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Material Impacts Assignment - Part 1

Step 1: Pick a material to research

Introduce your topic in a brief introduction. Why did you choose this material?

The material I chose to research is **rayon**. I chose this, because I often hear rayon as being advertised as a "sustainable" material since it can be made with bamboo or other wood pulp fibers. However, what the average person does not realize, is that the process to create rayon/viscose requires a large amount of chemicals, energy, and water. These chemicals used in the process are very toxic to humans and to the environment. Therefore, I wanted to do a deeper dive into this material. Rayon is also known as Viscose or Modal. There are now also more sustainable versions of Rayon on the market known as Lyocell.

Step 2: Research the material

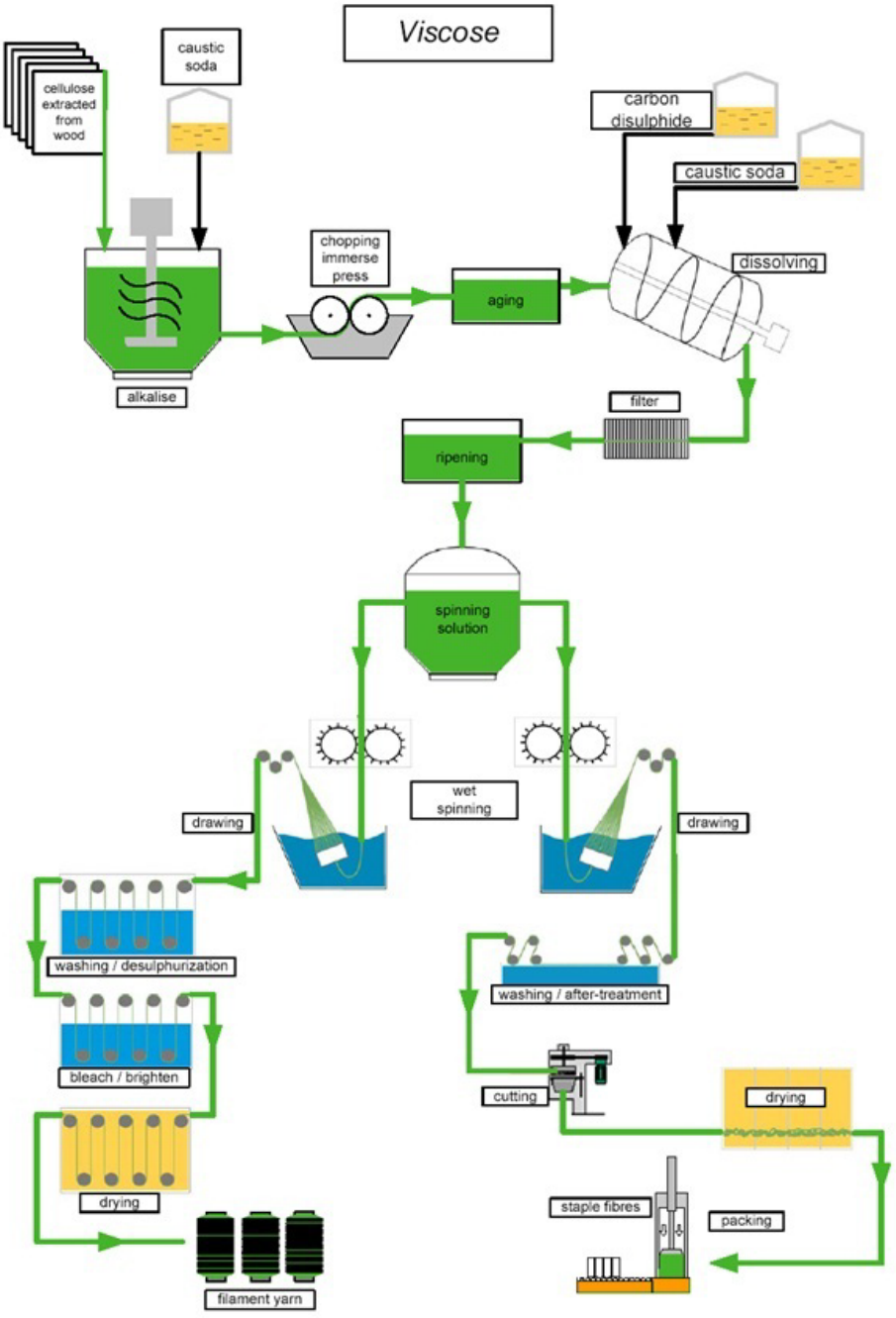
Consider the entire lifecycle of the material, the flows in and out of the lifecycle:

1. *Where and how it is sourced*

Rayon/viscose is made from regenerated cellulose generally made from wood pulp of eucalyptus trees. However, it can be made from other plants such as soy, cotton, and bamboo. In order produce this fiber, massive deforestation is required. Thousands of hectares of rainforest are cut down each year to specifically make rayon.

2. *How it is extracted, processed, produced, etc.*

Rayon is created by treating wood pulp with a caustic soda and other chemicals, and then is allowed to age breaking down the cellulosic fibers. This creates a viscose slurry (where the process and fiber get its name), and is then forced out through fine holes called spinnerets, and then hardens in a chemical bath to create a thread. See below diagram of the viscose process:



Source: https://oecotextiles.blog/2012/03/02/eucalyptus-fiber-by-any-other-name/

3. *The amount and types of energy used as inputs in all of the stages of the lifecycle*

Rayon uses a high amount of energy, and uses harmful chemicals for the viscose process. Chemicals used include sodium hydroxide, sulfuric acid, and carbon disulfide. Additionally, sourcing the wood pulp for rayon comes from endangered and ancient forests.

4. *The amount and source of water used*

Large quantities of water are used in the production of the fiber, as well as dying of the fabrics once the fabric is woven.

5. *Any processes used, or by-products output from the processes. Are there bad actors used in the processing that are worse than the material itself*

Untreated effluent water created from the chemical process of making this fiber is a huge concern. For instance, sodium hydroxide is not harmful to humans, but it is harmful to the environment. There is also GHG emissions created during the development of the chemicals, and the extraction of the raw materials.

6. *Is the material a bio-nutrient or a technical nutrient?*

There are three main types of fibers: Natural, Manufactured, and Synthetic. Natural fibers are fibers such as flax, wool, cotton, and silk. Manufactured fibers are derived from cellulose or protein (such as rayon). And synthetic fibers are made from synthetic chemicals such as polyester or nylon which are petroleum based fibers. Since rayon is a "monstrous hybrid" of natural and chemical materials, it is neither a renewable fiber, and it is not biodegradable.

7. *What are the impacts during the use phase?*

It seems that there is not a lot of large impact during the use phase of this fiber. The Oeko Tex certification shows that there are no trace chemicals found on the fiber or fabric itself that would harmful to the wearer

8. *What is are the potential "end of life" scenarios?*

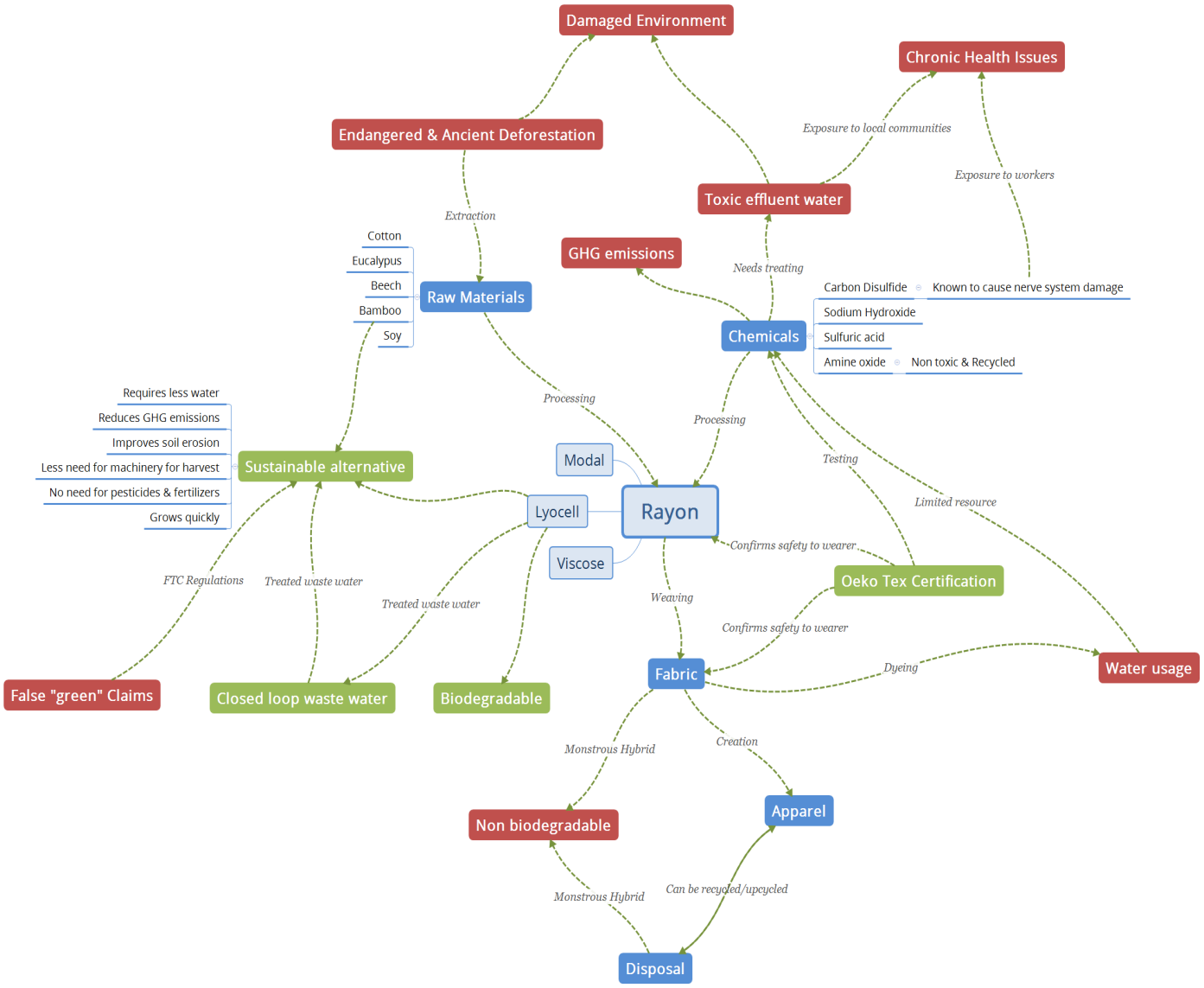
Once this fiber is spun and woven into fabrics, it is then sold as clothing garments. Today, clothing is frequently discarded, and occasionally can be recycled or upcycled. However, rayon as a material has proven to be non-biodegradable. There are more sustainable options of rayon that are being developed to allow for it to be biodegradable.

9. *What are the impacts along the lifecycle to communities of humans and natural communities? Who are the stakeholders?*

Stakeholders include those who create the materials, those who wear the garments, and the impact of the environment used to create the materials. For instance, carbon disulfide (used in the viscose process) has been shown to cause nerve system damage with chronic exposure. This would be harmful to those who work in the manufacturing of this fiber. However, rayon has been Oeko Tex certified, which confirms that there are no traces of these chemicals on the finished fiber, and therefore is not harmful to the health of the wearer.

Step 3: Capture your findings in a lifecycle diagram

Capture your findings in a rough lifecycle diagram. Point out key insights and information, such as: Where did you find the most intensive impacts to be in your lifecycle? Where are there hidden impacts? Where does the energy come from typically? What are the bad actors? including energy flows, material flows, stakeholders, bad actors/hazardous materials or impacts, and "waste" flows.



Conclusion:

After you do your research, answer these questions in your conclusion:

1. *How challenging or easy was it to research this material?*

I was pleasantly surprised how easy I found it to be to find information on this fiber. Quite possibly it is due to the fact that the fashion industry has been under scrutiny in the last decade for its environmental impact, and therefore is making an effort to become more transparent.

2. *What sources worked well for you?*

There was a ton of information on sustainyourstyle.com. As I read articles I kept finding links to more related articles and learned a great deal. This is also a great resource for me to use in the future.

3. *Did you feel that you were finding reliable data?*

Yes I did- many of the articles I found were backed up with scientific data.

4. *What did you learn about your material that surprised you?*

In reading about rayon, I then ended up finding much information regarding "sustainable" rayon, such as bamboo viscose. It confirmed my observations that many people are misled to believing that "bamboo" is a green fabric- even though what they are really advertising is "bamboo viscose". The Federal Trade Commission started to catch on these false claims, and charged sellers of clothing who made these "green" claims. However, the piece that was interesting to me, is that it has now gone so far in the other direction, where bamboo is often consider "not sustainable". Which as a material alone, bamboo is very sustainable. This clearly demonstrates the importance of context in making green claims.

5. *What opportunities and/or challenges did diagramming the lifecycle reveal or bring to your attention?*

The viscose process can actually be a sustainable one. It depends on the material being extracted (such as bamboo vs. eucalyptus), that the manufacturer captures emissions in the process, and also treats the effluent water created. So it is important for companies to be mindful of their claims, and for consumers to pay attention as well.

Sources:

https://www.sustainyourstyle.org/en/rayon-viscose-modal

https://oecotextiles.blog/2012/03/02/eucalyptus-fiber-by-any-other-name/

https://oecotextiles.blog/2009/08/19/348/