing my global prospective, I decided to register for a course on natural dying. Sookmyung's Fabric Finishing and Natural Dyeing course broadened my limited knowledge of fabric treatments and dyes during the manufacturing process. I was intrigued by the idea of producing fabrics with a minimal carbon footprint. These experiences caused me to think about finding solutions to these issues and making sure I would not be contributing to the harm of the environment. This shaped the concentration of my Senior Thesis.

Carbon Footprint in Fashion Industry

The clothing industry has become known as one of the largest contributors to pollution. This is only second to big oil companies. So much time and resources are spent on the production of a single garment; it is hard to image how much goes into the millions of garments produced in a year. Especially with fast fashion on the rise, articles of clothing are being produced and discarded at a rapid rate. (Fast fashion consists of garments created to replicate popular trends seen on the runway and created by luxury brands. They are meant to be made quickly to keep up with trends resulting in companies using cheap and often environmentally harmful materials. (Mohn)) The carbon footprint in the fashion industry is astronomical. With pesticide filled fibers and toxic dyes used to color fabrics, pollution is found at every turn. That's not even including the amount of resources that go into planting, harvesting, processing and everything in-between. Not to mention the gallons of water used to produce these fibers. According to EcoWatch it takes more than 5,000 gallons of what to manufacture something as simple as a jeans and a T-shirt. Importing the goods racks up even more on the pollution scale. With all the unsustainable production of fashion has in the world, something must be done. The largest part of the issue seems to be in the production of the fibers. This can certainly be reduced through alternative methods such as using pesticide free materials, recycled materials or even exploring natural dyeing (EWContributor).

ACRE

Over the 2017 Interim, I conducted an Interim ACRE project with one of my professors, MeeAe Oh-Ranck. In this ACRE, I further explore the process of using natural dye source materials to produce various unique colors. The results from this study contribute to the investigation of natural vs. synthetic dyeing, proving that clothing can be produced through natural means and can be beneficial to the environment without sacrificing aesthetics. I learned about the process one would take to create colorants from plants and insects. It was truly amazing to me how color could be produced apart from generic synthetic dyeing. This piqued my interest and created a desire in me to explore how one could achieve some of the most unique colors in the fashion industry.

Exploring the process of natural dyeing is important to me because it allows me to play a role in slowing the decay of the planet. When I decided to matriculate into Albright, my aspiration was to learn to design and construct garments to eventually build my own fashion brand, whereby my designs could be sold. However, I want to make sure I can do so in a way, which will minimize the carbon footprint on the world. This process will not only educate me on sustainability, but also introduce me to couture garment techniques needed to achieve my goal.

At the start of this ACRE project, we first began dyeing samples of fabric. This was done over a span of 4 days. The fabrics used to create samples were silk noil, silk charmeuse and silk crepe. The mordants used were baking soda, baking powder, vinegar and alum. Mordants are used to stabilize the color to whichever natural fiber you chose to work with. The dyes used were logwood, polygonatum, prickly pear, lac and alkanet.

Each sample underwent the same process. After being cut into a sample of either 8'' or 9'' in width, the sample was exposed to water. Next, the samples went through a pretreatment. This was where the mordants came in. Each mordant was placed into its own pot of water and combined with Cream of Tartar to enhance the color. The samples were then placed into separate pots. Next, the dye bath was created. In a fresh pot of water, the dye was added. Once it came to a boil at medium heat, the fabric sample was placed in the pot. It was very important to constantly agitate the sample. The amount of time to expose the fabric to the dye bath was completely dependent on the shade of color desired. As a result, each time varied. After this was done, the fabric were washed and rinsed with Seventh Generation Natural Dish soap to prevent any excess dye from exiting the fabric. The fabrics were then dried with paper towels and then pressed flat with an iron.

After creating the samples, the next task was dying the fabric I wished to use for the garment. After looking up dyes on Dharma Trading.com, I decided to purchase alkanet. We noticed a similarity between colors of logwood and alkanet from images online. From this we were able to conclude that using the same recipe to produce a dark purple/ brown color on the fabric, we could utilize the soda ash recipe. However, what I did not realize was that the alkanet I purchased would come as the root and not in the concentrated powder form I had been using working with. We attempted to blend and boil the alkanet, however, the dye bath was very light and not creating much of a change to the fabric. We then decided to add logwood dye into the solution, since they had been relatively close in color.

For the skirt, we dyed both silk charmeuse and silk crepe with henna. Using shibori-dyeing techniques, we were able to create a pattern. This was done by first dyeing the fabric, pleating it, tying it in intervals along the fabric, dyeing the fabric again then repeating the process once more. This provided the various shades on the garment.

(Please refer to attached lab reports for specific measurements and times)

As we preformed experiments and created sample, we made a few observations about the work created. After dyeing the different fabrics utilizing various mordants, it became clear that the mordants played a large role in the strength of the hue sustained in the fabric. With the mordants we used, we found that Alum produced the strongest color.

One challenge we came across during this ACRE was obtaining materials. Due to limited funds, we were unable to purchase a large amount of dye material and fabric. This at first appeared to limit our creative freedom in terms of what we hoped to accomplish with this project; however, it sort of forced us to think out of the box. We were able to still create an incredible piece.

The research conducted during this Interim ACRE project is currently on display in the lobby of Alumni Hall. The samples of the silk fabric dyed with their respective mordants and plant / insect are hung and labeled on two large black boards. The garment constructed is displayed on a dress form, providing viewers with an idea of how the dress would look on an actual person. In April, the garment, along with our samples, formulas and data will be displayed at the HECBC Conference at Kutztown University. Additionally, in May the garment can be viewed going down the runway at the 2017 Fashion Department Annual Fashion Showcase. Although we were able to complete what we set out to do in this project, this work is never done. There is still so much more to learn from fabric dyeing. We will continue to experiment and learn all we can.

Having the opportunity to work with Professor Oh-Ranck and explore the world of natural dyeing has truly inspired me to learn more. I have a better understanding of how the dyeing process works and want to incorporate it into more of my work. As a fashion design student, I'm constantly working to figure out where I belong in the fashion industry. I really enjoyed working with natural

materials and think that is the market I wish to work in the fashion world. As a result, I will be creating a line of garments with my naturally dyed fabric for my Senior Seminar. This will always me to utilize the techniques and knowledge I gained during this ACRE to produce additional pieces. This will also allow me to further explore what I can create with natural dyeing.

ACRE Lab Reports

Jan 3, 2017

Wetting process:

- Wash the Silk Crepe, 16 mm in lukewarm water and squeeze water out of fabric.
- Use paper towel to remove liquid

Mordanting Process: create two variables with Alum and Soda Ash to see how the mordanting process affects the color.

- Mordanting Recipe:
    - Alum
        - ¼ gallon of water
        - 2 tablespoons of Alum
        - ½ tablespoons of Cream of Tartar for enhancing deeper and bright colors
    - Soda Ash
        - ¼ gallon of water
        - 2 tablespoons of Soda Ash
        - ½ tablespoons of Cream of Tartar for enhancing deeper and bright colors
- Boil and bring the heat up to 200F for 45 min. Agitation throughout the mordanting process is required.
- Quick wash for the dye bath.

Dye Bath: Logwood natural dye is used to experiment in order to create the desired recipe for the final fabric dye.

- Dye Bath Recipe for Alum:
    - Add 2 teaspoons dye into the boiled water and dissolve the Logwood dye thoroughly
    - Add ½ gallon water for Alum Mordanted Silk Crepe fabric (1/2 of quarter yard) into the dye Bath
    - Lower the temperature to 90 F for about 20 min with constant agitation.
- Dye Bath Recipe for Soda Ash:
    - Add 3 teaspoons2dye into the boiled water and dissolve the Logwood dye thoroughly
    - Add ½ gallon water for Soda Ash Mordanted Silk Crepe fabric (1/2 of quarter yard) into the dye Bath
    - Lower the temperature to 90 F for about 20 min with constant agitation.

Jan 4, 2017

Wetting Process:

- Silk Noil was placed in a tube of lukewarm water. Water was extracted by squeezing and drying with paper towels.

Mordanting Process: Two variables were created with distilled vinegar and baking soda.

- Mordanting Recipe:
  - Vinegar
    - ¼ gallon of water
    - 1 ½ cups of distilled vinegar
    - ½ tablespoons of cream of tartar
  - Baking Soda
    - ¼ gallon of water
    - ½ cup of baking soda
    - ¼ tablespoon of cream of tartar
- Boiled and heated at medium temperature for 1 hour. Agitation throughout the mordanting process

Dye Bath: Polygonatum (Solomon's Seal)

- 150 grams were placed in ¼ gallon of water
- Boiled at medium heat for 1 hour

- Dye Bath Recipe for Distilled Vinegar:
  - Add 1/8 gallon of polygonatum tea
  - At medium heat, constantly agitate for 30 mins
- Dye Bath Recipe for Baking Soda
  - Add 1/8 gallon of polygonatum tea
  - At medium heat, constantly agitate for 30 mins

Jan 4, 2017

Wetting Process:

- Silk Charmeuse was placed in a tube of lukewarm water. Water was extracted by squeezing and drying with paper towels.

Mordanting Process: Two variables were created with distilled vinegar and baking soda.

- Mordanting Recipe:
  - Vinegar
    - ¼ gallon of water
    - 1 ½ cups of distilled vinegar
    - ½ tablespoons of cream of tartar
  - Baking Soda
    - ¼ gallon of water
    - ½ cup of baking soda
    - ¼ tablespoon of cream of tartar
- Boiled and heated at medium temperature for 1 hour. Agitation throughout the mordanting process

Dye Bath: Prickly Pear natural dye is used to experiment in order to create the desired recipe for the final fabric dye.

- Dye Bath Recipe for Distilled Vinegar:
  - Add ¼ gallon of water into pot
  - Add 2 teaspoons of dye into boiling water and mix thoroughly to dissolve the dye
  - Clip a small piece of fabric off the end of the distilled vinegar mordanted silk charmeuse sample and place into the dye bath, once the dye has dissolved
  - At medium heat, constantly agitate for 50 mins
- Dye Bath Recipe for Baking Soda
  - Add ¼ gallon of water
  - Add 2 teaspoons of dye into boiling water and mix thoroughly to dissolve the Prickly Pear dye
  - Place the baking soda mordanted silk charmeuse sample into the dye bath, once the dye has dissolved
  - At medium heat, constantly agitate for 50 mins

Jan 5, 2017

Wetting Process:

- Silk Charmeuse was placed in a tube of lukewarm water. Water was extracted by squeezing and drying with paper towels.

Mordanting Process: Four variables were created with no treatment, baking soda, distilled vinegar and alum.

- Mordanting Recipe:
  - Vinegar
    - ¼ gallon of water
    - 1 ½ cups of distilled vinegar
    - ½ tablespoons of cream of tartar
  - Baking Soda
    - ¼ gallon of water
    - ½ cup of baking soda
    - ¼ tablespoon of cream of tartar
  - Alum
    - ¼ gallon of water
    - 2 tablespoons of alum
    - ½ tablespoons of cream of tartar
- Boiled and heated at medium temperature for 1 hour. Agitation throughout the mordanting process

Dye Bath: Lac natural dye is used to experiment in order to create the desired recipe for the final fabric dye.

- Dye Bath Recipe for Distilled Vinegar:
  - Add 1 quart of water into pot
  - Add 2 teaspoons of dye into boiling water and mix thoroughly to dissolve the Lac dye
  - Clip a small piece of fabric off the end of the distilled vinegar mordanted silk charmeuse sample and place into the dye bath, once the dye has dissolved
  - At medium heat, constantly agitate for 45 mins
- Dye Bath Recipe for Baking Soda
  - Add 1 quart of water into pot
  - Add 2 teaspoons of dye into boiling water and mix thoroughly to dissolve the Lac dye

    - Place the baking soda mordanted silk charmeuse sample into the dye bath, once the dye has dissolved
    - At medium heat, constantly agitate for 45 mins
- Dye Bath Recipe for Alum
    - Add 1 quart of water into pot
    - Add 2 teaspoons of dye into boiling water for mix thoroughly to dissolve the Lac dye
    - Place the alum mordanted silk charmeuse sample into the dye bath, once the dye has dissolved
    - At medium heat, constant agitate for 45 mins
- Dye Bath Recipe without Mordant
    - Add 1 quart of water into pot
    - Add 2 teaspoons of dye into boiling water and mix thoroughly to dissolve the Lac dye
    - Place the no treatment silk charmeuse sample into the dye bath, once the dye has dissolved
    - At medium heat, constantly agitate for 45 mins

Jan 9, 2017

The fabric used in this process was used to produce the bodice for the final garment.

Wetting Process:

- Silk Charmeuse was placed in a tube of lukewarm water. Water was extracted by squeezing and drying with paper towels.

Mordanting Process:

- Mordanting Recipe:
    - Soda Ash
        - 1 gallon of water
        - ½ cup of soda ash
        - 2 tablespoons of cream of tartar
- Boiled and heated at medium temperature for 1 hour. Agitation throughout the mordanting process

Dye Bath: Alkanet natural dye is used to experiment in order to create the desired recipe for the final fabric dye. Logwood natural dye was also added

- Dye Bath Recipe for Soda Ash:
    - Add 1 gallon of water into pot
    - Add 12 teaspoons of dye into boiling water and mix thoroughly to dissolve the alkanet dye
    - Clip a small piece of fabric off the end of the distilled vinegar mordanted silk charmeuse sample and place into the dye bath, once the dye has dissolved
    - At medium heat, constantly agitate for 50 mins
    - Place the soda ash mordanted silk charmeuse sample into the dye bath, once the dye has dissolved
    - At medium heat, constantly agitate for 20 mins
    - Add 8 oz. of logwood natural dye, constantly agitate for 35 mins
    - Add another 16 oz. of logwood natural dye and agitate for 65 mins

Jan 9, 2017

The fabric used in this process was used to produce the skirt for the final garment

Wetting Process:

- Silk Crepe was placed in a tube of lukewarm water. Water was extracted by squeezing and drying with paper towels.

Mordanting Process:

- Mordanting Recipe:
  - Soda Ash
    - 1 ½ gallon of water
    - ¾ cup of soda ash
    - 3 tablespoons of cream of tartar
- Boiled and heated at medium temperature for 1 hour. Agitation throughout the mordanting process

Dye Bath: Henna natural dye is used to experiment in order to create the desired recipe for the final fabric dye.

- Dye Bath Recipe for Soda Ash:
  - Add 1 gallon of water into pot
  - Add 12 teaspoons of dye into boiling water and mix thoroughly to dissolve the henna dye
  - Place the soda ash mordanted silk crepe into the dye bath, once the dye has dissolved
  - At medium heat, constantly agitate for 7 mins
  - Remove fabric from the dye bath, rinse with water, and wring out the fabric
  - Iron fabric and pleat. Apply 1 ½ inches of string in 2 inch intervals.
  - Apply 4 more teaspoons of henna into original dye bath. Place newly pleated fabric into dye bath, constantly agitate for 20 mins
  - Add 3 more teaspoons of henna to dye bath, place fabric back into the dye bath and agitate for 30 mins
  - Remove fabric from the dye bath, rinse with water and wring out the fabric
  - Apply more string diagonally along the fabric
  - Apply 4 more teaspoons of henna into original dye bath. Place fabric back into the dye bath and agitate for 30 mins


Munsey
Buffet Range


Buffet Range


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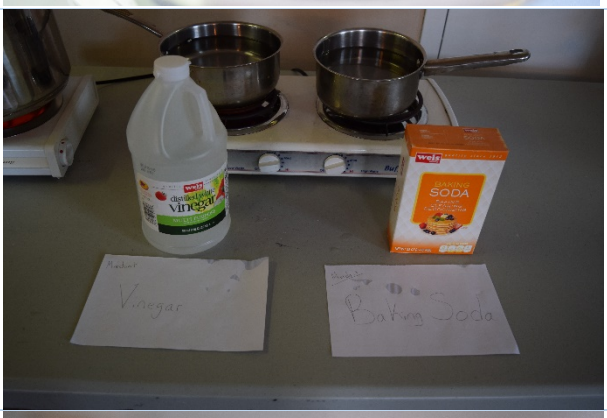

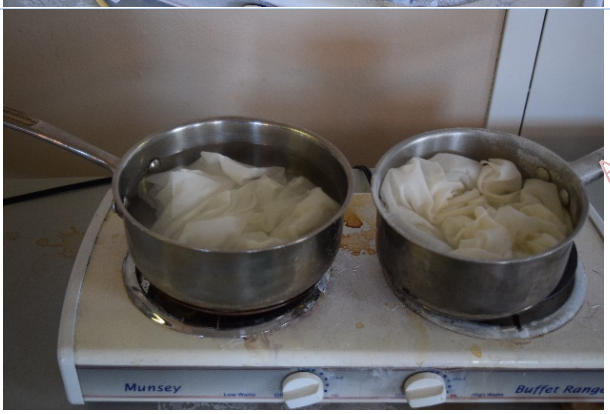

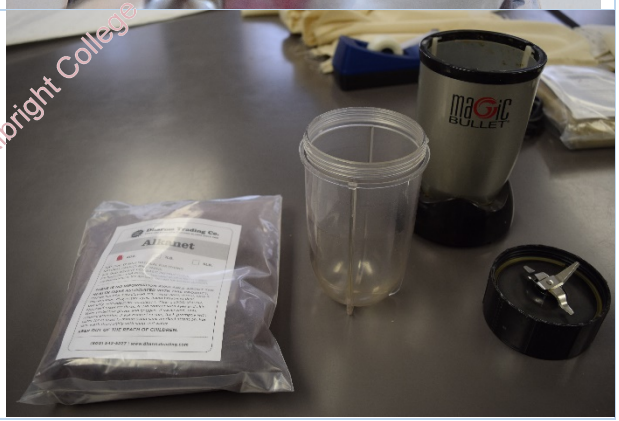

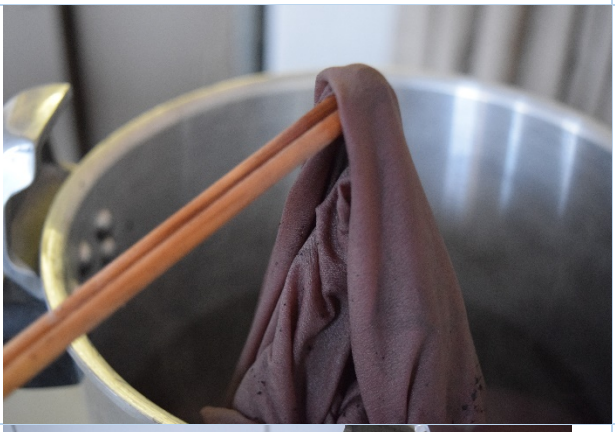

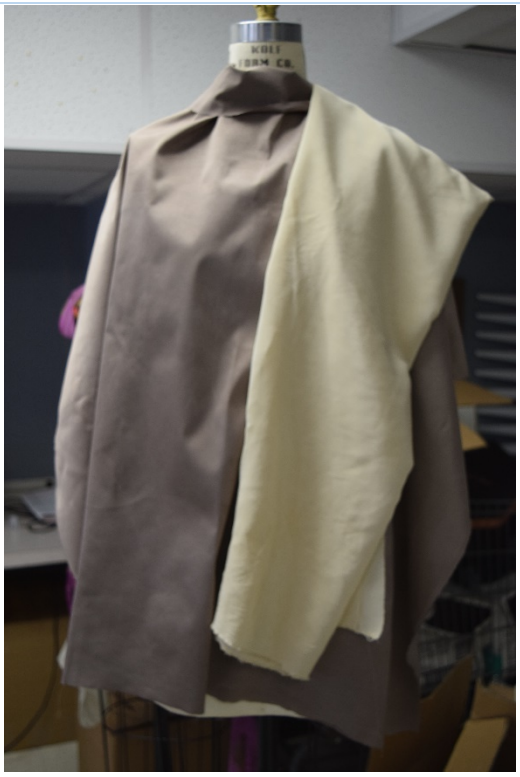

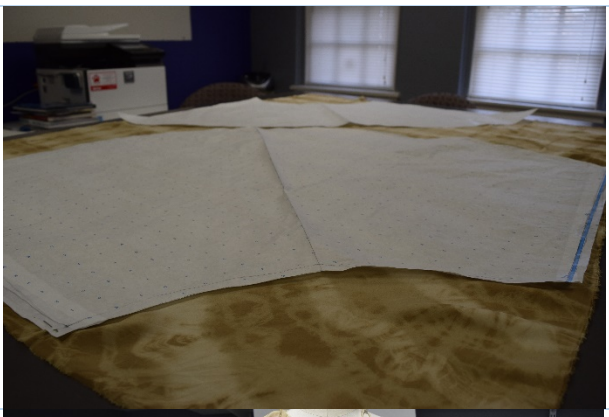

Fibers

We are living in an increasingly conscious world. People are beginning to become more aware of what they are exposing their bodies. Whether it's processed foods plagued by hormones or clothing covered in hazardous chemicals and pesticides.

Many of the fibers, manmade fibers such as nylon, polyester, rayon and natural fibers such as cotton and wool are used regularly to produce garments are unknowingly causing harm. Not only is the production of such fibers a problem for society, so is process that occurs to create it into a fabric. When these particular fabrics undergo the dyeing process, large amount of water is wasted. On top of that, some of the dyes use to create different colors can create another problem. The fixatives used to secure the bonding process between dye molecule and fiber might be released in major water sources, which also cause water pollution. This can be harmful because it the fixatives often possess metals. At times, some of the dye is released when it’s not fully fixed into the completed garment. This is all dependent on the dye formula used which consists of dye amount, water and fabric weight. This chemical dye eventually makes its way into rivers. Additionally, specially treated garments labeled as crease resistant, permanent press or easy care is treated with formaldehyde. This widely used chemical compound is quite toxic. As reported by the EPA, in small levels of exposure, formaldehyde can cause irritation to skin, nose, eyes and throat. However, on a larger scale, it can cause different types of cancers

Most of the cottons produced are heavily in pesticides herbicides and chemical defoliants, causing any to fall ill and in extreme cause death. These chemicals are absorbed so deeply into the fibers, they remain for a lifetime. As time passes by, the chemicals are slowly released. So much cotton is used to produce garment that it takes up space for growing food. This comes at a disadvantage for farmers wishing to grow local agriculture.

The use of manmade fibers is not always harmful to the environment however nylons and polyester are. These fibers are produced from petrochemicals making them non- biodegradable. Both nylon and polyester also consumer a multitude of energy. The production of nylon also creates a toxic gas found to be 310 times more dangerous than carbon dioxide: nitrous oxide. The process of polyester involves a great deal of water. This water is used to cool the fiber. Can you imagine the amount of water being used to create yards of this substance? (“Environmental Impacts”). Polyester is also produced from petroleum, a non- renewable resource that during the extraction process creates damage to the environment. While the process of developing polyester is harmful, it can however be recycled at the end of its life ("Resource Sheets."). Nylon on the other hand is notorious for filling up landfills as it has a very slow decay rate, causing companies to turn to incineration methods. This releases harmful chemicals into the atmosphere such as ketones, ammonia, carbon monoxide and more. The amount being release is also affected by the environmental factors, temperature and time of exposure ("Nylon: Background, Dangers, Disposal.")

The manmade fiber, rayon is made from wood pulp. This seems like a sustainable approach however, as a result of the used of wood pulp, the trees are substituted with wood pulp plantations. The trees planted here are eucalyptus, soaking up large amounts of water from the surrounding soil. Additionally, the wood pulp requires the use of chemical interventions for them to be turned into the manmade fiber. It undergoes a treatment process utilizing caustic soda and sulphuric acid, which are hazardous chemicals (“Environmental Impacts”). Caustic Soda also known as sodium hydroxide can cause resulting in dermatitis or chronic eczema when repeatedly exposed to skin as it affects the tissue of the skin ("Safe Handling of Caustic Soda (Sodium Hydroxide)."). Sulphuric acid reacts differently when exposed to certain elements. If released into the air, it can cause

irritation to the nose and heats up when exposed to water. When mixed with different chemicals, such as alcohols, acetones and finely divided metals, it can explode or catch fire ("Toxic Substances Portal - Sulfur Trioxide & Sulfuric Acid.").

When you think of wool, you most likely just think sheepskin. What would be so terrible about that? Individuals specifically craft and agricultural workers are exposed to organophosphate sheep dip. This pesticide, primarily used in the UK caused diseases. (“Environmental Impacts”)

The most common sustainable fabrics some manufacturers are leaning towards when creating an eco-friendly garment or clothing line includes cotton, hemp, silk, bamboo, and soya. Cotton is known to use a lot of water and land to produce it, however, manufactures have been searching for a way to make it more sustainable. It’s incredibly soft, durable and breathable so it’s a fiber companies want to keep around. Some have experimented with cotton blends integrated with hemp and bamboo. (Kaye)

Hemp has many benefits, the largest being rapid growth without excessive amounts of water and pesticides. This fiber is growing to become incredibly popular. It started out with the appearance of linen and now, thanks to the EnviroTextiles, can be simulate denim and wool. It’s also an incredibility durable fiber, it’s only down side is its ability to absorb dye. However, there are restrictions on its use in the US (Kaye).

New developments in creating sustainable fibers are being created daily. Manufactures are experimenting with fibers to manufacture something completely brand new. Sinterama recently produced a polyester yarn spun with recycled plastic bottles given the name Newlife. The production of this fiber spun in Italy strayed from the usual chemical methods and used mechanical means instead. Further the resources used in the production are far less. Less than 94 percent of

water and 60 percent less energy the carbon emission produced was also 32 percent less than that of virgin polyester (Chua). Not only that, petroleum used to produce polyester was not used in the production of this material ("NEWLIFE® Polyester). Centro Seta created a fiber combining Newlife fibers with spinning waste, GreenFiber to create a Bacx (Chua).

A fiber that feels like rayon but regulates body temperature and breathes like cotton, Asashi Kasei created cupro. It's made up of the ultrathin silky fibers that stick to the seeds of cotton plants also known as the cotton linter. It can make a comfortable substitute for silk as it provided coolness and absorbs moisture.

Re.Verso, created by a team of Italian mills: Green Line, Nuova Fratelli Boretti and Lanificio Stelloni is a fiber created by recycled cashmere and wool offcuts. Team Mill specialized in a different part of the production of the fiber. Green Line worked to source the yarn throughout Europe. Nuova Fratelli Boretti was responsible for the preparation of the materials to be converted into yarn and Lanificio Stelloni was tasked with transforming the fiber into various states, such as yarn and knitted and woven fabrics. The production of Re.Verso, having gone through each process was discovered to have created less than 96 percent of carbon emissions while used less than 89 percent of water and 76 percent less energy. (Chua)

How can we make a difference?

Some companies are seeking ecological/ sustainable attributions and here is what some have been doing to make a difference. For the past few years, the influential decision makers spanning over from over 35 counties have been gathering together for the Copenhagen Fashion Summit to discuss environmental impacts on the fashion industry (Hermes). The event just took place last year in early May. Since this has been an issue for quite some time, well-known companies have been coming together to come up with innovative ways to reduce the carbon footprint of the fashion world. Representatives for companies such as Nike Inc., Kering, Louis Vuitton and Vivienne Westwood. During the conference, they discussed creative solutions to waste fewer materials and use more elements found in nature to create fibers. Patagonia, a company known for producing outdoor wear has recently developed a wetsuit made of a natural rubber fiber instead of the popular neoprene. It's just as durable as neoprene but less harmful (Guilbault). With this new natural fiber, harmful CO2 emissions are reduced by about 80 percent (Hernandez). Consumers also have to power to make a difference too. Being more socially aware can really make a huge difference. If consumers paid more attention to what different popular brands were doing and informing themselves on the types of garments being produced, they would be able to better gauge what producers they should be supporting. Manufactures like H&M has in the last few years have been working to create a collection that is sustainable. The designs are also perfectly designed for consumers to create a more timeless wardrobe that can be worn any time of year. This will also eliminate the need for continual purchasing of goods, effectively minimizing the harmful effects of fast fashion.

The work some of these companies are conducting is definitely the step in the right direction and I am interested in exploring further. I want to aid in reduction of the negativity in

the fashion industry, and I have a desire to do it in an eco-friendly way. After looking into this issue over the past few months and exploring an alternative method to dye fabric with my ACRE, I have become very interested in this facet of the field and plan to explore careers in which I can continue this research.

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