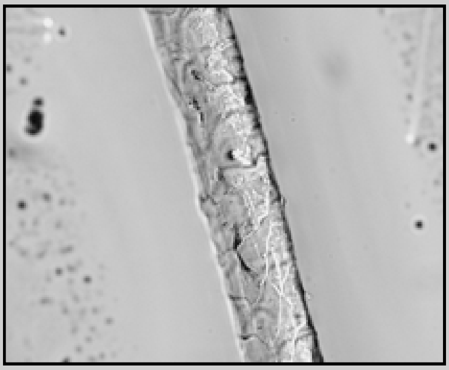
EXIT- posters

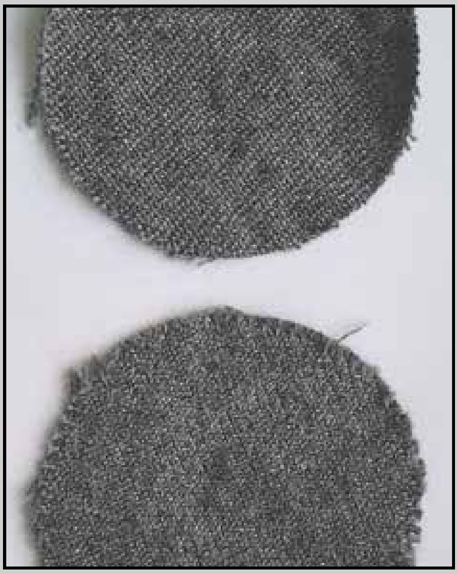
Graduates 2025

Master's programmes in
Textile Technology
and Innovation

Water and wind resistant wool fabric - Weaving with Gotlandic Swedish semi-worsted yarns

Moa Ekvall, MSc Technical Textile Innovation





Aim:

- Developing a fabric for outer layers that offers light to medium protection against rain and wind.
- Increase the utilisation of female Gotlandic sheep wool, a fibre that is available in large quantities and need to be put to usage.

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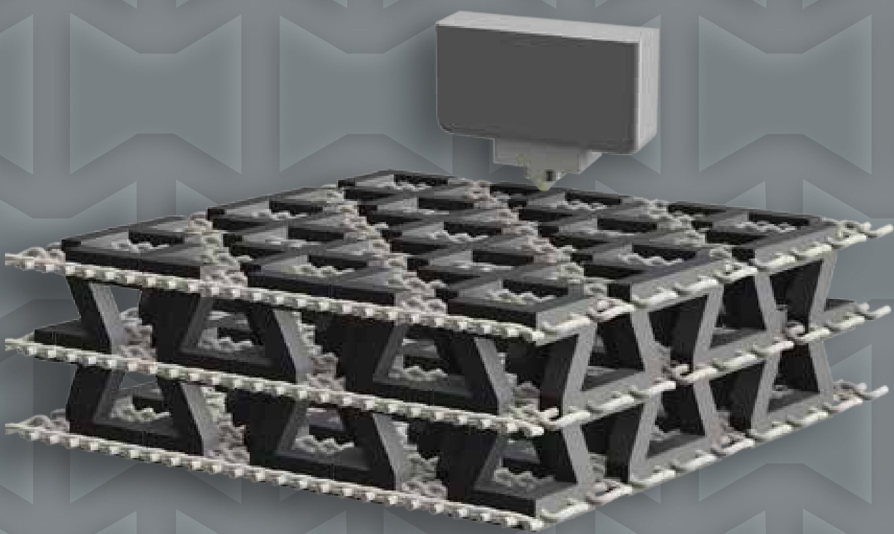
3D-PRINTED AUXETIC STRUCTURES WITH TEXTILE INTEGRATION

– Design Towards Adaptive Textile Hybrid Systems



An experimental study on how textile integrations affect the auxetic properties of re-entrant metamaterial.

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Izabell Gustafsson
Master Programme in Technical Textile Innovation
(TAMTI23)

THE ROLE OF EGGSHELL-DERIVED BIOCERAMIC COATINGS ON TEXTILE SCAFFOLDS FOR BONE TISSUE ENGINEERING

How might textile engineering and eggshells advance the circular economy and healing of broken bones?

THE NEED

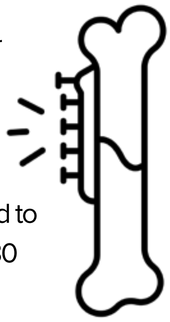
Eggshells are underutilized—but they're a promising renewable calcium source

Conventional metal implants don't support natural healing and remain in the body

Textile engineering offers a biocompatible, biodegradable alternative—designed to heal

1/3 patients experience chronic pain after bone graft harvesting, a common treatment for bone fractures

2.7 million tons of eggshells are expected to be wasted globally each year by 2030



OBJECTIVES

Turn waste into value
Instead of discarding eggshells, show how they can be turned into useful material for medical applications.

Engineer an improved implant
Develop a biodegradable scaffold that supports the body's natural healing process.

Evaluate scaffolds
Study how human cells interact with the scaffolds in the lab to see if they are safe and can support the cells towards heling the bone.

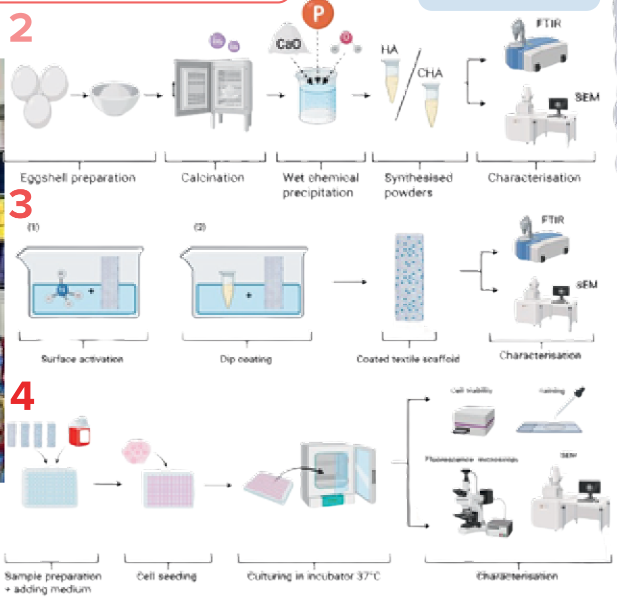
THE METHOD

1 PHA filaments fabricated through braiding → *Biodegradable Textile Scaffold*

2 Bioceramics produced from eggshells → *Hydroxyapatite (HA)*; *Carbonated Hydroxyapatite (CHA)*

3 Bioceramic coatings applied on the textile scaffolds → *100% HA*; *100% CHA*; *50/50% HA/CHA*

4 Bioceramics coated scaffolds tested for biocompatibility and bone-forming potential



THE FINDINGS

Eggshells → bioceramics:
- HA and CHA were successfully turned into bone-like inorganic materials (HA and CHA) from eggshells, with yields of 47% and 49%, respectively.

Application of coating:
- Bioceramic particles were clearly observed on the surface of the textile scaffold using a specialized microscope.

Cells response:
- All scaffold types, coated and uncoated, were biocompatible.
- Coated scaffolds improved early cell attachment and spreading compared to uncoated.
- HA-coated scaffolds supported the stem cells to turn into bone-like cells.

WHAT IT ALL MEANS

- Eggshells can be recycled into useful bioceramics for medical use.
- The process was simple, low-cost, low-temperature and is promising for scalability.
- All materials were safe for stem cells without showing any toxic responses.

→ Cells survived on biodegradable textile scaffolds with bioceramic coatings: a way towards sustainable and effective bone healing treatments.

FUTURE IMPACT

Circular Economy Turning food waste (eggshells) into high-value biomedical materials.

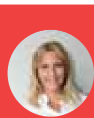
Medical Innovation A less invasive, more natural solution for patients needing bone healing treatments

New Avenues for Textile Engineering Demonstrating how textile technology can power healthcare solutions.

UNIVERSITY OF BORÅS

REACH OUT TO ME FOR A DEEPER DIVE

JULIA BELLVIK
BORÅS | JULIA.BELLVI @GMAIL.COM



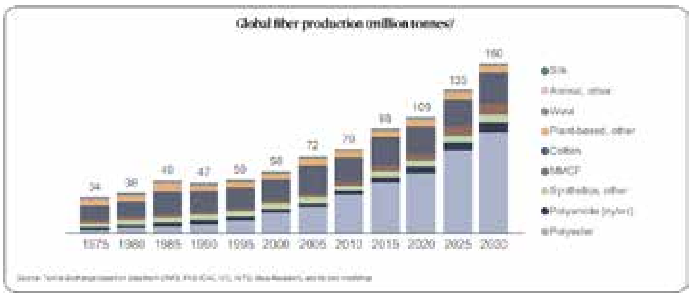
Cellulose Isolation and Wet Spinning of Protein Extracted Clover Grass

- Material and Process Development of Non-Wood Regenerated Cellulose Fibres

Julia Ronkainen
Master Student in Textile Technology
University of Borås

BACKGROUND:

- There is a globally increasing demand for textiles
- A cellulose gap has been identified, a larger demand than supply
- Non-wood regenerated cellulose fibres have sustainable growth potential



This thesis is part of the EU project Green Valleys 2.0, where **green biorefineries** are explored to process grass and clover into different fractions:

- **Primary product:** Protein for animal feed to replace imported soy
- **Biproduct:** Fibre-rich protein extracted clover grass (press cake)

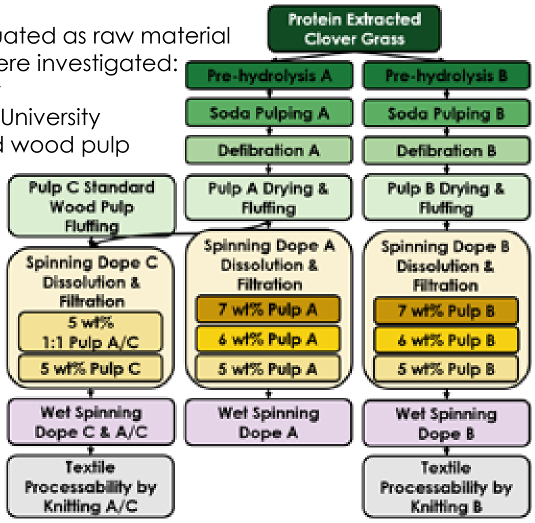
Growing grass and clover is beneficial for:

- Biodiversity
- Increased soil carbon storage
- Reduced nutrient leakage
- Positive crop rotation effects, e.g. minimised weed

Hypothesis: Compared to a conventional regenerated cellulose fibre, the regenerated cellulose fibre from protein extracted clover grass will have equal performance.

THESIS SCOPE:

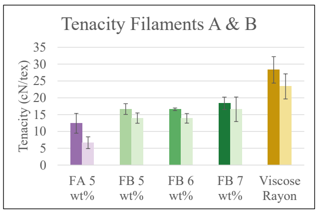
Protein extracted clover grass was evaluated as raw material for textile production. Three scenarios were investigated:
A: Pulp produced at Chalmers University
B: Pulping process refinement at Aarhus University
C: Blending 50/50% pulp A with standard wood pulp

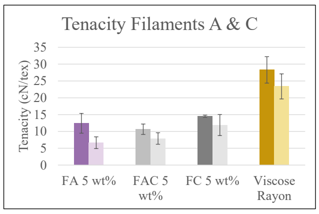


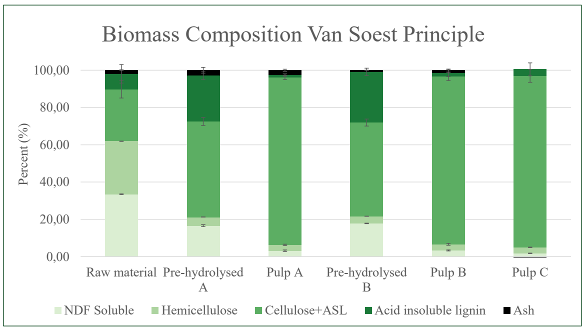
Analysation Method/Material	Protein Extracted Clover Grass	Pre-hydrolysed Biomass	Pulp	Spin Dope	Filament Yarn
Van Soest Principle*	X	X	X		
CHN(O)S		X	X		
FTIR			X		
Crossover Point				X	
Polarised Microscope				X	
Lightness*					X
Linear Density, Elongation at Break*, Tenacity* & Initial Modulus*					X
Cross-Section Shape					X
Textile Processability by Knitting					X

RESULTS & CONCLUSION:

- **Protein extracted clover grass is suitable for textile production!**
- Cellulose isolation of protein extracted clover grass is possible with high purity
- Process refinement (scenario B) resulted in filaments more similar to viscose
- Textile processability was achieved by both process refinement (scenario B) and blending with 50% wood pulp (scenario C)







I'm forever grateful to everyone who has been involved. Thank you!

THE SWEDISH SCHOOL OF TEXTILES UNIVERSITY OF BORÅS
AARHUS UNIVERSITY DEPARTMENT OF BIOLOGICAL AND CHEMICAL ENGINEERING
CHALMERS
WARGÖN INNOVATION
GREEN VALLEYS

SUSTAINABLE WOOD FIBERS FOR AUTOMOTIVE TEXTILE APPLICATIONS

Authors Kashif Munir (1), Sumit Sharma (1), David Maibach (2), Anneli Wärn (3)

Affiliations (1) University of Borås; (2) Polestar; (3) Borgstena

ABSTRACT

With rising demand for sustainable alternatives in the automotive textile sector, this study explores a hybrid method for extracting wood-based fibres using mechanical drafting and ultrasonic vibration. Initial tests analysed fibre properties using FTIR and single fibre testing. Ultrasonic treatment, applied post-drafting, improved fibre looseness and separation efficiency. Cavitation forces aided lignin and pectin removal, reducing the elastic modulus from 8 GPa to 3.4 GPa, indicating 58% decrease and enhancing flexibility and spinnability. This eco-friendly approach offers a scalable solution for sustainable fibre production.

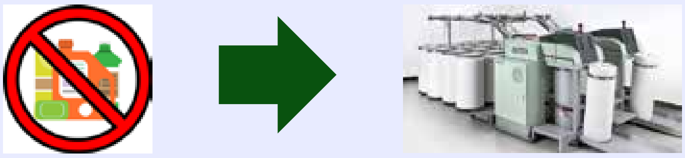


Figure 1: Replacing Chemical Treatments with Mechanical Methods

RESULTS

The hybrid method significantly improved fibre separation. Mechanical drafting at a 45° angle led to better fibre opening compared to axial feeding. When followed by ultrasonic treatment at 360 W and 100% amplitude, separation efficiency increased markedly, particularly in pre-drafted samples. The elastic modulus dropped from 8.0 GPa to 3.4 GPa—a 58% reduction—enhancing flexibility and spinnability. Post-treatment fibres also showed improved elongation and cleaner filtrates, validating the effectiveness of combining mechanical and ultrasonic methods for sustainable fibre processing.

CONCLUSION

This study demonstrates that combining mechanical drafting with ultrasonic vibration offers an effective, chemical-free method for separating wood-based fibres. The hybrid approach improved fibre flexibility, separation efficiency, and spinnability, making it a promising solution for sustainable textile applications, particularly in the automotive sector.

OBJECTIVE

The objective of this thesis is to develop a sustainable hybrid method for efficient separation and improved spinnability of wood-based fibres using mechanical and ultrasonic treatments without the use of any chemicals.

METHODOLOGY

The following methods were used to investigate and optimise the fibre separation process:

- Mechanical Characterization
- Chemical Characterization
- Mechanical Drafting
- Ultrasonic Treatments
- Fiber Characterization

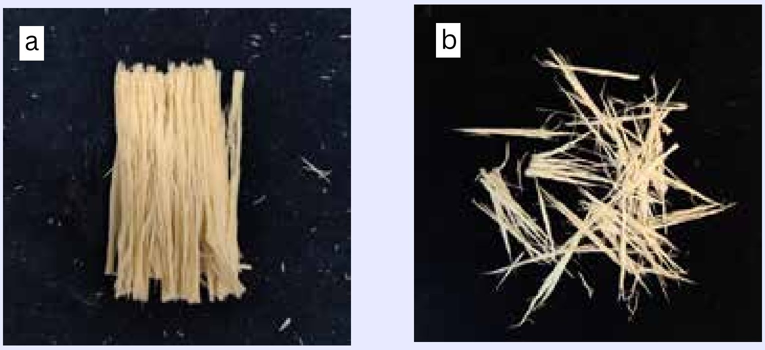


Figure 2. Results from Drafting. (a) Initial Sample with increased water content of 400% after passed through the drawing frame along the fiber axis (b) Initial Sample with increased water content of 400% after passed through the drawing frame at 45° orientation

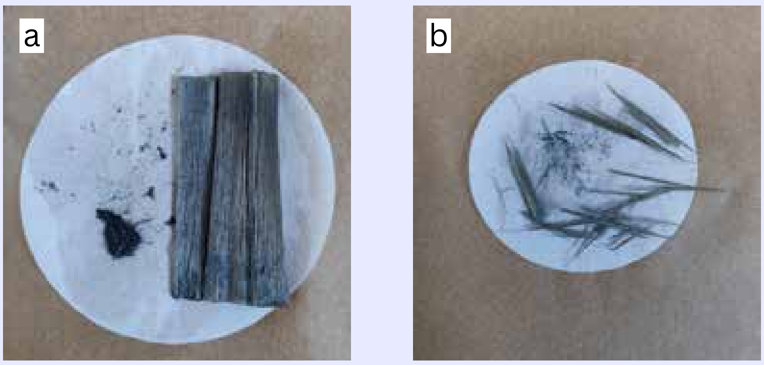


Figure 3: Results from ultrasonic treatments. (a) Filtrate obtained from the Ultrasonic treatment of untreated pulp (b) Filtrate obtained after the ultrasonic treatment of the sample passed through the drawing frame

REFERENCES

[1] Patil, S.V., Rane, A.V., and Kanny, K. (2022). Ultrasonic Cavitation: An Effective Cleaner and Greener Intensification Technology.

[2] Majeed, K., Khan, S., and Nasir, A. (2023). Innovative Design of a Continuous Ultrasound Bath for Effective Pretreatment of Lignocellulosic Biomass.

[3] Singh, J., Kumar, A. and Sharma, S. (2022). Hydrodynamic Cavitation for Lignocellulosic Biomass Pretreatment: A Review. Bioresources and Bioprocessing.

MASTER PROGRAM IN TECHNICAL TEXTILE INNOVATION
Final Thesis Project

Biomimicry- Inspired Reusable Incontinence Pad Development

Presented by Dilma Kulasena

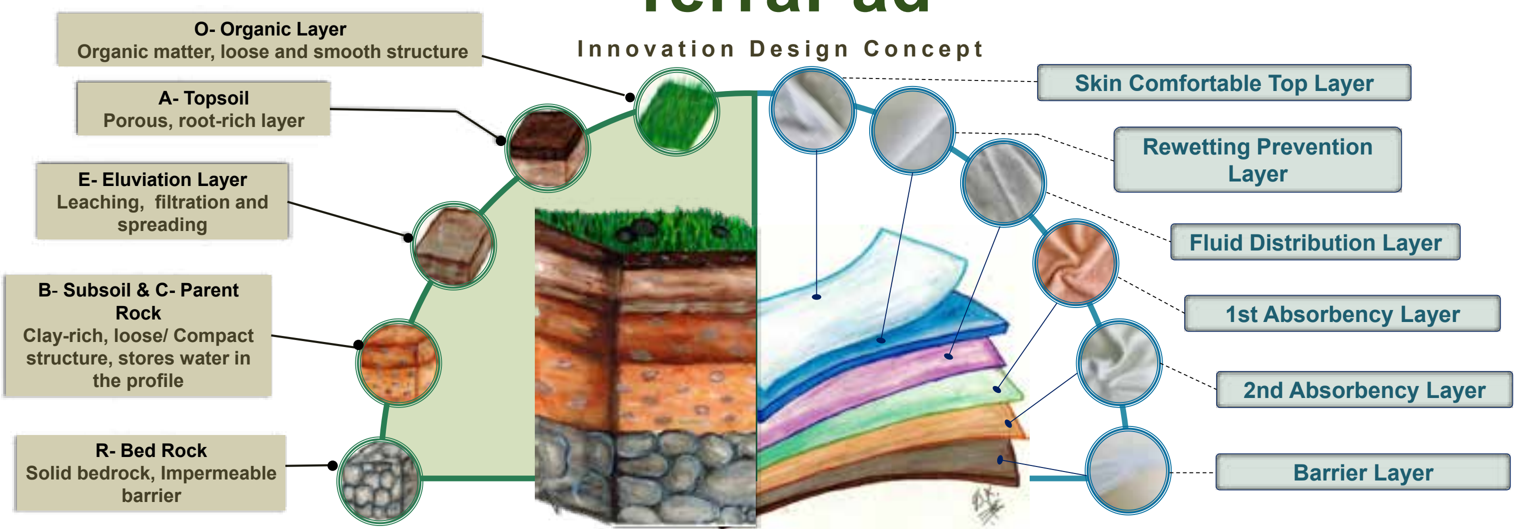
UNIVERSITY OF BORÅS

Abstract

The project aims to explore effective product development by evaluating biomimicry innovation theory to create a lightweight product with maximum performance. The purpose is to enhance the quality of life for users and promote environmental sustainability by reducing waste from disposable products.

TerraPad

Innovation Design Concept



Problem Description

- Approximately 40% of women and 11% of men experience light urinary incontinence[1].
- Disposable product pads produce over 6,600 tons of solid waste daily[1]

Material & Method

- Material structure analysis

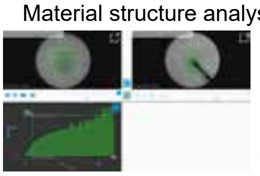


Figure 1. *Fluid spreading analysis*

Figure 2. *Microscopic analysis*

- Fluid absorption, rewetting, leakage, retention capacity, vertical spreading and horizontal spreading analysis

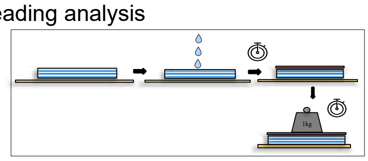


Figure 3. *Retention, leakage and rewetting test procedure*

- Prototype design and testing

Results

- Prototype design and testing

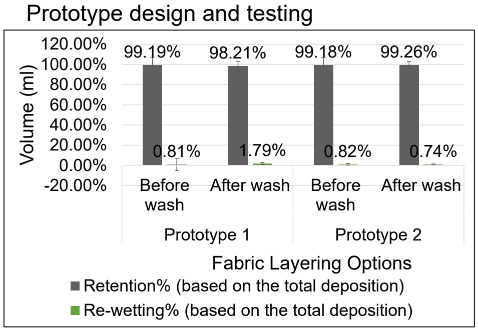


Figure 4. *Prototype testing before and after 10 wash tests,*

	Absorption Capacity (ml)	Average Weight (g)
Prototype 1	199.25	33
Prototype 2	136.7	25

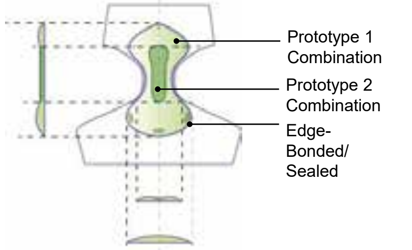
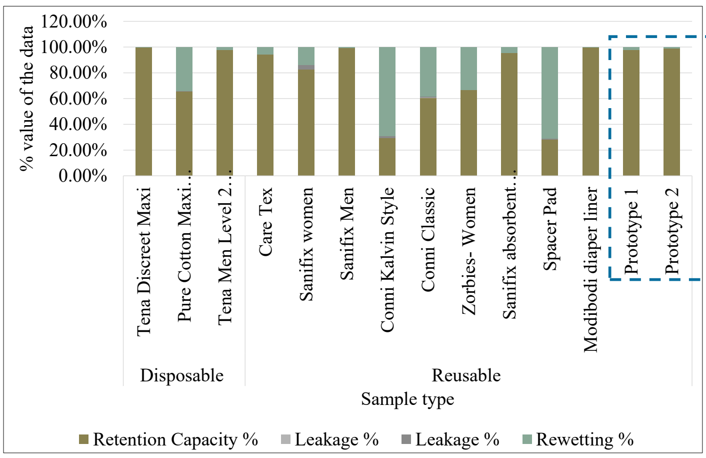


Figure 5. *Prototype test results and performance*



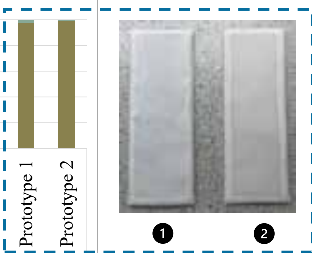


Figure 6. *Prototype functionality comparison with the other reusable and disposable incontinence*

Video Introduction

Conclusion

The biomimicry of soil horizon theory aligns well with human fluid absorption and retention-related developments in textile-based products.

Examples: Advanced wound dressing (provides moisture control, fluid absorption and bacterial filtration), Bioactive components (healing while oxygen permeability), menstrual pad, Smart bandages for burns (natural healing)

Acknowledgement

All the lecturers and academic staff of the University of Borås

References

[1] Minassian, V.A., Bazi, T. & Stewart, W.F. (2017). Clinical epidemiological insights into urinary incontinence. *International Urogynecology Journal*, [online] 28(5), pp.687–696. doi:https://doi.org/10.1007/s00192-017-3314-7.

Kulasena, 28.05.2025

SMART TEXTILES FOR STROKE REHABILITATION

A STUDY WITH A HUMAN CENTRED DESIGN APPROACH TO EXPLORE THE USABILITY OF A SMART TEXTILE BIOFEEDBACK SYSTEM WITH SEMG FOR HOME-BASED AND CLINICAL STROKE REHABILITATION

AUTHOR

Saga Ingerholt. Master student in Technical Textile Innovation (TAMTI23)

AFFILIATIONS

Swedish School of Textiles

INTRODUCTION

STROKE IS ONE OF THE LARGEST REASONS FOR ADULT DISABILITY AND AMONG THE MOST COMMON POST STROKE CONDITIONS IS MOTOR DISABILITIES IN UPPER LIMB. THIS EFFECTS THE EVERYDAY LIFE AND INDEPENDENCE OF STROKE SURVIVORS. SMART TEXTILES THAT CAN MEASURE AND COMMUNICATE THE MUSCLE ACTIVITY USING TEXTILE ELECTRODES COULD HELP WITH AN ENGAGING REHABILITATION THAT COULD BE PERFORM IN HOME ENVIRONMENTS. THIS COULD SAVE RESOURCES IN THE HEALTHCARE AS WELL AS INCREASE THE LIFE QUALITY FOR INDIVIDUALS.

AIM

The aim of this study is to explore how smart textiles with biofeedback can support upper limb stroke rehabilitation by identifying user needs and evaluate these from a Human Centred Design approach

METHODOLOGY

Thie methodlogy used fror this study was **Human Centred Design** using a qualitative approach:

- Semi structured Interviews - analysis **FITT-framework.**
- Focus group discussion (evaluation)
- Low, mid and high fidelity prototyping

Participant were professionals working with stroke rehabilitation and included physiotherapist and occupational therapists.

RESULTS/FINDINGS

The semi-structured interviews resultet in three main user needs:

- The technologu should be easy to understand and use
- The technology should motivate the patient to perform training
- The technology should inlude functional movements

These needs were used to evaluate low-mid fidelity prototypes in a Focus group discussion which then resulted in two final high fidelity prototypes.

- Prototype 1: Targets muscles in hand and forearm
- Prototype 2: A full sleeve that targets muscles in both forearm and upper arm

Previous research developed at The Swedish School of textiles which is the foundation for this study. A knitted sleeve with sEMG electrodes and biofeedback.

Final Prototype 2: A full sleeve that can enable rehabilitation of the whole arm.

BIOFEEDBACK ENABLE REAL TIME COMMUNICATION OF THE MUSCLE ACTIVITY MEASURED BY THE SEMG ELECTRODES. THE ACTIVITY IS SHOWN IN AN APP AND ENABLES REHABILITATION.

SUGGESTED LAYOUT DESIGN OF THE APP CONNECTED TO THE TEXTILE SLEEVE WERE CREATED. THE APP CAN HELP THE USER TO CHECK THE POSITION OF THE ELECTRODE TO ENSURE THAT THE SEMG ELECTRODES WILL CAPTURE THE MUSCLE ACTIVITY.

THE APP CAN SEND MOTIVATING MESSAGES DURING TRAINING TO HELP THE USER REACH THEIR GOALS. A PROTOTYPE OF THE APP WAS OUTSIDE THE SCOPE OF THIS STUDY, ONLY SUGGESTED DESIGN LAYOUT WAS PRESENTED.

DISCUSSION

The most significant finding was that the technology must be simple for a successful integration. This means few design features and few steps to operate.

Furthermore, lack of motivation and not being able to see the progress are challenges that many stroke survivors face. This is connected to usability and that the technology must be simple to understand, otherwise the technology might be opted out. This supports the Human Centred Design approach where the users are involved in the design process to always stay focus on the needs of the user.

CONCLUSION

Home based rehabilitation using a smart textile biofeedback system could contribute to less resources needed in the healthcare when looking at time and money. An effective rehabilitation would not only lead to less care needed for stroke related injuries but also an increased life quality for stroke survivors.

UNIVERSITY OF BORÅS

Supercritical carbon dioxide dyeing of cellulosic woven textiles using madder dye and gallnut mordant.

UNIVERSITY OF BORÅS

A. Sasindu Lakshani Silva
The Swedish School of Textiles, Borås, Sweden
sasindu13@gmail.com

Introduction

Supercritical carbon dioxide (scCO2) dyeing technology is identified as a greener dyeing technology for synthetic materials. But the usage of scCO2 dyeing for cellulosics is challenging due to the inability to make the reactive dyes solvable in scCO2 and the inability of non-polar scCO2 to weaken the strong hydrogen bonds and swell the cellulosic fibers to facilitate the reach of dyestuff into the inner fiber structure. This research explores the ability of madder (Rubia Tinctorum L.) as a natural dye and gallnut (Quercus Infectoria) as a natural mordant in scCO2 dyeing with the collaboration between the university and the industry (Mission 0 House) aiming at omitting emissions in the industry. The experimental work is conducted in laboratory settings and only cotton and modal are examined as cellulosic fibers.

Materials & Methods

Experimental planning

- A four-factor full factorial design is utilised.
- High-level parameters are color-coded with white and low-level parameters are color-coded with yellow.

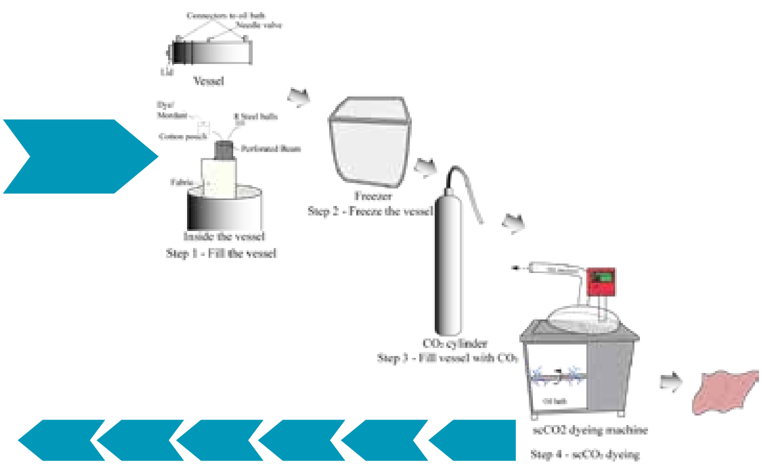
Factor	Level (+)	Level (-)
Mordant concentration (wt%) - m	1	0
System temp (°C) - t	150	120
Dyeing time at max temp (Same ramping speeds) - d	60	90
Auxiliary addition - Water (wt%) - w	50	0

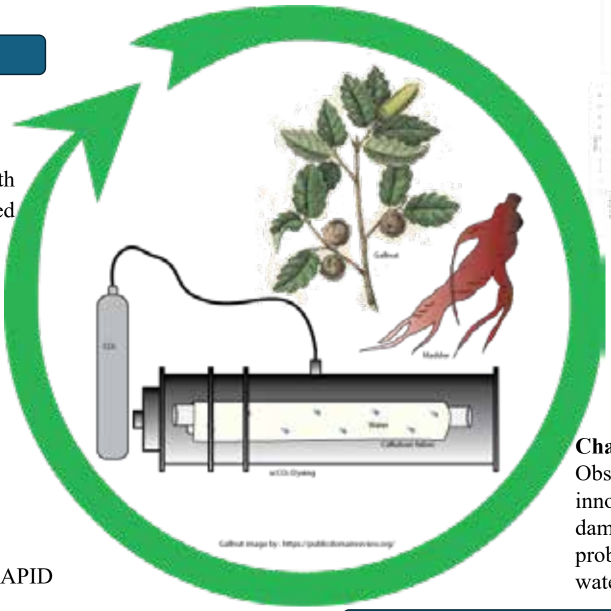
Main materials used

- 50/50cotton/modal woven fabric
- Madder Rich Extract powder
- Finely ground Gallnut
- De-mineralized water

Dyeing and Finishing

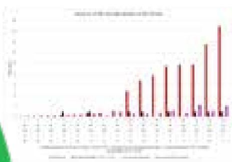
- Dyeing was performed in LABCOM – RAPID COLOR CF/SF TYPE LA2002 machine

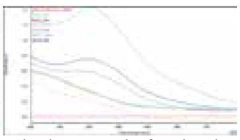




Results

- Dye uptake - $\hat{Y} = 0.48855m + 0.00401t - 0.00403d + 0.01174w$; $0 \leq m \leq 1,\ 120 \leq t \leq 150,\ 60 \leq d \leq 90,\ 0 \leq w \leq 1$
- Cotton showed significant dye uptake than modal.
- Color levelness is negatively influenced by the presence of water and initial creases of the raw fabric.





Absorbance graph for the de-mineralized water in pH 7 and dye in different pH levels.

Sustainability and Innovation

Advantages;
Safe materials, waste as input, creating agriculture & processing related jobs, circular technology, reduced water consumption

Challenges;
Obsoleting existing industry by a disruptive innovation, water and land consuming, risk of damaging current ecosystems, consistency related problems with plant-based material, inability to omit water consumption

Conclusion

- Madder shows the possibility to use in scCO2 dyeing for cellulosics.
- Dye uptake is positively influenced by the presence of mordant, water, and the increment of temperature while duration affects negatively.
- The presence of water in the fabric highly affects the color levelness in a negative way. Water added to the system should be optimized to achieve both dye uptake and levelness.
- Madder dye is highly sensitive to pH changing color. So, measuring fixation using color data would not be a suitable method.

Future Research

- Observe effect of pressure and find optimum water to achieve both uptake and levelness.
- Explore the possibility of scCO2 dyeing focusing on cotton.
- Observe effect of an alkali on final color.
- Explore the possibility using pH sensitivity of Madder for a textile sensor.
- Find other ways to measure fixation.

Acknowledgment

Special thanks to University of Borås, Veronica Malm, Anneli Wärn, David Rehnlund Maibach

Mission 0 House BORGSTENA

References

Any Questions? Contact sasindu13@gmail.com

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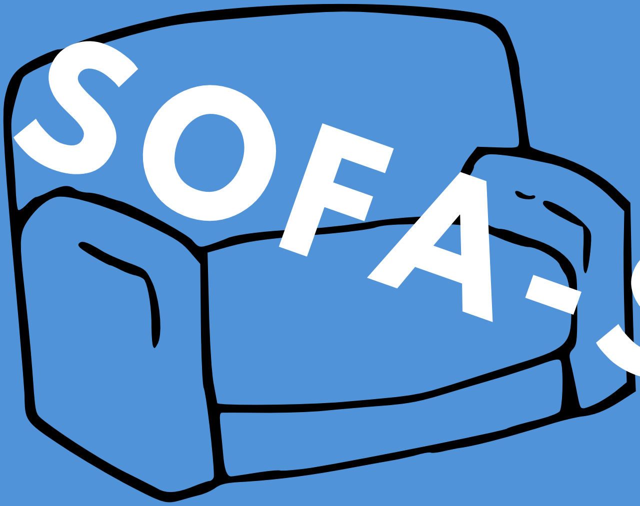

SOFA-STICATED DRAPE

BY

AUGUSTA JERKERSSON, SELMA SVENSSON

EVALUATING THE INFLUENCE OF FABRIC PROPERTIES ON DRAPE BEHAVIOUR IN UPHOLSTERY FABRICS INTENDED FOR THE USE OF SOFAS

AIM

The purpose of this thesis is to investigate fabric attributes, evaluate and conduct appropriate testing methods, and propose a value-ranking grid relating to the drape quality of fabric.

METHODS

Crease recover, air permeability, shear stiffness, fabric thickness and drape were measured. Data received from IKEA was also evaluated on bending stiffness and thread density in warp and weft direction, fiber composition, weave structure, backing, elasticity in warp and weft direction and weight. Statistical analysis were done using Pearson's product-moment correlation coefficient. P-values below 0.3 considered statistically insignificant.

RESULTS

Upon analysing the factors, it was found that the thickness, thread density and elasticity in the weft direction, shear angle and crease recovery in warp direction with the back side upwards had most influence on the fabric drape quality. However, only one of these properties reached a value of strong linear correlation, with a r-value of negative 0.617.

Factor	r-value
Elasticity Weft	-0.612
Shearing	-0.434
Thickness	-0.370
Thread density Weft	0.336
Crease recovery angle, back side, warp	-0.336

CONCLUSIONS

Creating a value-ranking grid based on correlations between the drape coefficient and other fabric attributes was possible, however further studies on the subject is necessary due to the many factors differing between the specimen.