"With the co-financing of Greece and the European Union"

Regenerated Cellulosic Fibers from Agricultural Waste

A research project to transform peach residues to sustainable textiles

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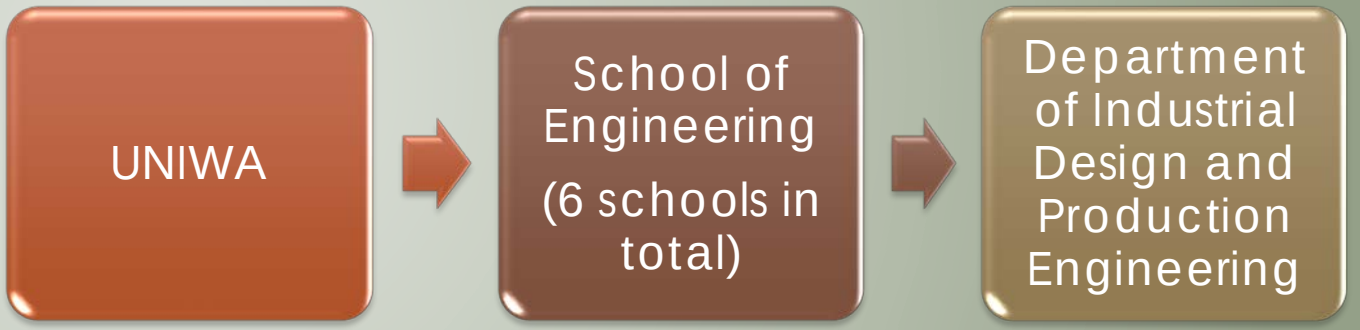
"UniWA is the third largest university in Greece with regards to the number of undergraduate students (in regular season) whereas it hosts over 50,000 students in total"

- The University of West Attica (UNIWA) was founded in March 2018. The foundation of the newly established University resulted from the merging process of the former Technological Educational Institute of Athens and the Piraeus University of Applied Sciences.



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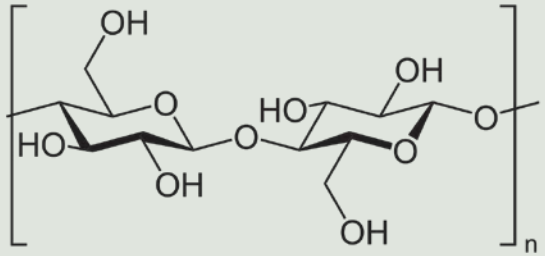
The idea

- In a climate changing environment, the sift to sustainable production is becoming a necessity.
- The increased activity in the modern agricultural sector produces plenty of wastes the handling of which is putting more pressure to the public waste management systems.
- Agro-wastes are annually renewable and a low-cost source for natural cellulosic fibres.
- There is a declining supply of natural raw materials in the textile industry making the utilization of agricultural waste fibre an attractive option to make use of the tremendous wealth of natural plant fibre which is currently discarded.
- Cellulosic crops such as cotton take up space from food because of their higher monetary value. Fashion may be considered to fuel food shortages.

The idea

- Greece: 5th place in world production of peach
- Processed peaches (compote, jams, juice) have been successfully exported all over the world + 98% of the canned peach produced in Greece is exported
- New fields are planted with peach trees for the food processing sector
- It is estimated that about 100.000 tons of peach residues end up in land fields

Extraction of cellulose research results



- Orange Fiber S.R.L. (Catania, Italy) utilizes a part of the huge amounts of wastes from Sicilian orange juice industry and produces a regenerated cellulosic fiber. The process is described in the patent application in detail.
- Extraction of cellulose from borassus fruit waste to create regenerated cellulosic film targeted to the packaging industry. (Reddy et al, 2017)
- Sugarcane bagasse waste as the raw material for regenerated cellulosic film. This method suggests pre-treating bagasse with steam. The results showed that the final cellulose pulp has a low percentage of lignin and a high percentage of alpha cellulose. (Phinichka & Kaenthong, 2018)
- Argan press cake, a powder generated from oil production of argan nuts as raw material to produce cellulose powder suitable for pharmaceutical and food applications. (Hu et al, 2017)
- Corn husk, is another source of agricultural waste that has been utilized for the purpose of extracting cellulose to create films. (Cao, 2010)

Methods for producing regenerated cellulose fibers

- Viscose method. Environmental disadvantages due to the use of chemicals such CS2
- Lyocell method with NMMO monohydrate as solvent that is recyclable.
- Use ionic liquids. Even though, remarkable results have been reported in cellulose dissolution and production of fibers using ILs, large scale production hasn't been achieved yet, since the processes require further optimization.
- Cellulose acetate process developed in large scale in 1923 to produce cellulose acetate fibers prepared from cellulose acetate flake. Research focuses to substitute acetone based dry-spinning technology with wet spinning technology with organic solvents such as NMMO. (Yuan, 2018)

The project

Innovative Bridal Dresses and Baptismal Clothes From Peach Textile With eco-Consciousness IBDPTEC

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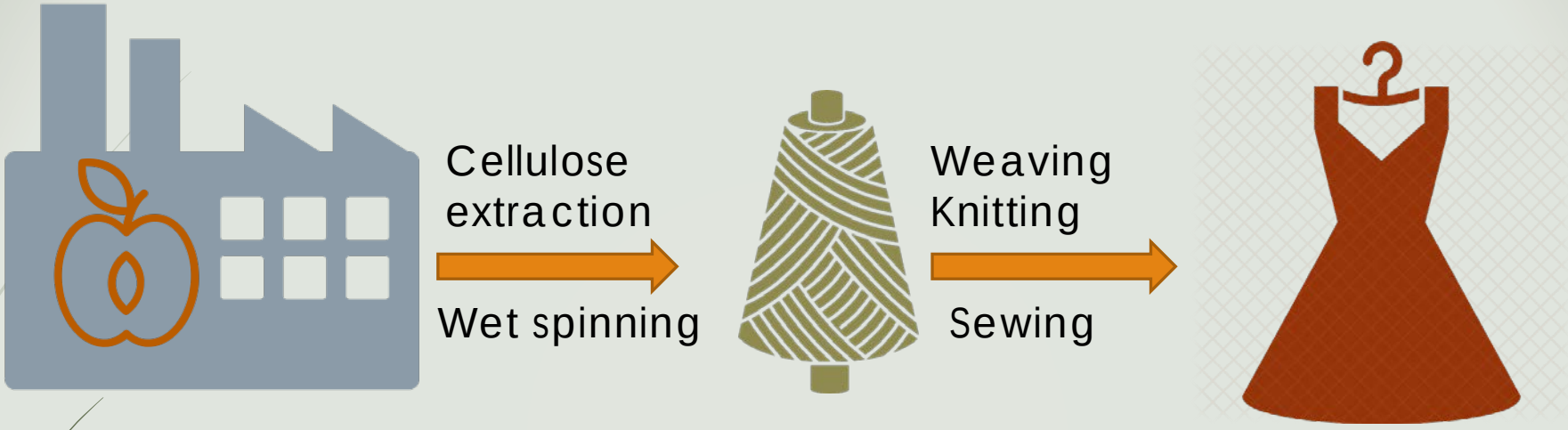
Targets



- Valorizing the peach wastes and turning them to luxury goods
- Use of eco-friendly processes
- Shift to ethical and fare trade fashion
- Circular economy
- Boost of collaborative initiatives between the food sector and fashion
- Reactivation/reinvention of the textile sector in Greece that has shrunk during the past decades

Methodology

IBDPTEC project steps include

- An extensive literature review of the state-of -the art technology to transform biomass to usable cellulose fibre.
- The development of the experimental process to extract cellulose from the food industry's peach residues by exploring different chemical and mechanical methods.
- The creation of the regenerated fibre via wet spinning to be used as raw material for the fabric production. The use of blends for strength or texture will be considered.
- Testing the final properties of the regenerated cellulose fibre/fibers developed.
- The analysis of the best possible type of fabric to be produced (woven, knitted) and its design in line with the final properties of the developed regenerated fibre or fibres.
- Testing the final properties of the fabric produced.
- The study of different dyeing methods.
- The final design of garments taking into consideration the specific properties of the prototype fabric that will be created.
- A capsule collection of bridal dresses and christening cloths made of the peach-cellulose fabric by Luccia B.

The partnership

Collaborating with :

HELLENIC MINISTRY OF RURAL DEVELOPMENT AND FOOD
HELLENIC AGRICULTURAL ORGANIZATION - DEMETER

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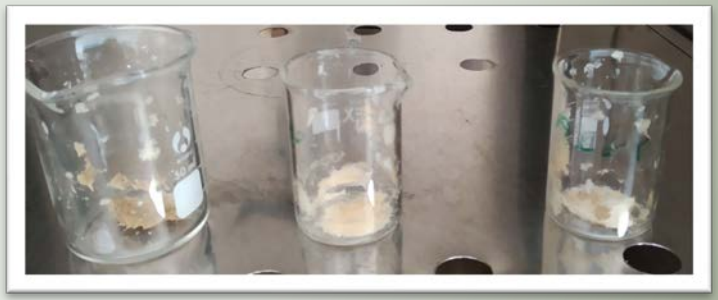
Preliminary results:
Cellulose Extraction from peach residues

Cellulose extraction optimization procedure

Core step	Optimization parameters
Raw material selection	• Form (flakes, ground) • Moisture
Pre-treatments	• Drying (sun, oven 70-100ºC) • Grinding-sieving (1-3 mesh)
De-fatting	• +/- Acetone
Bleaching	• H_2O_2 treatment (tissue : solvent, time, temperature) • O_3 treatment (concentration, time)
Cleaning	• Acid treatment (acid, tissue : solvent, time, temperature) • Alkali treatment(tissue : solvent, time, temperature)
Final processing	• Drying (30-50º C)

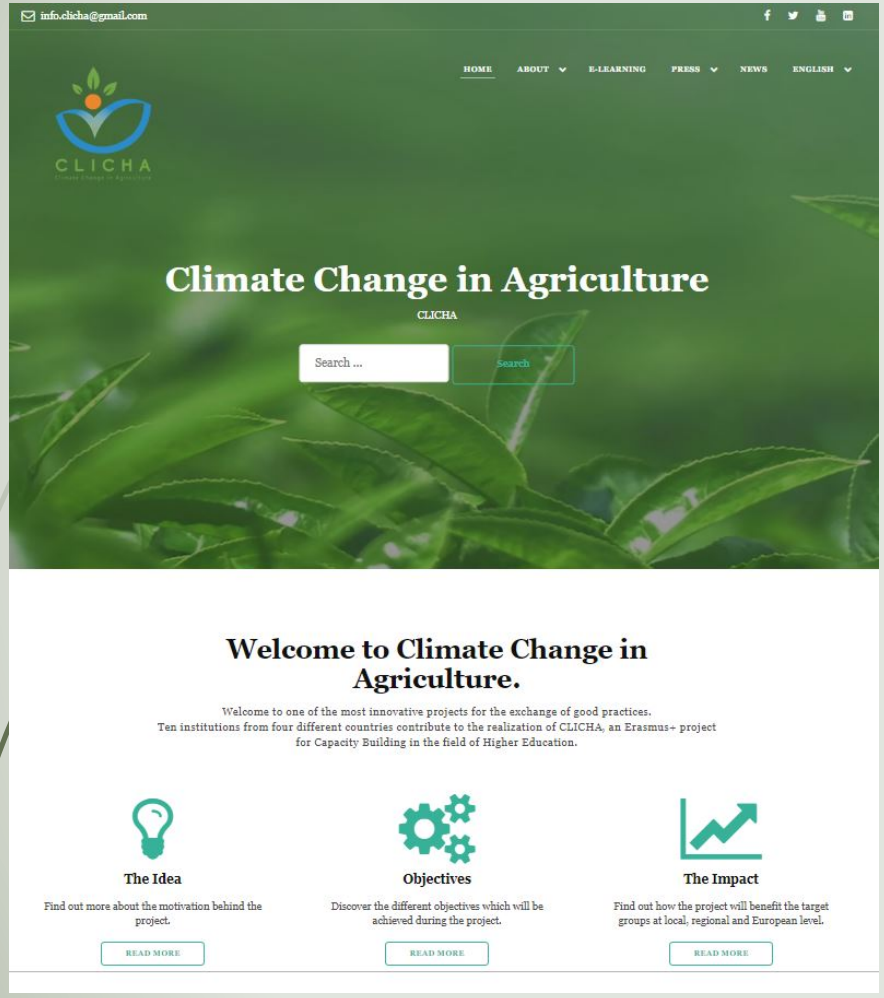
Cellulose extraction data

Core step	Implemented parameters
Raw material selection	• Form: Flake form from industry without primary processing • Moisture: 80%
Pre-treatments	• Drying: Sun dried for 48 h; Oven dried at 100°C for 24h • Grinding-sieving at 1 mesh
De-fatting	• Acetone: tissue:solvent = 1:1
Bleaching	• H_2O_2 30% v/v (tissue : solvent = 1:50, 2h, 70°C)
Cleaning	• Acid treatment: Formic:acetic acids = 1:1 (tissue : solvent = 1:10, 30 min, RT) • Alkali treatment: NaOH 20% w/v (tissue : solvent= 1:10, time= 1.5h, 70°C)
Final processing	• Drying (50° C, 12 h)



Final product > 90% cellulose; efficiency = 10%

Other projects



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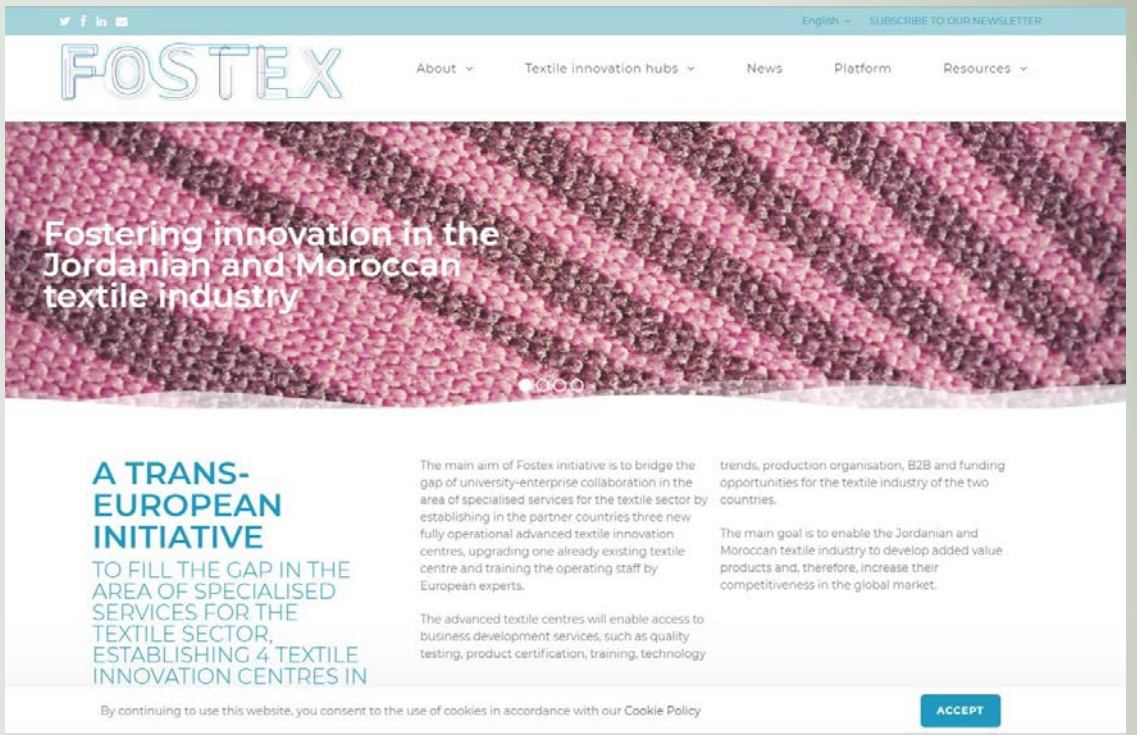

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Thank you for your attention!