CHEMARTS 2014

LOST IN THE WOODS

Introduction

The Finnish Forest Industry is well known for its high quality wood used in the production of multiple merchandises such as lumber, pulp, paper, and packages, as well as cellulose derivatives such as glues, food supplements and pharmaceuticals. However, for several years the prognosis for this industry has been the diminution in demand, which presents the necessity to discover new ways to utilize the forest potential and timber - the gold of Finland.

The forest industry is looking for novel and innovative ways to use raw materials and develop new methods and techniques, to create the possibility of combining natural materials with advanced technologies. Concurrently, fresh perspective is still on demand and hence, the industry collaborates with university facilities to conduct research at these emerging areas.

“Forest - the gold of Finland.”

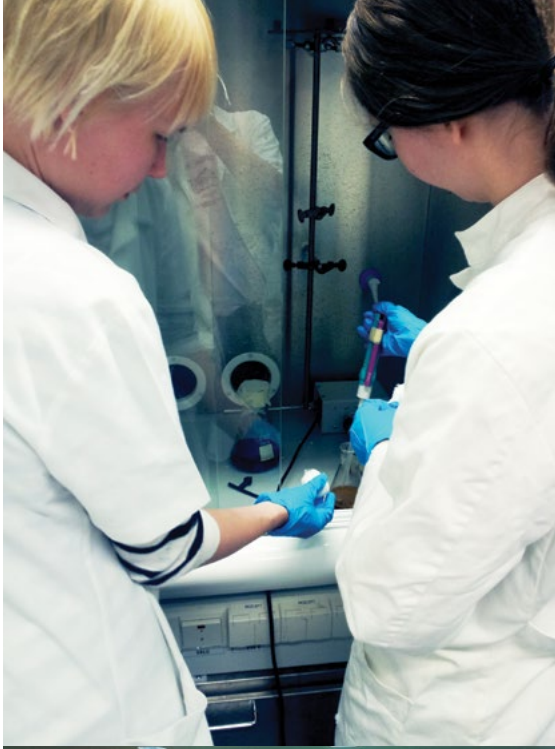
Thus, the idea of combining creative design minds with practical engineers occurred. Aalto University established a project where students from the School of Arts, Design and Architecture (ARTS) and the School of Chemical Technology (CHEM) merged their forces with the aim to invent new ways to harness wood and cellulose.

About CHEMARTS

CHEMARTS is a long-term strategic collaboration between two Aalto schools, the School of Chemical Technology and the School of Arts, Design and Architecture. The objective is to inspire students and researchers to explore biomaterials together and to create new concepts for the future use of cellulose. CHEMARTS consists of various actions e.g. multidisciplinary study courses, summer projects for Masters' students and externally funded research projects on cellulose.

"Students from School of ARTS and School of CHEM come together to explore the fascinating world of wood and cellulose."

During the CHEMARTS summer projects of 2012 and 2013, students were examining the collaboration in practice. In 2013, students developed several product concepts while envisioning how advanced materials could make life easier and more comfortable. They also developed a platform for individuals to present their cellulose related innovations - the new learning hub AEREA.
During the summer 2014, Chemarts project was focused on hands-on prototyping and experimenting with materials.



Materials

What is cellulose?

Cellulose is one of the most abundant materials found in nature and is mainly produced by plants, but also by bacteria and algae. It is a structural component of plant cell walls, which is considered sustainable, renewable and multifunctional. Due to its abundance, biodegradability and chemical tunability, new methods of using cellulose have become an active research topic besides the traditional wood-based products. In this project, all final outcomes were made of cellulose-based materials.

“Cellulose fibres are sustainable, renewable and multifunctional.”

In our project, we were focused on aerogels, bacterial cellulose, carboxymethyl cellulose, and microfibrillated cellulose. These materials were used to create our conceptual art pieces. Following the notion of sustainability and delving deep into research of Finnish plants and trees we used pigments as well as natural dyes (beetroot, birch leaves, bark and jäkäkä) to dye these materials for our projects.

Bacterial Cellulose

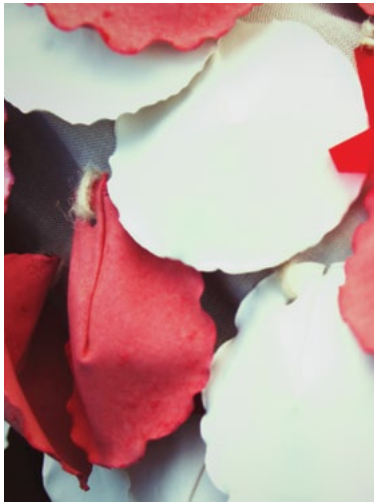
We used a bacteria strain called **Gluconacetobacter medellinensis**, which was discovered in Colombia.
A layer of bacterial cellulose was produced on the air-liquid interface in a medium containing sugars. We also experimented with growing bacterial cellulose in different types of media including red wine, beer, beetroot juice, and carrot juice. Different natural dyes such as red onion, nettle and birch leaves were used to bring different colors to bacterial cellulose.

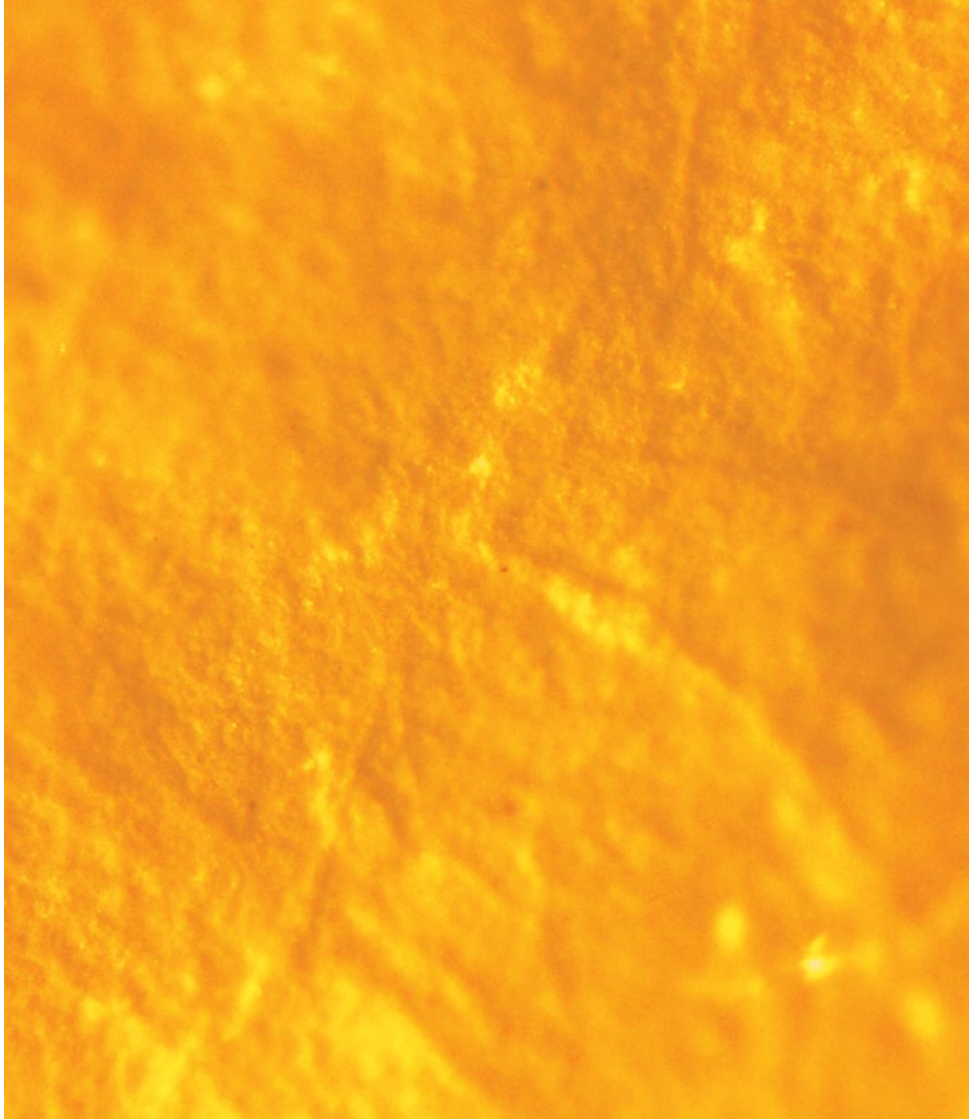
Aerogels

Aerogels are highly porous, ultralight aAerogels are highly porous, ultra-light and insulating materials that can be produced by removing the solvent in “gentle” ways from different types of gels. We produced aerogels or aerocellulose from nanofibrillated cellulose, TEMPO oxidized cellulose, CMC, bacterial cellulose and birch pulp with starch through freeze casting. Additionally, we experimented with three different cooling methods, with different solid contents and salt concentrations. The gel was first frozen and then put into a freeze dryer to remove the liquid in the gel and replace it with air. These porous materials can be suitable thermal insulators and can be shaped in different forms, constituting an interesting tool for designers.

Microfibrillated Cellulose

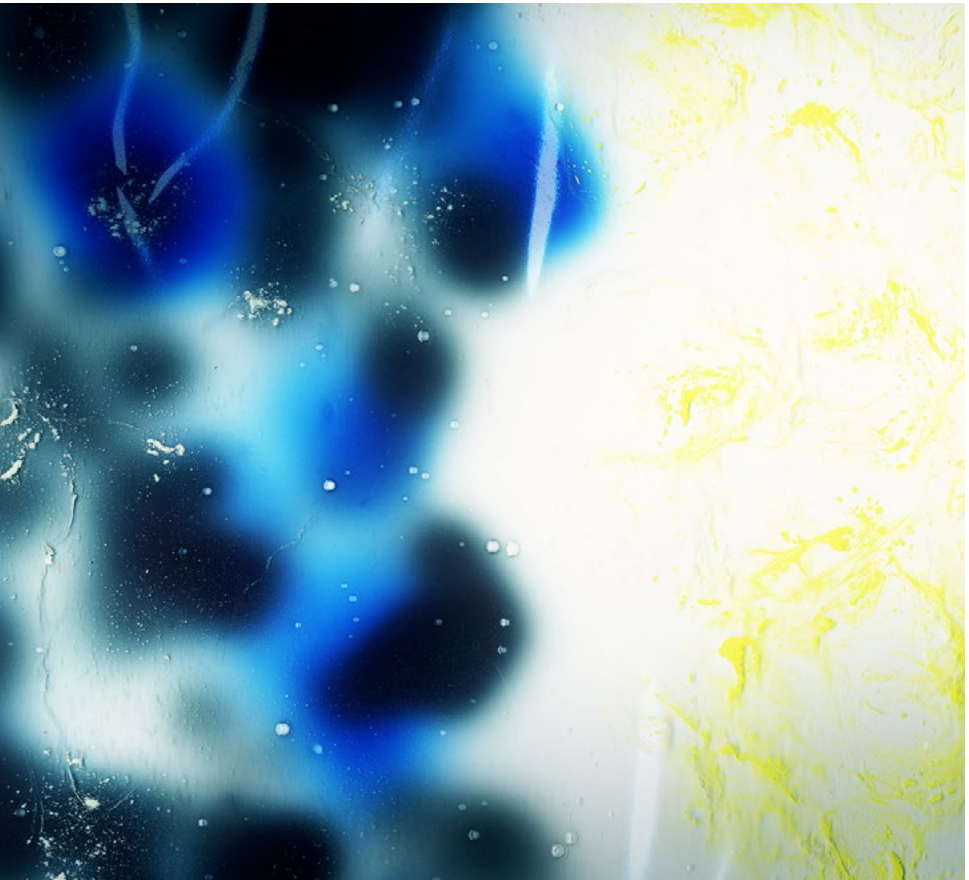
Microfibrillated cellulose (MFC) consists of cellulosic fibrils obtained by mechanical deconstruction of cellulose pulp that behaves like a gel in normal conditions. They can be filtered like paper fibers to obtain thin films with superior strength, high durability and low weight. In our work, we produced paper with aqueous dispersions of MFC and precipitated calcium carbonate (1:1 mixture) and we took advantage of the ability of the paper to be reshaped when wet for garment design.





Carboxymethyl Cellulose

Carboxymethylated cellulose (CMC) is a chemically modified cellulose that can be used to obtain transparent films. In this project the films were produced by casting the CMC gel on plastics at room temperature.



We also experimented with cellulose nanocrystals (CNC) and with a mixture of birch pulp and starch. CNC films are strong and have an iridescent effect. We investigated with coating fabric and yarn with CNC. The birch pulp and starch mixture was used for 3D shaping, producing aerogels and films.

Workshops

When people from different backgrounds and fields of study join to work together, the different styles of working should be taken into account. People of ARTS require something visual and tangible for inspiration when people of CHEM are more accustomed to research work.

Eventually, we started to blend these styles and concluded with using visual aids in engineering methods of working and having some structure for artistic working habits. As a result we had four workshops.

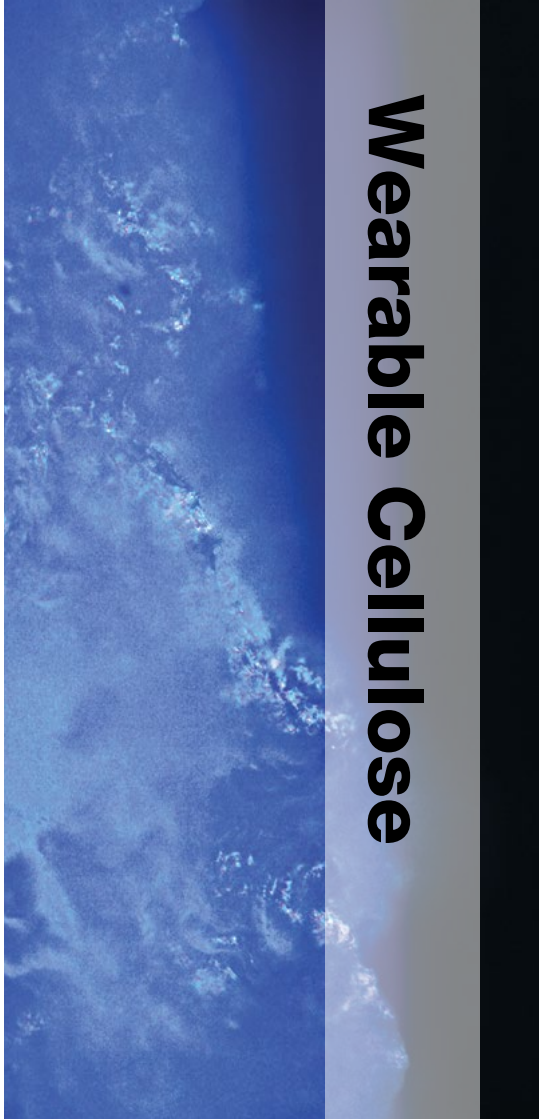
“People of ARTS require something visual and tangible for inspiration when people of CHEM are more accustomed to research.”

The School of ARTS arranged the first workshop, named “wearable cellulose”. Then we had an “Ideation Workshop”, which established the basis for our concepts. Afterwards, the engineers brought forward their inner designer in the “Design Workshop”. The creative work continued with designing the “Moodboard” for our products.

Conducted by Heidi Wikar, our first workshop was to begin the creative process of our project and operated as an inspiration for the upcoming design work. The idea of the workshop was to create shapes and textures inspired by nature. We worked outdoors in the forest and used fabric to drape trees and rocks with interesting shapes to later create garments that kept visual elements inspired by nature. Each of us constructed one garment, which was later photographed.

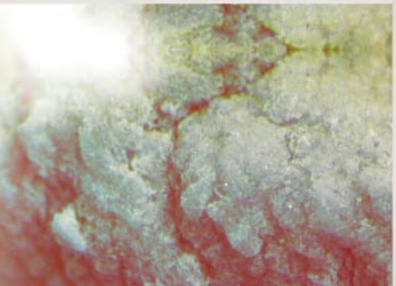
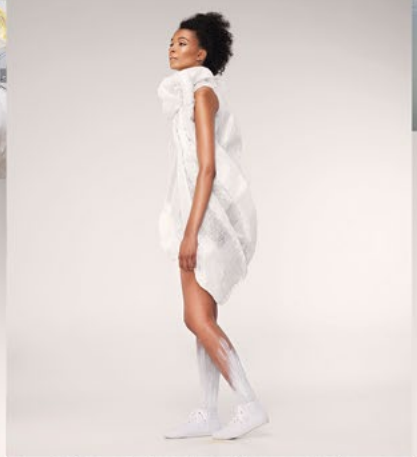
“The Idea was to work with shapes and textures inspired by nature.”

The second part of this workshop was to create a pattern inspired by the surrounding environment of Arabia. We used several different sketching techniques that resulted in 6 different digitally repeated patterns.

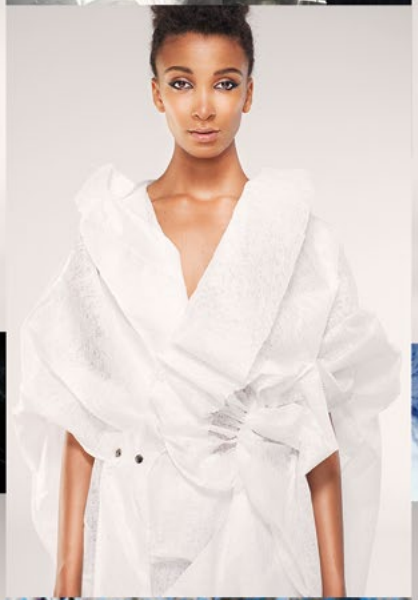
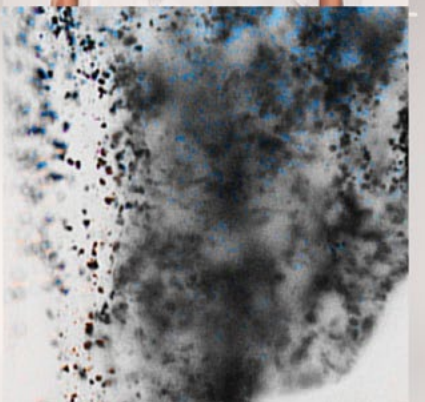


Wearable Cellulose





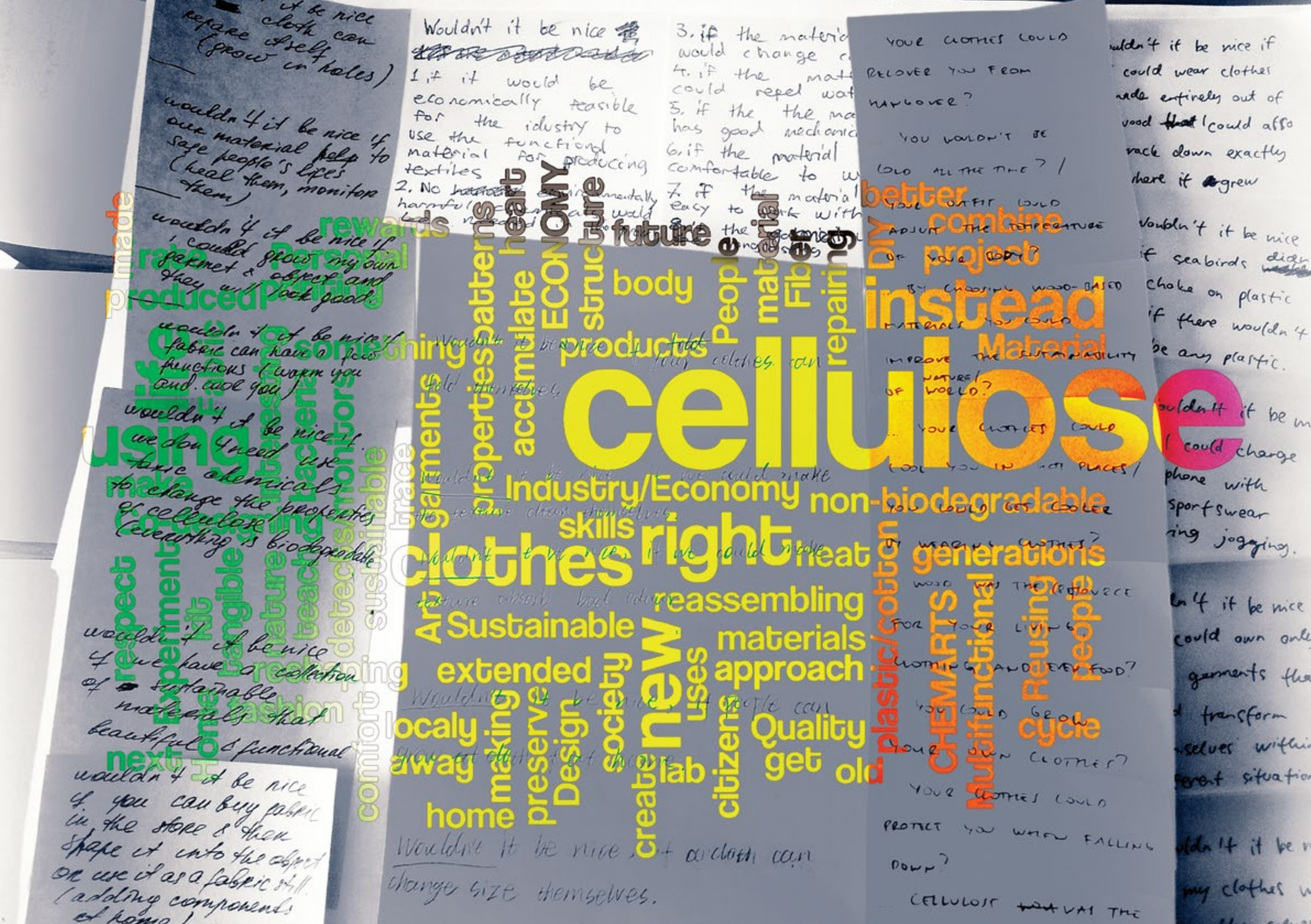

Ideation workshop

The aim of this workshop was to figure the goals and requirements of our project and to find solutions to achieve these goals. We brainstormed about the future of cellulose-based materials, attempting to combine desired properties and the market demand for them.

We summarized the goals we had developed into three categories: sustainable, promotional, and team working. At this point of the project, we decided to further focus on the promotional and artistic aspects rather than designing industry-oriented products.

The main future challenge we came up with was as followed: We must design a functional cellulose based material and suggest applications for sustainable production, so that we help promoting the use of cellulose for both the public and the industry.

“We must design a functional cellulose based material and suggest applications for sustainable production, so that we help promoting the use of cellulose for both the public and the industry.”


cellulose
clothes
right
Industry/Economy
non-biodegradable
instead
Material
better
combine
project
generations
reassembling
Sustainable
materials
approach
extended
Quality
get
old
localy
away
home
lab
create
new
uses
citizens
society
Design
preserve
making
Art
garments
properties
accumulate
ECONOMY
structure
body
People
material
Fiber
repairing
DIY
future
heat
rewards
Personal
printing
produced
made
something
life
Fabric
using
make
respect
Experiment
Kit
tangible
nature
teach
bacteria
monitors
sustainable
skills
plastic/cotton
CHEMARTS
Multifunctional
Reusing
people
cycle
reshaping
fashion
comfort
next
Home
Wouldn't it be nice
1. if it would be economically feasible for the idustry to use the functional material for producing textiles
2. No harmful ... environmentally
3. if the material would change
4. if the material could repel water
5. if the material has good mechanic
6. if the material comfortable to
7. if the material easy to work with
wouldn't it be nice if our material help to safe people's lifes (heal them, monitor them)
wouldn't it be nice if fabric can have a few functions (warm you and cool you)
wouldn't it be nice if we have a collection of sustainable materials that beautiful & functional
wouldn't it be nice if you can buy fabric in the store & then shape it into the object or use it as a fabric still
YOUR CLOTHES COULD RECOVER YOU FROM HANGOVER?
YOUR CLOTHES COULD PROTECT YOU WHEN FALLING DOWN?
Wouldn't it be nice if I could wear clothes made entirely out of wood
Wouldn't it be nice if seabirds didn't choke on plastic
if there wouldn't be any plastic.
Wouldn't it be nice that cloth can change size themselves.

Moodboard

In this workshop, we attempted to find similarities in visual perspectives between all team members, to gain inspirations from one another and to organize them into visual moodboards. The outcome was two visual groups, which we further described verbally to clarify their atmospheres. These moodboards facilitated us to communicate our visual concepts and to associate them with our final prototypes.

“Our objective was to combine new and innovative materials with the long-lasting traditions of utilizing wood.”

The two final themes were: Techno and Heritage. These subjects presented the concept of our project and our objective was to combine new and innovative materials with the long-standing traditions of utilizing wood. Based on the colors we had investigated, we selected a color palette that inspired the colors used in our prototypes.

Bright

Vibrant

Synthetic

Vivid

Contrast

Wavy

Pulsating

Human Made

Transform

Dynamic

Present future

Unnatural

Smooth

Natural

Calm

Serene

Simple

Pale

Shape

Structure

Earthy

Light

Comfortable

Touching your heart

Unpredictable

Peaceful

Design workshop

The design workshop operated as a stimulating tool to develop our concepts. Within the first day of this workshop, the engineering students started to understand the different aspects of design process.

One of our first concepts was about Bikewear, so we started by sketching different biking-related products for 10 minutes and moved on to the next idea. Consequently, we managed to formulate some basic designs for our final prototypes.

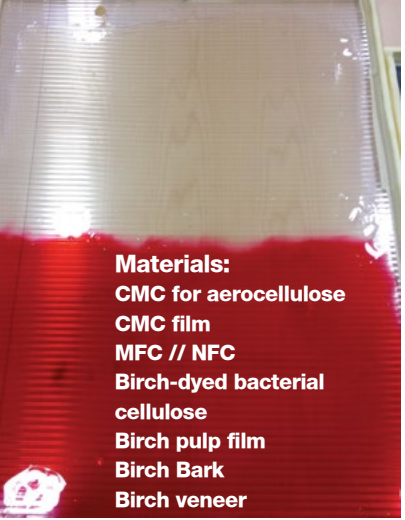

shirts
for
doodle pants
accessories
technical
helmets
bags
gloves
clothes
jackets
people
shoes
shorts
bike
back
front

Koivu // Birch

The concept of this jacket was entirely based on birch. The patterns on the bodice are predominantly from the shape of one specific birch tree, its branches and leaves. The structure of the sleeves mimics the layers of a catkin, while the aerocellulose-pocket part in the front represents different interpretations of the two different seeds of the birch tree.

Most of the materials used in the jacket originate from birch. Those that are not directly from the tree have been dyed with birch leaves. Other parts of this prototype are developed from common birch materials, veneer and the bark of the tree itself.

Koivu // Birch


Materials:
CMC for aerocellulose
CMC film
MFC // NFC
Birch-dyed bacterial cellulose
Birch pulp film
Birch Bark
Birch veneer

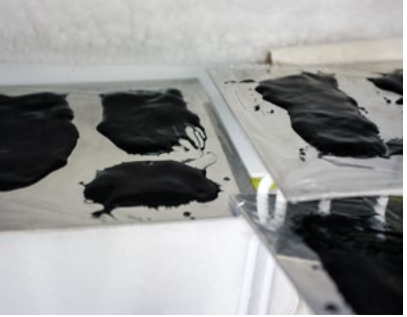

DELTAFORCE

Mänty // Pine

The idea of the scarf was generated from the insulative properties of aerogels and the natural structure of the pine tree bark. The Scarf is composed of small pieces of aerocellulose that are layered similarly to the bark. The design utilizes both living and dead pine trees. The living tree trunk provides the structure of the aerocellulose pieces while the dead pine tree trunk offers the shape of the scarf.

The pine tree trunk with its dark bottom and top orange hues inspires the color palette used in this piece. The beige color is produced from pine tree bark.

Mänty // Pine



Materials:
CMC for aerocellulose
CMC film
Pine tree bark dye
Black ink

Jäkälä // Lichen

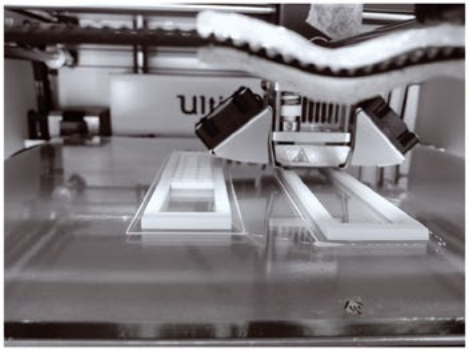
The shoe, inspired by jäkälä structure, represents the pattern of lichen on its outer part. This expanded iterative pattern resembles both the plant structure and fractals.

Traditional knotting and weaving techniques are employed on the front, the inner part, and the insole of the shoe. The weave structures allow creating flexible surfaces, which make it easier for the material to follow the body contours. In contrast, the heel and the sole sections are made of highly novel papers and porous materials (aerocellulose), which signify the possible future applications of cellulose.

The sole contains seeds from the Finnish forest and is completely biodegradable. The life cycle of the shoe ends in a forest where it began.

Jäkälä // Lichen

Materials:
Birch pulp for aerogel
Bacterial cellulose dyed with birch leaves
Hemp yarn
CMC film dyed with jäkälä
Burch bark and seeds
MFC paper



Summary // Future Work

We entered this project, each with our personal tools and knowledge from our study fields. Our instructor, Julio Arboleda, introduced cellulose-based materials and via learning those bases we started to create shapes, colours and concepts for fashion and textile industry. We learnt significantly from one another through conducting lab experiments and creative workshops as a team.

Since the materials were new to us it acquired great amount of time to understand and learn how to work with them. But eventually we discovered the most appropriate raw materials and techniques for us. Each individual had their own area of expertise with the materials. As mentioned earlier, our project resulted in conceptual art.

The CHEMARTS project will continue next year, which will bring boundless opportunities to explore the potentials of cellulose world further. There still exists immense demand to research into these materials deeper and more extensively. These materials have the potential to help the world in environmental issues. They possess great variety of properties and can be exploited in unexpected ways.

“Eventually we discovered the most appropriate raw materials and techniques for us.”

The Team

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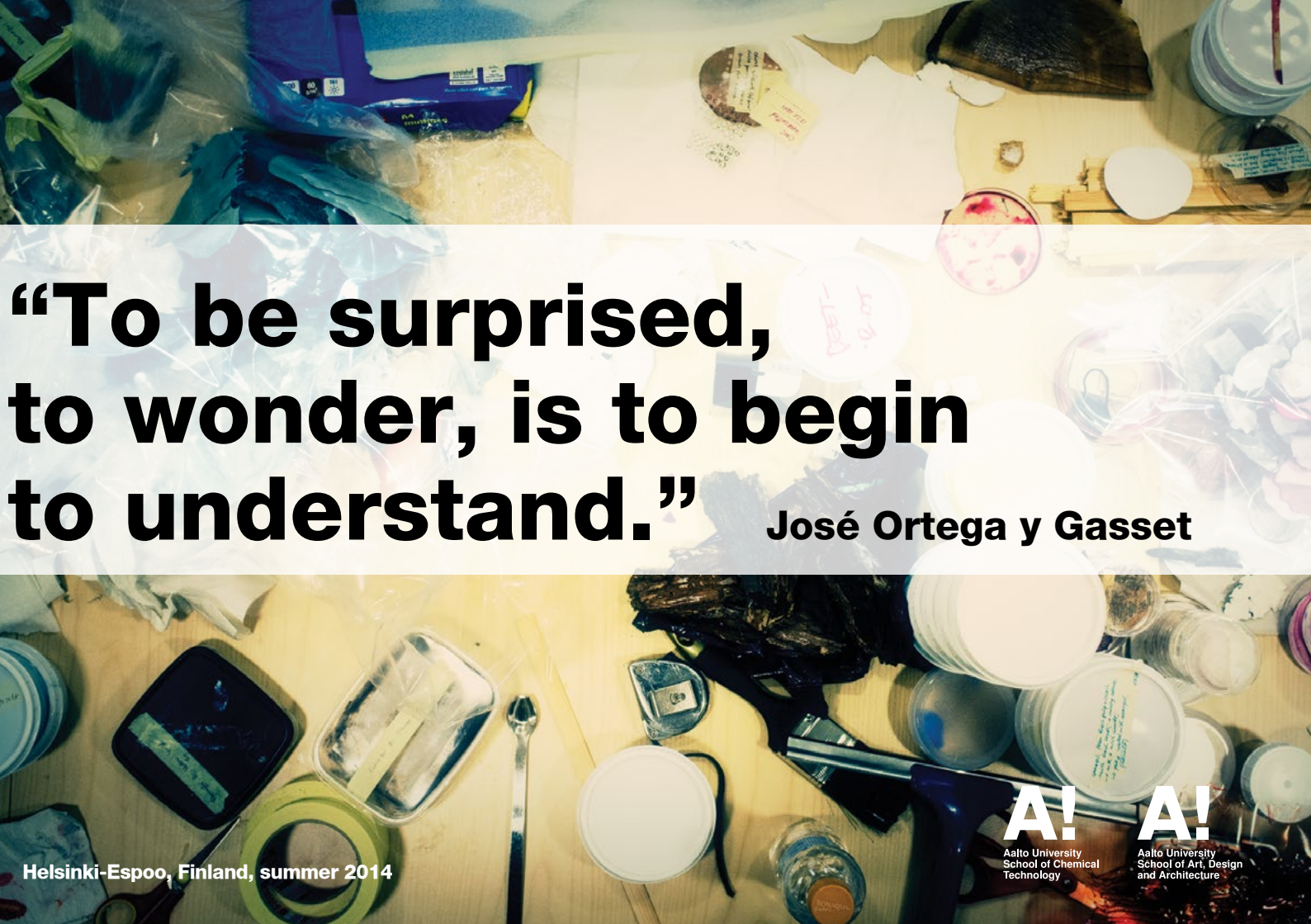
Also we would like to thank Dr. Orlando Rojas, Adriana Restrepo and all other people who were helping us to explore the world of cellulose!



“To be surprised, to wonder, is to begin to understand.”

José Ortega y Gasset

Helsinki-Espoo, Finland, summer 2014

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School of Chemical
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