CHEMARTS

SUMMER SCHOOL 2020

CHEMARTS

CHEMARTS is the long-term collaboration project of the School of Chemical Engineering (CHEM) and the School of Arts, Design and Architecture (ARTS). These schools combined forces in 2011 with the aim of researching bio-based materials in innovative ways and creating new concepts for their advanced use. The core values of CHEMARTS are the sustainable use of natural resources, experimental working methods, and the respectful cross-pollination of design and material research.

CHEMARTS arranges multidisciplinary study courses and a Summer School for degree students, thesis projects, and workshops for elementary and high school students. It also participates in externally funded research projects

SUMMER SCHOOL 2020

Despite the Covid-19 situation, CHEMARTS Summer School 2020 was successfully organised in the spirit of multidisciplinary collaboration. All 22 students were free to propose their own interests on bio-based materials before deep dive into the chosen topics withsupport from the tutors and peers. The course resulted in highly diverse projects, from utilising various plants as novel cellulose or colorsources to experimentation on creative form-giving processes.

PROFESSORS: Pirjo Kääriäinen, Tapani Vuorinen
TUTORS: Nina Riutta, Iines Jakovlev, Eveliina Juuri, Talisa Dwiyani, Iina Solala, Jinze Dou
PHOTOGRAPHY: Esa Naukkarinen, Irene Purasachit (page 33)
LAYOUT: Irene Purasachit
PRINTING: ....




From Biowaste to Biowaste Bin

Hanna Arhe
B.A. Design

Target of this experimentation project is to invent a material that is visually attractive, biodegradable and optimal for collecting biowaste at home kitchen. The material is shaped like clay, but it is fired only in 40-70°C. It is possible to apply different biowaste sources as dry material. In room temperature the material is solid and applicable for collecting biowaste, or it could be used as a package in stores or market places.

As all ingredients are biodegradable, the whole bowl can be recycled as biowaste. All the pretty things do not need to stay forever with us.

Materials: Microfibrillar cellulose (MFC), microcrystalline cellulose (MCC), methyl cellulose (MC), cellulose pulp, potato starch, various dry materials such as pine bark powder

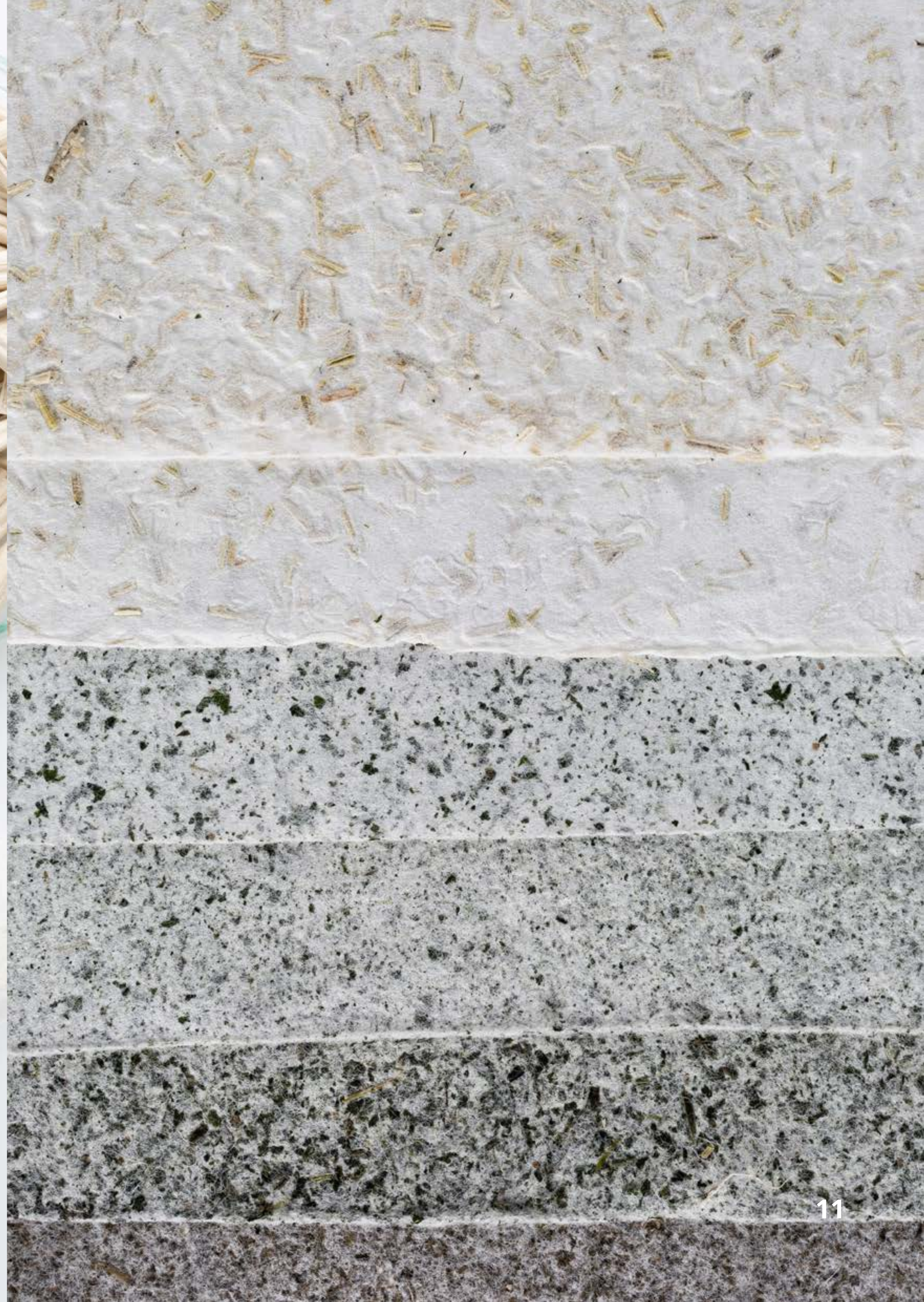
Exploring Nettle

Henna Salminen
B.A. Design

Nettle is a common plant in Finland, known for its stinging properties and mainly treated as a weed. However, nettle has multiple uses: for example, it's leaves are nutritious food and the stem contains beautiful fibres suitable for textile use. Nettle is not commonly cultivated due to quite a modest amount of actual fibre per plant.

The aim of my nettle experimentations was to explore the material properties of nettle further, and to find uses for every part of the plant–stem, leaves and fibre. Using every part of nettle extends its possibilities in textile use. Materials created with nettle vary from soft to hard, from using only nettle to mixing it with other cellulose-based materials.

Materials: Nettle, pulp, nanofibrillar cellulose (NFC), microcrystalline cellulose (MCC), methyl cellulose (MC), viscose fibres



Creatures of Cellulose

Ene Rönkkö
B.A. Design

Creatures of Cellulose is an artistic material project that started from the exploration and sculpting of the cellulose derivatives. It results in fantasy-like figurines that are born from intuitive use of the material. The sculptures are simple and playful, fully compostable, and decorated with petals and flowers, or built with origami-inspired paper structures. The sculpting material is viscous pulp-based bio-clay, which is adjustable by its consistency. It holds detail, air dries, and combines beautifully with paper. The finished piece is wood-like and hard with a papery texture. The clay creates possibilities for sustainable, single-use ornaments.

Materials: Pulp, carboxymethyl cellulose (CMC), nanofibrillar cellulose (NFC), starch

PALO
Lampshade from Willow Bark Fibres

Edith Kankkunen
B.A. Design

Palo project is inspired by the beautiful colour and consistency of willow bark fibres. Willow is a fast- growing tree with great properties and plenty of potential for different kinds of uses, but it is still a poorly utilized material. Willow bark fibres together with cellulose derivatives resulted in soft and leather like textures as well as stiffer materials.

The outcome of the project is a collection of different willow bark fiber sheets and a lamp shade made from willow bark fibres and methyl cellulose. The fine colour of the willow bark fibres together with the shine from methyl cellulose created a thin, partly translucent lamp shade.

Materials: Willow bark fibres, methyl cellulose (MC), nanofibrillar cellulose (NFC), microfibrillar cellulose (MFC), glycerol

Experiments for Nonwoven Textiles

Auri Lukkarinen
B.A. Fashion

Petra Lehtinen
B.A. Fashion

Our project researches ways to reuse unwanted textiles by combining them with bio-based materials. One of the big challenges of the textile recycling systems is the recycling of material blends. While waiting for the technology to do so, we wanted to embrace the great qualities of these fabrics consisting of various materials without the need to separate the fibres chemically. The aim was to achieve textile-like materials with qualities such as drapiness and strong structure.

We grinded used fabrics and leftovers to create textures, and used recycled yarns as reinforcing filaments. These materials could be used as alternative textiles in experimental fashion design or in other creative purposes such as in contemporary art pieces.

Materials: Nanofibrillar cellulose (NFC), methyl cellulose (MC), glycerol, grinded fabrics, yarns

Cellulose Felt

Elina Onkinen
M.A. Fashion, Clothing and Textile Design

It is estimated that less than one percent of all clothing is recycled back into clothing. The idea of this project was to test different possibilities of recycling textile waste, with a simple, yet sustainable production method: foam-forming. The aim was to produce a collection of biodegradable and recyclable fabric samples suitable for garment making.

Foam-forming is a fast way to produce materials that are light and affordable, enabling zero-waste production. It also enables a creation of soft and bulky materials, adding options to the possible applications.

Another objective was to test the properties of methyl cellulose (MC) in textile and clothing context. By using MC as a binder, it is possible to create materials that either dissolve in water in low temperatures or can be washed in higher temperatures.

Materials: Cotton fibres, viscose fibres, pine pulp, methyl cellulose (MC), sodium dodecyl sulphate (SDS)


30g FIBER (N1)
WATER
SDS 3%

Colours From Around Us

Edith Kankkunen
B.A. Design

Henna Salminen
B.A. Design

The project Colours from Around Us was initiated by two textile designers who wanted to find out what colours can be found from nature. Commercial textile dyes are synthetic and often contain harmful chemicals, and natural dyes could offer an alternative.

This project is an experiment with natural colours from everything around us, such as flowers, trees, roots and food waste. The intriguing process of finding out what colour a plant can give is always exciting and surprising, as the results often differ from what was expected – a flower can be one colour but the dye from it completely something else. With different mordants and modifiers several beautiful shades of colour can be obtained from the same plant.

Materials: Yarns, alum, potassium bitartrate, ferrous sulfate, baking soda, vinegar

Flowercycling

From Flower Waste to Sustainable Florist Supplies

Bingdie Huang
M.A. Contemporary Design

Irene Purasachit
M.A. Contemporary Design

While flowers are beautiful, they have an incredibly short lifetime. After months of nurturing and travelling across the world, cut flowers with any sheer imperfection will be thrown away even before reaching our hands. With the heart of sustainability, Flowercycling addresses the issue by turning discarded flowers into pulp and pigments, which are then used for making paper, flower leather and fibre bricks. As we aim to circulate the waste within the industry, the sample applications are directed towards a more sustainable alternative for florist supplies. Paper and flower leather can be made into bouquet accessories while fibre brick has the potential to further develop into a substitution for floral foam.

Iris and rose are used as the benchmarks for flowers with a soft and a hard stem.

Flowercycling has been done in collaboration with FloweRescue ry.

Materials: Wrapping paper: flower fibres (iris fibre, rose fibre), cooking oil, carnauba wax / Fibre Brick: flower fibres (iris fibre, rose fibre), calcium hydroxide ($Ca(OH)2$) / Flower Leather: flower petal powders, corn starch, vinegar, micro fibrillar cellulose (MFC), glycerine, pulp

Piceaney
Coatings from Picea Abies

Jasmin Hiekkamies
B.A. Landscape architecture

This experimentation concentrates on making a coating for natural materials from bio-based materials. The main ingredient in this project is found in our forests, from below Picea Abies bark. This spruce inner bark has UV protection and antibacterial properties in compounds called stilbenes. By extracting stilbenes with water and ethanol, you get warm-toned brown liquid. Combining extract with cellulose-based materials such high viscosity methylcellulose (MC) and cellulose diacetate (CDA), it produces a honey-like gel that can be applied on top of different surfaces. After air-drying it is still transparent with a hint of warm-tone, and it stays there without tearing itself apart from the surface. The coating is smooth and semi-waterproof.

Materials: Spruce inner bark, water, ethanol, methylcellulose (MC), carboxymethyl cellulose (CMC), acetone, cellulose diacetate (CDA)

Carbon Capturing Images

Aman Asif
M.A. Creative Sustainability

In collaboration with researcher Valentina Guccini
Department of Bioproducts and Biosystems

As the world becomes aware of the implications of the rising global temperatures there is a need for alternative solutions and inspiring visions for the future. Carbon Capturing Images explores the potential of Synechocystis (Cynobacteria) embedded in bio-based materials to create living images. These prokaryotic microorganism capture C02 by performing oxygenic photosynthesis. The living images were created by the microorganism growth within the nanocellulose and alginates matrixes. The images were also integrated in materials, for example in ornamental structures, lamps or earrings, in which they evolved with time as the microorganism were still able to grow and capture CO2.

The living element can change the way we relate to the materials we use. The lifespan of these products rely on how they are taken care of. Apart from the artistic and material experimentation the project can also be seen as a way to visualize and speculate what this kind of living material can look like beyond the lab setting and in our daily environments. It can spark debate about what kind of alternative futures we would like to have. Can you imagine a world where the posters on your wall and the jewelry that you wear could capture carbon and produce oxygen?

Materials: Nanofibrillar cellulose (NFC), Synechocystis (prokaryotic microorganism), BG11 growth medium, sodium alginate, calcium chloride

C. Filament

Laura Rusanen
M.A. Fashion, Clothing and Textile design

Project C. Filament looks into how we could utilize Cladophora glomerata, one of the most common filamentous algae in Finland. Filamentous algae cause excessive richness of nutrients in the Baltic Ocean, one of the most polluted seas in the world.

Cladophora's fibres are weak as such, and to create these samples they have been mixed with nanocellulose and cellulose derivatives to give strength to the material. The biodegradable mass was then extruded through a syringe into the desired shape. This method eliminates the traditional yarn spinning and the labor of preparing the fabric when it's extruded directly into the shape of a net.

Materials: Cladophora glomerata, nanofibrillar cellulose (NFC), carboxymethyl cellulose (CMC), methyl cellulose (MC), aqueous calcium chloride (CaCl2) solution

Playing for the Future

Ruut Launo
B.A. Design

At the moment children play with toys that will stay on this planet longer than themselves. My aim was to create an experimental material for new kinds of toys that spark the imagination, and at the same time educate children about the material world. Combining cellulose-based substances with potato starch and pulp allowed me to create and sculpt durable 3D shapes. These experiments then led into a playful family of unique characters, which are wood-based and manufactured from Finnish ingredients. In the future, they can offer a more sustainable option for plastic toys.

Materials: Methyl cellulose (MC), carboxymethyl cellulose (CMC), microcrystalline cellulose (MCC), microfibrillar cellulose (MFC), potato starch, pulp, lignin, eggshell, sand, cellulose diacetate (CDA), glycerol, mineral colorants

Biodegradable Beauty Masks

Noor Agourram
B.Sc. Chemical Engineering

The facemask sheets displayed here are not like the ordinary ones. These are fully biodegradable and free from any potential microplastics, a huge problem in the cosmetic field at the moment. The facemask sheets are composed of cellulose-based and natural materials infused with active ingredients that heal and rejuvenate the skin. Dip the mask into water to activate the ingredients and place it onto your skin!

As I wanted to showcase a thought-out life cycle of the product, I prototyped a package which, too, is bio-based. The adhesive used to hold the packaging together is a thin coating of methyl cellulose (MC) instead of a regular synthetic glue. This means that the packaging alongside the mask are both recyclable and biodegradable.

Materials: Cellulose, methyl cellulose (MC), natural ingredients such as berries and plants


NOOR
SKINLAB
Revitalizing
-LIPMASK-
Vitamin boost from the Finnish nature
Contains rose petals, mint, apple and xylitol to hydrate
& give a fullness-boost to the lips
Both the mask and the packaging are 100% biodegradable.
Throw us in the bio-bin after use!
100% vegan and cruelty free.
100% from the nature.
No microplastics.
No unnecessary waste.

Utu

Riikka Savolainen
B.A. Interior architecture

The project is inspired by a furniture design course, where the assignment was to design a lamp. Utu explores replacing plastic in diffusers that are used in lamps to hide the light source and to make light softer. This project aims to create bio-based prototypes to be used in future lamp designs. Many experimentations produced dome shaped samples and sheets that let the light trough beautifully and get their fogginess from potato flour.

The color choices are inspired by wanting to make something colorful with bio-based materials that are often presented in earthy tones.

Materials: Nanofibrillar cellulose (NFC), potato flour, glycerol

Tones of The Unwanted

Tessa Dean
M.A. Creative Sustainability

Tones of The Unwanted is a colour exploration delving into the lost potential of natural resources that we deem waste. The project applies manual handcrafting methods to create biodegradable artist's paints that live and transform before they expire. The majority of the dyes used in the project are cold-extracted from the petals of waste flowers provided by the project partner FloweRescue ry.

In order to increase the locality of the paints, yet achieve desirable applicability, gum arabic has been substituted with nanocellulose derivatives as the binder. An important aim for the project is to encourage artists to engage more with basic natural colourant production in order to promote self-sufficiency, resource-efficiency and tacit knowledge.

Materials: Natural dyes, hydroxypropyl cellulose (HPC), carboxymethyl cellulose (CMC), glycerol / May also contain: white sugar (mixtures marked B), microcrystalline cellulose (MCC)


dried petals
RED ROSE
dried petals
POPPY
dried petals
RED GLADIOLA
dried petals
LILY
dried pollen
YELLOW ROSE
dried petals
ORANGE ROSE
dried petals
ORANGE ROSE
dried petals
JAPANESE ROSE
dried petals
IRIS - A+MCC
Diluted. Filtered.
Stored cold.
PINK PEONY - A+MCC
Diluted. Filtered.
Stored cold.
RED TULIP - A+MCC
Diluted. Filtered.
Stored cold.
RED POPPY - A+MCC
Diluted. Filtered.
Stored cold.
RED GLADIOLA - B+MCC
Diluted. Filtered.
Stored cold.
RED GLADIOLA - A+MCC
Diluted. Filtered.
Stored cold.
PINK ROSE - B+MCC
Diluted. Filtered.
Stored cold.
PINK ROSE - A+MCC
Diluted. Filtered.
Stored cold.
YELLOW ROSE - A+MCC
Diluted. Filtered.
Stored cold.
LILY POLLEN - A+MCC
Diluted. Filtered.
RED ROSE
MAGENTA ROSE
PURPLE COLUMBINE
RED ROSE
RED ROSE
PINK ROSE
MAGENTA ROSE
PURPLE IRIS
RED ROSE
YELLOW ROSE
JAPANESE ROSE

Hemp Wallpaper

Mira Niittymäki
B.A. Design

Hemp is a strong, fast growing and versatile material that has been used for papermaking way before trees. In this project I wanted to create a naturally beautiful wallpaper collection from it. My aim was to use the sidestream from Finnish hemp oil production: fibres that are left in the fields when the seeds are harvested.

This wallpaper is fully biodegradable and can be cleaned by wiping with hot water. It is also easy to use since the adhesive is already in the paper so it only needs to be sprayed with water in order to apply it. In the future I would like to see more hemp used in the paper industry to ease the pressure off from our forests.

Materials: Hemp fibres, spruce needles, methyl cellulose (MC), glycerol, flowers, calcium hydroxide

Temporal Surfaces

Hilla Ruuska
B.A. Costume design

Costume design field has a huge variety of imaginative surface manipulation methods to achieve effects from fantastic to disgusting. Unfortunately most of them rely on materials that are not only bad for our planet, but also make the final costume impossible to recycle. The use of such problematic materials for costumes that don't need to last longer than their performance run, or a single scene in a film, is unsustainable and calls for improvement. My aim with this project is to explore ways in which the lifespan of a costume could be optimised for its purpose using cellulose derivatives and other bio-based materials to manipulate the surface of a fabric in a way that would allow the effect to be undone, and the materials could be circulated after the use.

Materials: Methyl cellulose (MC), carboxymethyl cellulose (CMC), sodium dodecyl sulfate (SDS), glycerol, potato starch, vinegar, baking soda, water, various organic colorants and materials from nature

Betulina
Ancient Remedies Rediscovered

Sonja Dallyn
B.A. Design

Linh Tong
B.Sc. Chemical Engineering

Inspired by Finnish nature, Betulina is a minimally designed bandage that is activated by water. It consists of three biodegradable layers: a water-resistant chitin coating, a skin-safe adhesive-layer, and a non-adhesive healing-layer. The product is derived from natural ingredients, with 80% from Fomitopsis Betulina, the Birch Polypore. All chemical processing is minimized.

Birch Polypore has been used in traditional medicine all around the Northern Hemisphere for over 5300 years. In recent years, there has been a growing interest within the medical and scientific communities to truly understand the effects and potential applications of this abundant fungi. The notable properties of F. Betulina in medical applications include anti-inflammatory, anti-bacterial, antiviral and antiseptic agents. Betulina offers a simple solution to harness the fungi's natural drug cocktail and moisture absorbing qualities into use as a medical bandage.

Materials: Fomitopsis betulina, microcrystalline cellulose (MCC), carboxymethyl cellulose (CMC), glycerol, sodium hydroxide (NaOH), baking soda

Unwasted Invaders

Niina Hyry
M.A. Contemporary Design

Some plant species are known as 'invasive alien species' and also classified as harmful. The reason for this is their aggressive spreading and threat to fragile local ecosystems. I wanted to take one of these well-known unwanted plants, large-leaved lupin (Lupinus polyphyllus), and try to find its usable features.

I divided the plant into different parts and performed experiments on its materials. Fibres, wooden stem parts, natural colors, together with methyl cellulose, beeswax, and modified recipes from The Chemarts Cookbook were combined for new, experimental materials. These unwanted plants, lupins, were used for textile dyes, paper sheets and bowls.

Materials: Plant parts (stem fibres, stems, flowers, leaves), methyl cellulose (MC), hydroxypropyl cellulose (HPC), pulp, beeswax, alum, glycerol, gum arabic, chalk

Shape-shifting Cellulose

Kitty Zheng
B.A. Architecture

Shape-shifting Cellulose project explores the inherent moisture-reactive properties of cellulose. This project is inspired by research on shape-memory polymers, which can remember pre-determined shapes by exposure to stimuli such as light or heat. Often, deformations caused by water in cellulose based prototypes can be a problem. Instead of treating water-reactivity as a problem, this project aims to use the property as an advantage, offering a bio-based alternative to petroleum-based shape memory polymers.

The project consists of various experiments with extruded shapes and bilayer sheets, which transform from their initial shape as they are exposed to moisture by spraying with water or increase in humidity.

Materials: Peanut shell, microfibrillar cellulose (MFC), nanofibrillar cellulose (NFC), carboxymethyl cellulose (CMC)