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The stages of paper

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CONTENTS	2
1. INTRODUCTION.....	3
2. THE JOURNEY OF PAPER.....	3
2.1 Forests.....	3
2.2 Impacts of felling the forest.....	3
2.3 Transportation and impacts.....	4
2.4 Wood processing and its impact in the factories.....	6
2.5 Felix Schoeller Group.....	7
3. MATERIALS AND PRODUCTS.....	8
3.1 Nanocellulose.....	9
3.2 Ioncell.....	10
3.3 Others.....	11
4. JOBS AND PROFESSIONS.....	11
5. SUMMARY.....	12
6. SOURCES.....	12
6.1 Websites.....	12
6.2 People.....	12
6.3 Photos.....	13

1. INTRODUCTION

In this research work we are discussing the journey of paper from the very beginning to a final product and all the stages in between. We are also extending beyond that by taking into account circular economy, different sociological and environmental impacts as well as jobs and professions needed along the way. As students, our group is presenting our knowledge and the information we have gained in this topic during the Erasmus+ project.

2. THE JOURNEY OF PAPER

Making paper is a long process which includes multiple different stages and with that various impacts both globally and locally. Even though paper production differs around the world, the used methods are quite similar. In this particular topic we focused on Germany and especially Finland.

2.1 Forests

The journey of paper starts in the forest. Many trees used for paper making grow in production forests which take up to around 20 million ha of Finland's forest area. Therefore it's important to look after the forest and take care of it so that the trees are as high quality as possible. To ensure this the forest must be thinned out around every ten years. During the thinning process worse trees are cut down so that better ones have enough room and sunlight to grow. When the forest is profitable enough, private forest owners sell the trees to companies which cut them down and transport them to paper factories. In many cases forest owners might even get free saplings from the companies.

2.2 Impacts of felling the forest

Utilization of the forest has a significant impact on the environment, because trees work as important carbon sinks on Earth and they provide living space and ecosystems for numerous species. If the forests are not taken care of before and after the usage of the trees, it can significantly affect the organisms, natural landscape and surrounding areas. Not only does the forest's state affect the species living in it, but also humans in a direct and indirect way. Because forests are one of the most important factors in fighting against climate change, they play a more significant role in people's lives than many might think. Other smaller benefits that forests can offer are grounds for hiking and camping, possibility for collecting berries and mushrooms as well as fresh air and beautiful scenery. Paper production itself uses up to 40% of all the tree founts in the world which is why it is highly important to take into account the forest's wellbeing in this particular industry.



logging border and a logging hole

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In Finland there is a project called “Laplands green deal program” which has many long lasting goals regarding forestry. These goals relate to protecting biodiversity, preserving the carbon sinks at the current level and replacing the usage of fossil fuels with renewable wood raw materials. In today's world goals such as these are very important when fighting against climate change and trying to keep care of our nature.

2.3 Transportation and impacts

Getting the wood materials from the logging sites and roadside depots to the paper factories has changed throughout the years. Back in the days, for example in Finland trees were transported mainly through water- and railways because of the good river connections and lack of motorways. However nowadays with the help of highly developed road transport equipment and extensive road networks some of the previous ways of transportation have been replaced with especially trucking and car transport while trains have mainly maintained their same position.



most common ways of transporting trees nowadays are by trains and trucks (4)

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Using vehicles to move the tree material from one place to another creates emissions that harm the environment. If the logging site is located far from the factory or even in another continent may its transportation require building new road connections or cutting down areas that can't be made use of in the paper process itself. This is why many transportation companies try to plan the trip from the forest to the factory as short and sensible as possible so that it will be more eco-friendlier.



(6)

2.4 Wood processing and its impact in the factories

First step to paper making at the factory is removing the bark from the tree in a debarking drum. Later on the bark is either used for energy production or as soil conditioner. After debarking and before wood chipping, the trees are cleaned of extra bits like small rocks. The formed wood chips are transported to pulp mills where they go through steaming and are boiled under high pressure in lye. During this process lignin exits from the mixture leaving behind cellulose fibers that are then formed into pulp. This pulp is then washed, bleached, dried and cutted into sheets. For different kinds of paper products certain fillers can be added into the paper pulp, such as coloring, kaolin, talc and calcium carbonate.

The making of paper uses up a lot of energy and water. It also works with a lot of chemicals that may be harmful when not disposed of correctly. Not all parts of trees are eligible for paper making which would create a lot of waste in the industry unless they weren't turned into side stream products. Because of the factories impact on nature all of them must have environmental permits in order to operate in the first place. These permits ensure that the factories work in a responsible manner by for example taking care of their surrounding natural water systems .

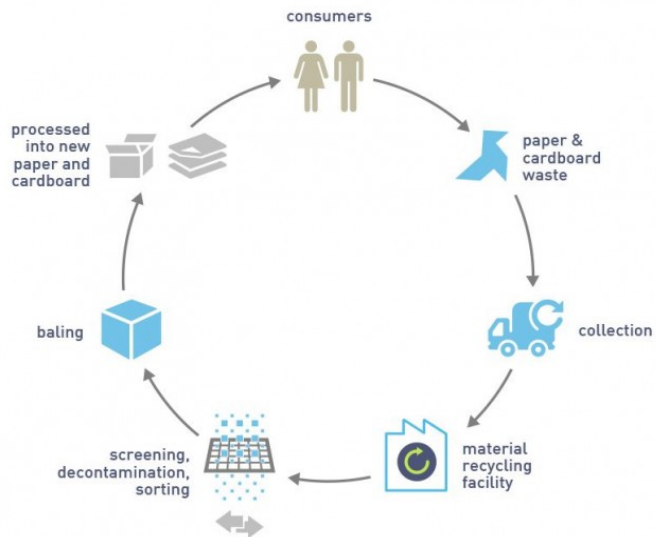
reducing the factories carbon footprint

When the paper gets used and reaches the end of its lifespan it will in most cases be recycled. Like most materials, paper can't be recycled forever, since the quality decreases after every reuse, but utilizing old materia saves a lot of water and energy and therefore also the environment and money.

2.5 Felix Schoeller Group

While staying in Penig, Germany our group visited the paper factory owned by Felix Schoeller Group. The factory's manager gave us a tour and told us facts about the building and the company. We learned that they are trying to recycle as much as possible and only about 10-20% of the material used in their papers is new, while the rest is recycled. The company's clients send back their used papers which get recycled and made into new ones. During our visit we were also introduced to different kinds of papers that the Felix Schoeller Group produces. The company makes packaging materials for foods and medicinal instruments etc. They also produce drawing and photo papers, textile fibers, paper backing for tapes, wallpapers as well as paper for books and newspapers.





(8)

3. MATERIALS AND PRODUCTS

Paper making produces multiple different types of products from the most basic paper to packaging materials such as cardboard. At the same time various different side stream products are created from leftover and extra wood materials for example lignum.

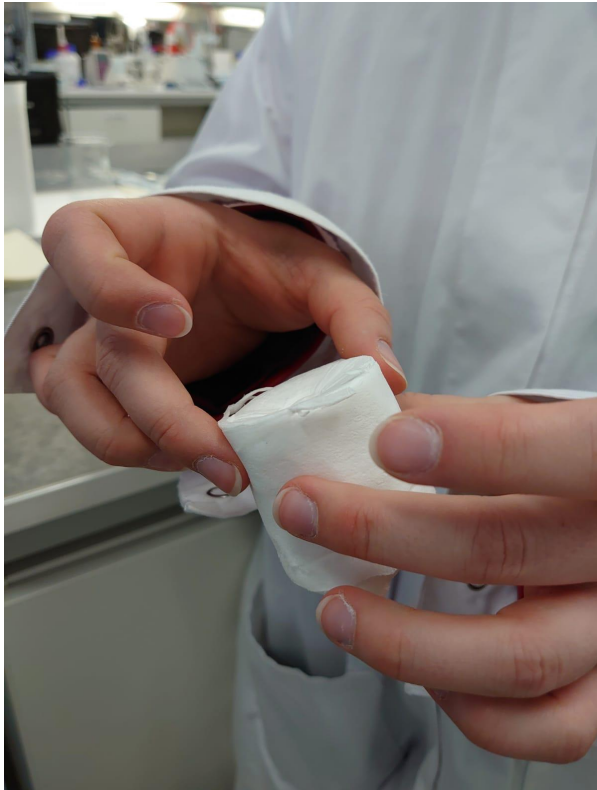


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3.1 Nanocellulose

In April we visited the University of Oulu. During the visit we had a chance to create nanocellulose and learn how it can be used to improve the environment. Members of the university had for example invented a “sponge” which only absorbs oil from water. This invention can be used for cleaning oil spills from water systems. They are also working on making organs out of nanocellulose in their laboratories. Other examples of products that can be made from nanocellulose are blood veins, packaging materials, bullet vests as well as plane parts and structures. Nanocellulose is a light but strong material and that’s why it is so versatile in many applications from medicine to technology.





(11)

3.2 Ioncell

The demand for eco-friendly textile fabrics is increasing globally. Ioncell is a Finnish invention which resembles mercerized cotton from appearance and touch. The fabric can be made from wood, textile waste or old cardboard. It is developed in collaboration with Aalto and Helsinki universities. The Ioncell method can be used as an ecological alternative for cotton production because cotton needs a lot of water to grow and therefore is more harmful for the environment. In the process cellulose is changed into fibers which are then used for making fabrics.



(12)

3.3 Others

At the beginning of our project we had an online meeting with the HR manager of Metsä Group (*Forest Group*). He gave us a lot of information about the factory in Kemi and the different side stream products of paper production. These include things like heat, electricity, turpentine, liners, pulp, cellulose, saw, cardboard, oils, building materials and different kinds of fibers.

During our visit to the Science Center Pilke in Rovaniemi, Finland we had the opportunity to see and find information on multiple products either made out of wood or using certain parts of wood as a material. For example, some cosmetic products from the Finnish beauty brand Lumene, biodiesel and household items like cutting boards, sauna water buckets and kitchen utensils.

4. JOBS AND PROFESSIONS

The paper industry employs a variety of different jobs and professions such as factory managers, lumberjacks, forest owners, train and truck drivers, product designers, factory workers, chief technology officers, supervisors, forest caretakers, finance managers, environment specialists, engineers, environmental designers, laboratorio workers, landscape architects, process technologists, raw material industry workers and many more.

There are all kinds of work tasks from planning the usage of forests and the material gathered from them, to designing new products and ways of using wood and paper. As far as focusing on making more advanced recycling methods and cutting out carbon emission.

Workers in this field are expected and required not only to be efficient on their job, but to also know about circular economy and take it into account.

We were also lucky to have mentors during the project. One of them being a student from Oulu university, who studies process engineering. She told us about ecological aspects of paper making, professions in the industry and studying in university. She pointed out that it is important to take into account how much chemicals and poisons are used when making compensatory products for plastic. She also told us that many processes will become automatic in factories in the future so there will be a need for specialists focusing on environmental aspects.

5. SUMMARY

In general, working on this project has given us a lot of new information about paper production, what kind of impacts it causes, how pulp factories work, what kind of products can be made out of wood and which jobs and professions work on these factors. We were also able to create relations abroad and learn of each other's cultures and normal life which we are very grateful for.

6. SOURCES

For this final work we used numerous different sources that we collected throughout the few years. We gathered information from websites as well as people we met and talked to online.

6.1 Websites

- <https://forestbiofacts.com/>
- <https://www.upmmetsa.fi/tietoa-ja-tapahtumia/videoartikkelit/puutavaran-kuljetus/>
- <https://www.tonerbuzz.com/facts-about-paper/>
- <https://sciencing.com/how-does-recycling-paper-affect-the-environment-5171772.html>

6.2 People

Katri Hendriksson - Circular Economy Specialist and Coordinator of Sustainable Development from the Lapland University of Applied Sciences

Sirpa Kokko - Circular Economy Specialist and Project manager from the Lapland University of Applied Sciences

Sofia Tirroniemi - student mentor from Oulu university

Matias Titoff - Project manager (Metsä Group)

Mikko Kylmälä - HR manager (Metsä Group)

6.3 Photos

- Photo taken by a group member "Penig" (1)

- <https://www.rte.ie/news/world/2021/1118/1261839-brazil-deforestation/> (2)

- <http://hannuhuttu.com/gallery/displayimage.php?album=7&pid=540> (3)

- <https://www.vastavalo.net/rautatiekuljetus-talvi-puun-kuljetusta-650946.html> (4)

- <https://www.saaskipuu.fi/puunkuljetus> (5)

- <https://www.lapinkansa.fi/rovaniemen-keskustan-tuntumaan-on-sailottyna-jopa/2682705> (6)

- <https://www.talouselama.fi/uutiset/veitsiluodon-ja-kaipolan-kohtalo-oli-nahtavissa-jo-viime-kesana-lue-talouselaman-artikkeli-joka-kertoi-miksi-tehtailla-ei-ena-ollut-elintila/b4887157-4024-4cba-8f2a-72f745186256> (7)

- https://qdcqatar.org/projects/project_details/Environmental-Impact-Assessment-Study-Proposed-Paper-Manufacturing-Factory (8)

-<https://ismwaste.co.uk/recycling-services/paper-recycling> (9)

- Photo taken by a group member "Oulu" (10)

- Photo taken by a group member "Oulu" (11)

-<https://www.maaseuduntulevaisuus.fi/metsa/b4e47af7-2e68-5ee0-9898-e79393f00fd2> (12)