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Erasmus+ Programme  
of the European Union



# Experience of Morocco in in the Area of Advanced Textile Sector

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R&D Director ESITH



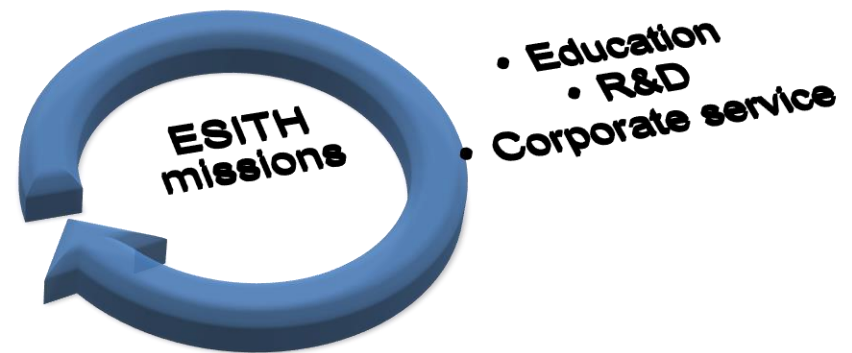
# Outline



- ESITH in brief
- Portrait of the Textile-Clothing (TC) sector in Morocco
- Strengths of the TC sector
- Ecosystems of the TC sector
- Technical Textile in Morocco
- Research and development
- Innovation: Collaborative projects

# A higher education institution based in Casablanca

- Created in 1996.
- Public-Private Partnership: Pioneer model in Higher Education governance.
- The only higher education institution in Morocco which specializes in Textile.



# Undergraduate and Graduate Programs

## Engineer of state

(3 years)

- Industrial Engineering with three options:
  - International
  - Logistics
  - Product Manager
  - **Textile and Clothing**
- Computer Science and Systems Management.

## Specialized Master

(2 years)

- E-Logistics
- Distribution and Merchandising
- Hygiene, Security and Environment
- **Management of textile-clothing products**

## Professional Bachelor

(3 years)

- Supply Chain Management
- Purchasing & Sourcing Management
- **Clothing Production Management**
- **Textile Production Management**
- **Clothing Development**



# Executive Programs

## Masters

(18 months)

- Logistics Management
- Strategic Management of Purchasing and Sourcing
- Industrial Management
- Maintenance Management
- Quality, Hygiene, Safety and Environment
- Management of Laboratory Tests
- Resource Efficiency and Lean Management
- Finishing Management, Printing and Dyeing
- Digital Marketing

## Executive MBA

(2 years)

- Supply Chain Management





# Textile-Clothing sector in Morocco



# Portrait of the sector

**The textile and clothing sector is one of the driving forces of the national economy, several indicators tend to confirm this :**

Employs  
160,000  
persons, 27%  
of national  
industrial  
jobs.

24% of  
Moroccan  
exports of  
goods

5% of  
Industrial  
Production

5% of  
Industrial  
turnover.

7% of  
Industrial AV,

# Portrait of the sector

The Moroccan textile sector has extremely shown strong dynamic and vigorous export performance over the last five years.



- Local Market estimated at EUR 4.5 billion in 2015, and projections at EUR 9 billion in 2025
- 1600 companies, mainly small and medium-sized companies (SMEs), produce 1.1 billion pieces.



# Strengths of the sector

The strategy and general interests of the sector have been defended and supported by **AMITH** for more than fifty years.

## Training Skills :

- A technical centre (CTTH)
- Higher School of Engineering (ESITH) created in 1996.
- Higher School of Fashion Creation / Casa Moda Academy created in 2008.
- Interprofessional association for Assistance to Consultancy (GIAC)
- Establishments of the Office for Professional Training and Labour Promotion OFPPT (ITA & ISTA)
- CFA Apprenticeship Training Centres



# Ecosystems Sector



## 6 ecosystems

Integrate the industrial sector locally around leading companies

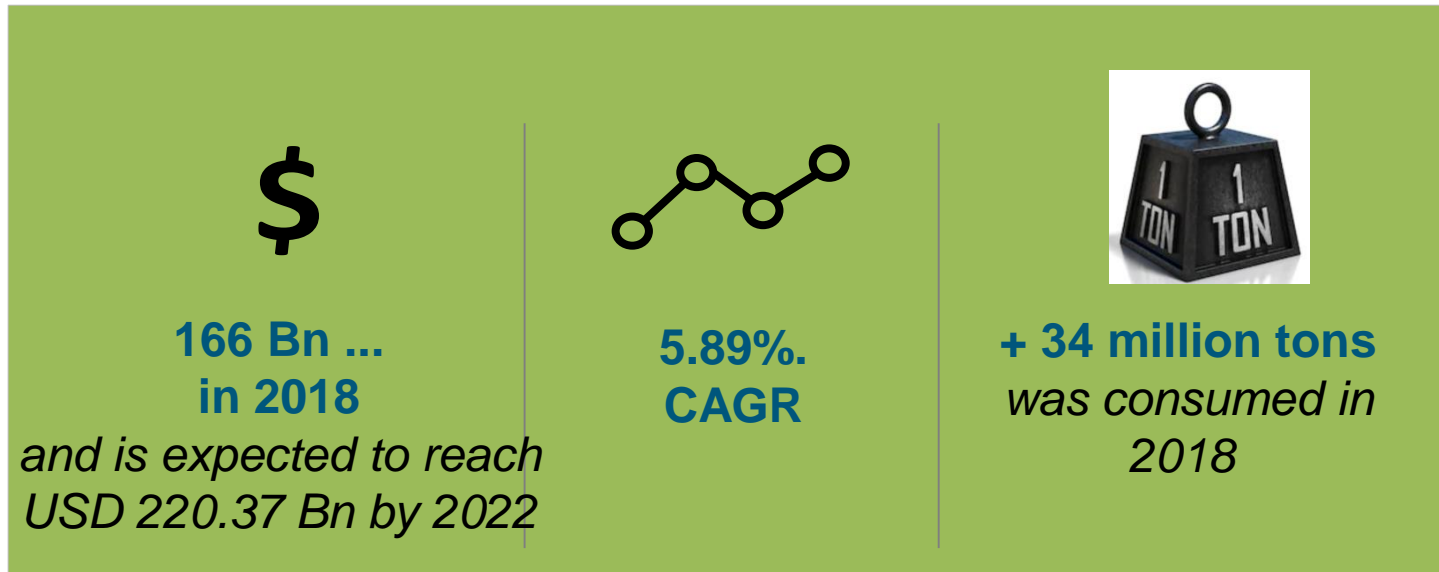
- Denim,
- Fast Fashion,
- Industrial distributors of national brands,
- Knitwear,
- Home Textile
- Technical Textile.

## 3 clusters

Develop innovation in the sector by targeting high added-value products

- Moroccan Denim Cluster (MDC),
- Moroccan Technical Textile Cluster (C2TM),
- Casablanca Home Textile Cluster (CHTC).

# Technical textile Market and trends

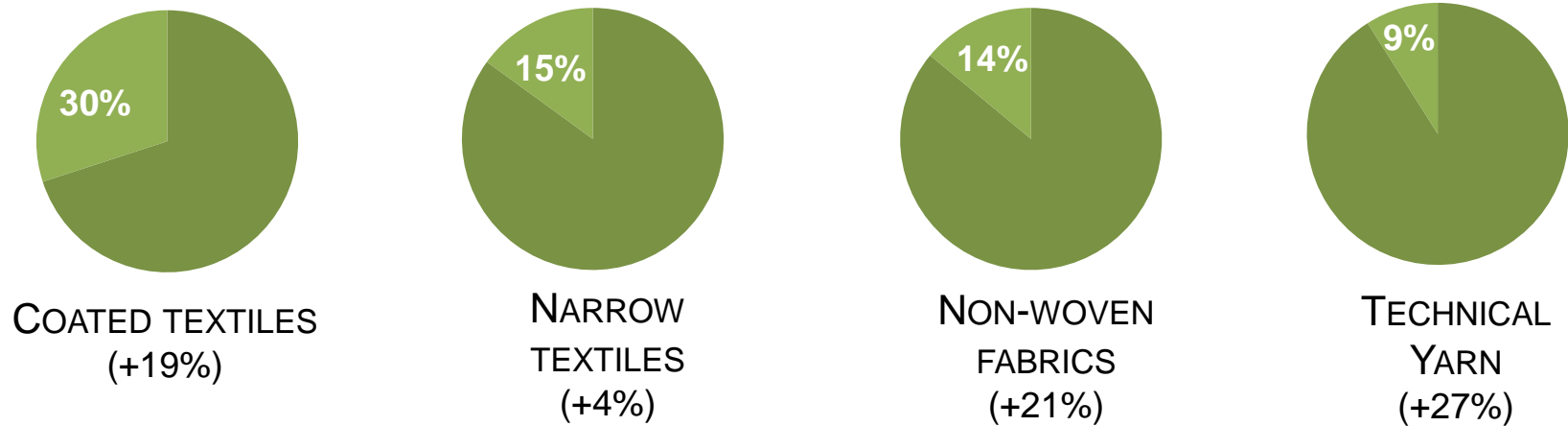


- ❗ *The increasing use of technical textile in end-use industries such as automotive, healthcare, construction, and geotextile is also driving the market.*

*The increasing usage of technical textiles in these industries can be attributed to the unique functional properties such as hygiene and safety, cost effectiveness, durability, strength, lightweight, versatility, user-friendliness, eco-friendliness, and logistical convenience of technical textile.*

# Technical textile Moroccan market

**In 2018, the Technical Textiles market represented a total of more than EUR 1.3 billion**

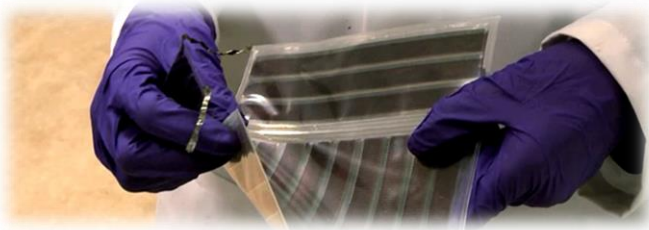


**!** *The average annual growth rate has been 13% over the last ten years. That is 2 to 3 times the growth of the world market.*

# Research and Development - ESITH



# R&D ESITH



For more than 10 years, ESITH's R&D Department has been working on a daily basis to support companies in development and innovation projects.



Respond to the company's daily problems and its future needs in terms of product development, decision-making tools and innovative processes.





# R&D ESITH

## Research Laboratory REMTEX

### Research areas

Valorisation of Natural Resources.  
Intelligent Textiles.  
Advanced textile materials.  
Reference Materials.



## Center of Excellence in Logistics CELOG

### Research areas

Logistics network engineering.  
Industrial Management..  
Reverse logistics.  
Green logistics.



## Scientific production and projects

More than 55 applied research projects

- 21 projects concerning themes, responding to the needs of companies
- 34 projects are PhD projects.

PhD projects were awarded

- more than 100 scientific publications,
- 21 patents likely to interest companies and lead to industrial developments.

# Research areas REMTEX

## Valorisation of Natural Resources and waste textile

1. Development of Phosphate glass fibers for fertilizing textiles.
  2. Valorisation of textile waste in the thermal insulation of the building.
  3. Development of nonwovens based on feather waste for applications in thermal insulation and composite reinforcement.
  4. Elaboration and Characterization of composite materials based on natural fibers woven in 2D and 3D.
- ...

## Intelligent Textiles

1. Development of flexible photovoltaic fabric textile.
  2. Elaboration of a piezoelectric textile using Electroactive Polymers PVDF.
- ...

# Research areas REMTEX

## Advanced textile materials

1. Synthesis and Characterization of Ferrimagnetic Nanoparticles and their grafting on textile matrices for application in Bioreactor.
2. Synthesis of photosensitive fluorescent sensors and their grafting onto textile matrices for applications in the food industry.

## Advanced textile materials

3. Development of functional coating formulations for applications to textiles with barrier properties.
  4. Removal of toxic heavy metals from wastewater with modified acrylic fibres.
  5. Development of a multifunctional textile via ionic liquids.
- ...

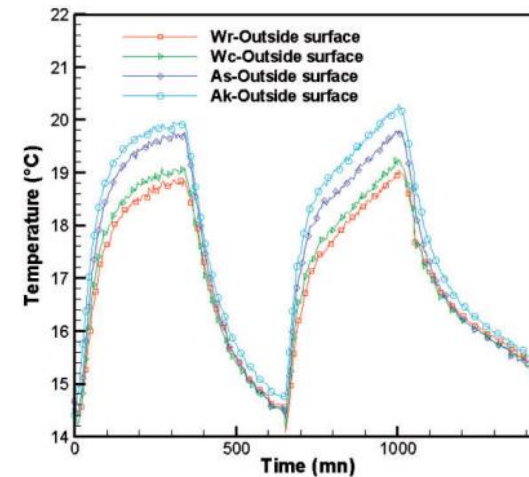
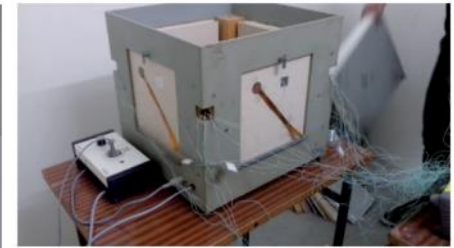
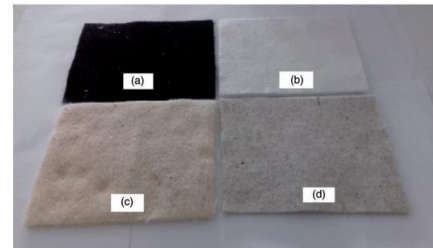
# Research areas REMTEX

## Development of new insulation materials based on textile waste

- Evaluation of thermal performance in a cavity which simulates a building room at reduced scale.
- Results show that all developed nonwovens have an excellent insulation performance, the thermal conductivity is in the range of 0.034–0.048 W/(mK).
- The insulation improves the thermal behavior of the walls, in 24%.

**M. EL WAZNA, M. EL FATIHI, A. EL BOUARI, O. CHERKAoui,** Journal of Building Engineering. (2017)

## Results and discussion

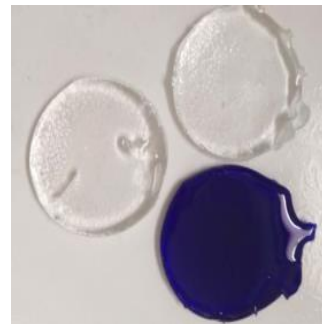


# Research areas REMTEX

## Development of Phosphate glass fibers for fertilizing textiles.

- Development of phosphate glass formulations ( $P_2O_5$ ,  $MgO$ ,  $K_2O$ ,  $Na_2O$ ,  $ZnO$ ,  $CaO$ ).
- Production and characterization of glass fibers.
- Studies of fibre dissolution
- Elaboration of fertilizing non-woven fabrics
- Two products have been developed:
  - Protective and Fertilizing Composite Envelope: MA 37881 patent, PCT/MA2016/000005.
  - Protective and Fertilizing Composite mulching : MA 37882 Patent , PCT/MA2016/00000006

## Results and discussion



Filament diameter 45 to 11  $\mu m$ .  
Breaking strength 1.8 GPa.  
Specific mass: 2.5  $g/cm^3$ .



50% Phosphate  
Glass fibre  
50% Wool (NPK)





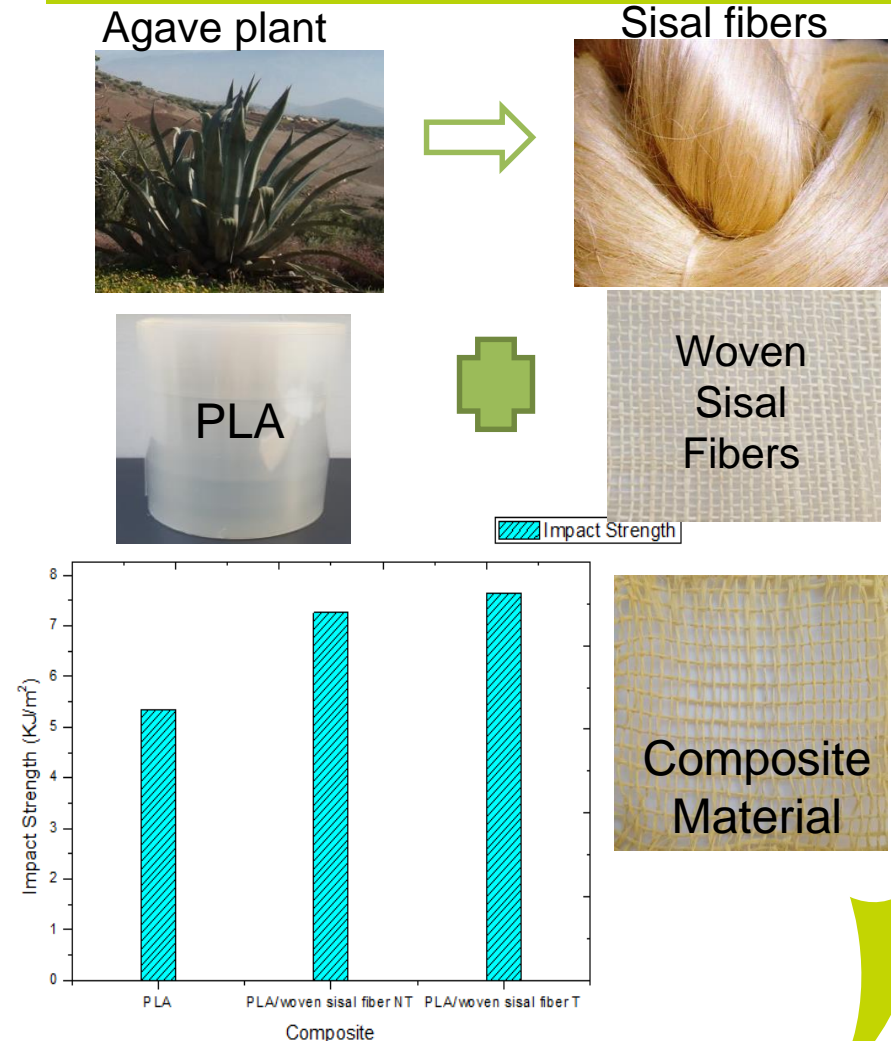
# Research areas REMTEX

## Elaboration composite based on natural fibers woven 2D & 3D.

- Extraction and Characterization of Moroccan Natural Fibers (Mechanical Properties, Thermal Properties, Morphological Properties).
- Development of Different forms of reinforcement using Moroccan Natural Fibers. (2D and 3D woven forms).
- Conception of the Composites Materials with Different Methods (RTM, Compression Moulding).
- Evaluation of the properties of the Composite Materials based on woven Moroccan Natural Fibers (Mechanical, Thermal, Dielectric and Rheological Properties...).

Z. SAMOUH, K. MOLNAR, F. BOUSSU, O. CHERKAoui, R. EL MOZNINE, Polymers for Advanced Technologies, (2018)

## Results and discussion



# Research areas REMTEX

## Development of functional coating formulations for applications to textiles with barrier properties.

- Development of a multifunctional PU-based coating recipe.
- The barriers required:  
(RF, waterproof, anti-stain, black out, rotproof, anti-bacterial,...)
- Optimization of the parameters of the recipe components.
- Study of application mode by dipping and by scraping and adjustment of application parameters.
- Evaluation of the performance of functional coated fabrics.

## Results and Discussion

Functional  
PU-based  
paste

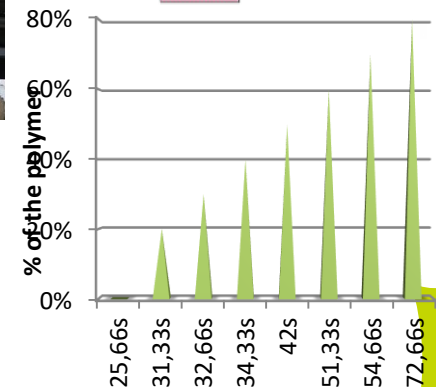
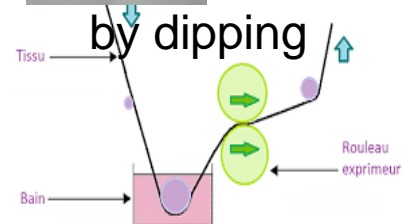


by scraping



Functional  
solution  
based on  
PU

by dipping



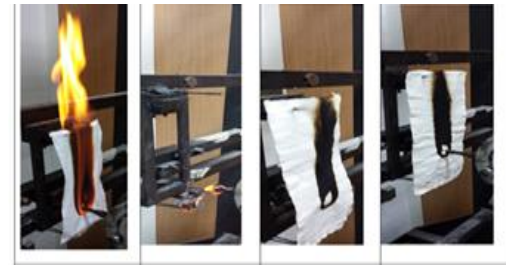
Fire behaviour test

# Research areas REMTEX

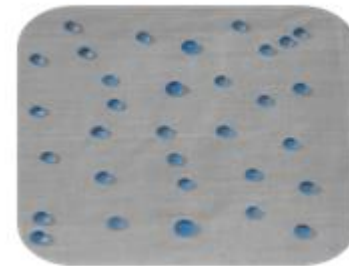
## Development of a multifunctional textile fabrics by the sol-gel technique.

- Sol-gel synthesis and preparation.
- Sol-gel treatment of textiles fabrics.
- Studies of Thermal, hydrophobic and anti-bacterial properties of the functionalized textiles.
- The elaborated textile fabric exhibit a high multifunctional properties by one treatment : flame retardancy , water repellence and antibacterial properties .

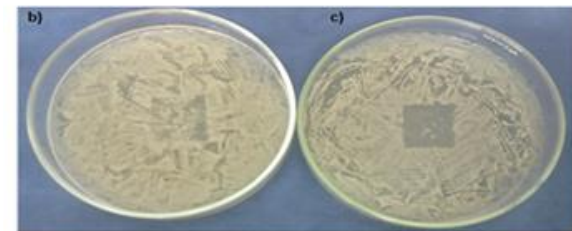
## Results and discussion



Flame retardancy



Water repellence



Antibacterial properties

# Research areas REMTEX

## Development of a Conductive Textile as a Flexible Substrate of Organic Photovoltaic Cells

- The conductive textile was developed by inserting a conductive yarn (Silver, Stainless steel, Copper) into the weft of the woven fabric. Other way by coating the fabric with a paste containing dispersed particles.
- These elaborate conductive fabrics have different electrical resistances. This depends on the fabric weave and the type of yarn used. In the case of coated fabrics, conductivity depends on the type of particles and their concentration.

H. JAOUANI, D.SAIFAoui, M. DALAL, Journal of Materials Science and Engineering B, (2018)

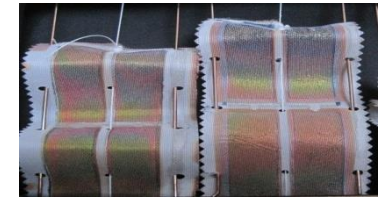
## Results and discussion



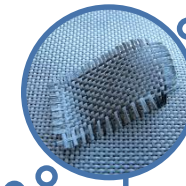
Coated conductive textile



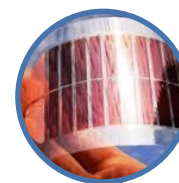
Conductor Textile woven by conductive yarns



Flexible Photovoltaic Textile



Conductor Textile



Organic Photovoltaic Cells



# International conference INTELLIGENT TEXTILES & MASS CUSTOMIZATION ITMC

The ITMC conference is organized every two years; the first edition took place 11 years ago (2007) at ESITH Casablanca in partnership with ENSAIT Roubaix, France.

ITMC'2017 was held at Ghent University in Belgium

ITMC'2013 was held at ENSAIT, Roubaix, France

**ITMC2019**, was organized by **ESITH**, in **Marakech Morocco**

**Next editions:**

ITMC2021, will be organized in sept 2021 by GCTT, Canada

ITMC2023, will be held at Shinshu University, Japan





# Innovation: Collaborative Projects



# Overall methodological approach of the study

## Phase 1: Market study

Sector diagnosis

Market study

Selection of targeted products

## Phase 2: Technical study

Analysis and testing  
Characterization of  
targeted products

Analysis and  
identification of the  
technological  
process

Development of  
prototypes and  
evaluation of their  
performance

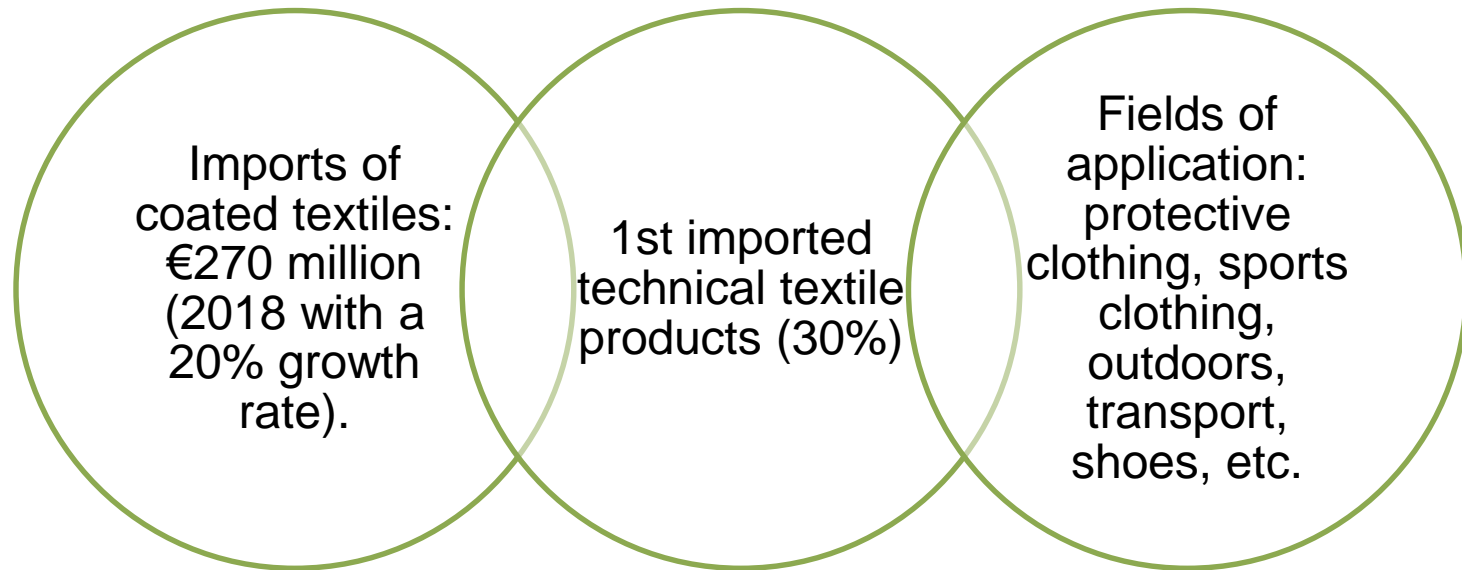
## Phase 3: Semi-industrial study

Product  
development on a  
semi-industrial scale

Product promotion

# Collaborative projects

## 1- Coating:



The projects developed in coating have the following objectives:

- Assess the potential for the coating development in Morocco for textile functionalization.
- Meet an ever-increasing need for high added-value products.

# Collaborative projects

## 1- Coating :

Project “**OPAQ’TEX**” : An innovative project that aims to develop a PU-based coating to add opacity, waterproofing and fireproofing functions to a cotton/PES fabric. The coating paste is mainly composed of PU, phosphate salt, polyfluorocarbon, black pigment.

This project is being carried out in close collaboration between two SMEs, C2TM cluster and ESITH R&D.



Caïdale tent



knife scraping

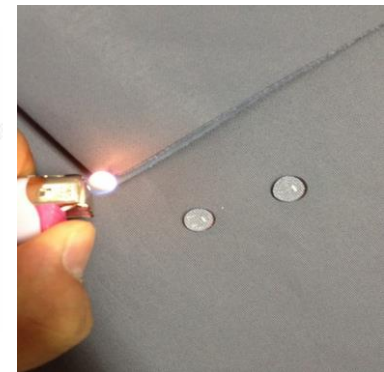
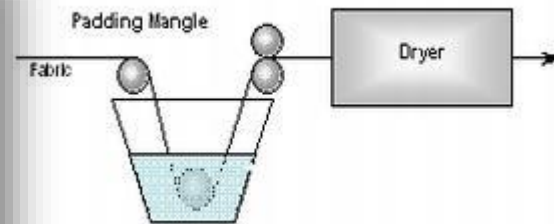
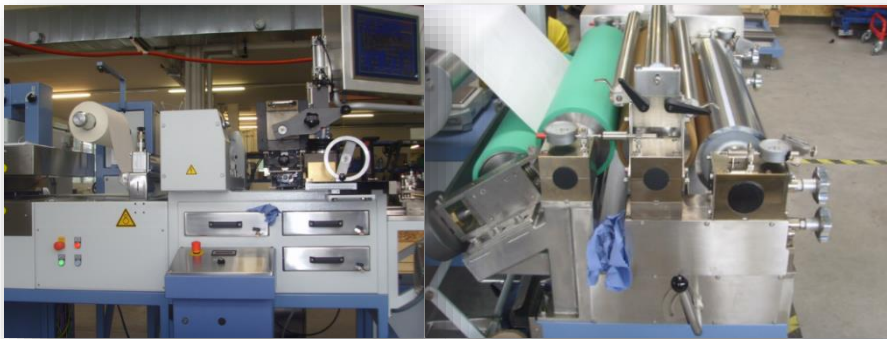
# Collaborative projects

## 1- Coating

**Project “3i’TEX”:** This project is about the development of a textile with fireproof, waterproof and rot-proof properties for the Moroccan army. The project partners are: an SME, ESITH R&D and C2TM Cluster.

The recipe developed is based on PU polymer, polyfluorocarbon, phosphate salt and copper salt.

The fabric is submerged in the coating solution then the excess squeezed out by the rollers, which dictates the pick-up percentage, the fabric is then dried and cured.



Continuous coating line "KTF-S"

# Collaborative projects

## 2- Non-woven valorization:

### Non-woven valorization



**200 000 T**

of textile waste produced  
each year in Morocco by  
the Textile/Clothing  
sector.



**35 000 T**

of textile waste  
exported each year for  
international  
valorization.



**2**

Main regions where  
textile waste are  
available: Tangier and  
Casablanca

This project aims to evaluate the potential of textile waste valorization in Morocco in order to meet a growing demand for high added value products.

# Collaborative projects

## 2- Non-woven valorization:

The axes of valorization



Waste collection

→ Sorting →



Waste recycling  
(cutting, opening  
and cleaning)



Regenerated yarn



Filling (Bedding)



Non-woven fabrics (bedding,  
insulation, geotextile, agro-  
textile...)



*Non-woven valorization is the best suitable  
method for textile waste.*



# Collaborative projects

## 2- Non-woven valorization:

The non-woven line was used in the development of insulating products for the building industry.

- Fiber preparation, opening, cleaning & mixing
- Carding
- Cross lapping
- Needle punching
- Thermal bonding



# Collaborative projects

## 2- Non-woven valorization :

**"Insulation Solution for Buildings"** Project: A project, carried out in collaboration with the CETEMCO technical center, the C2TM cluster and the ESITH R&D Center, aims to use textile waste for the development of non-woven insulating products for the building sector. Two products have been developed:

1. Insulation in panel format
2. Insulation in roll format

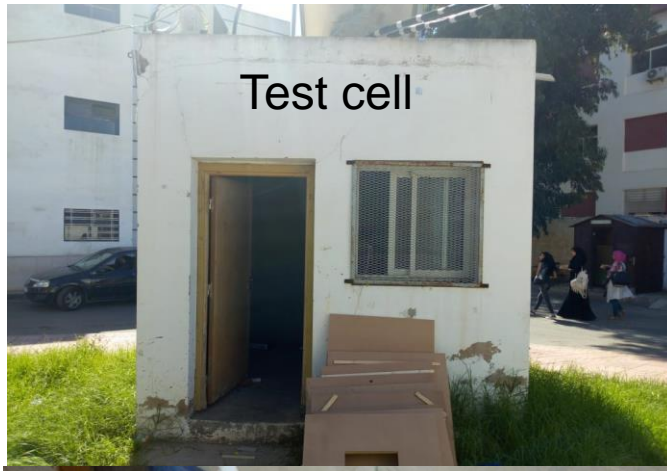


Test results	Insulation in panel format	Insulation in roll format
Density ( Kg/m <sup>3</sup> )	37	33
Thermal conductivity $\lambda$ (W/m.K)	0,0370	0,04082
Thermal resistance R (m <sup>2</sup> .K/W) (thickness 50mm)	1,351	1,225

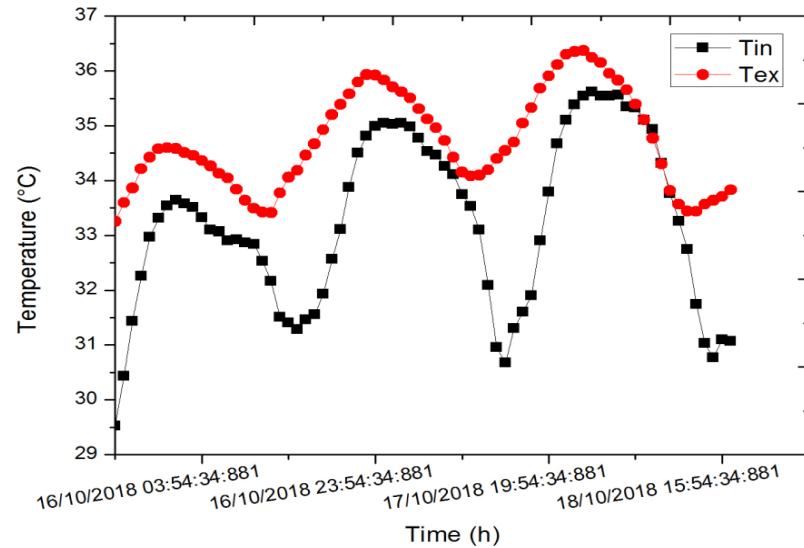
# Collaborative projects

“Semi-industrial test”

## 2- Non-woven valorization :



Location of the textile insulation

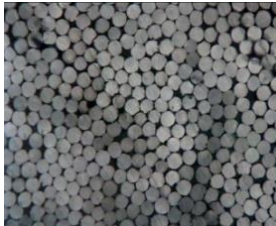
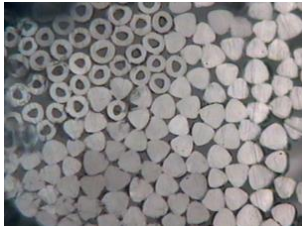



	Face externe		Face interne	
Jours	Tmax (°C)	Tmin (°C)	Tmax (°C)	Tmin (°C)
Jour 1	34,5	33	33	28
Jour 2	36	33,5	34,7	30
Jour 3	36,4	34,2	34,1	28.2

# Collaborative projects

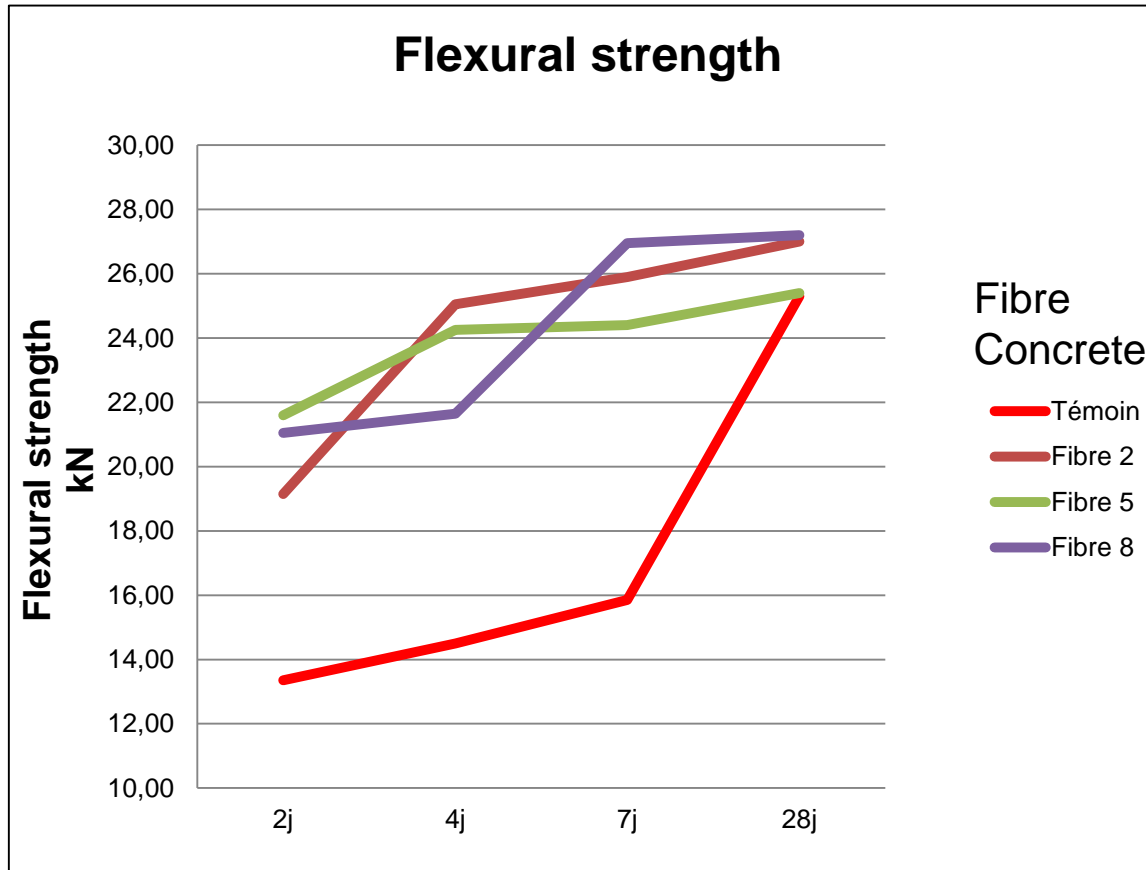
## 4- Fiber-reinforced concrete:

**"Fiber-reinforced concrete" project:** This project, with a strong innovation component, aims to develop a high-performance fibre-based concrete for the construction sector.

Fibre reference	F2	F5	F8
<b>Chemical composition</b>	100% Polypropylene	100% Polypropylene	100% Polypropylene
<b>Filament type</b>	Multi-filaments	Multi-filaments	Multi-filaments
<b>Length (mm)</b>	12	6	6
<b>Diameter (µm)</b>	33,2	33,8	37
<b>Density (g/cm3)</b>	0,90	0,90	0,90
<b>Linear title (dtex)</b>	7,79	8,08	9,68
<b>Section</b>	Circular section	Two types of Fibres: circular and hollow-core fibers, and triangular fibers	Circular section
<b>Tranverse cut</b>			

# Collaborative projects

## 4- Fiber-reinforced concrete





# Conclusion



- The textile and clothing sector is one of the driving forces of the national economy principally in employment and export.
- The sector is represented by its association AMITH and have various technical support and assistance in the training skills to companies.
- 6 ecosystems have been created in role to integrate the industrial sector locally around leading companies and SMEs.
- 3 clusters have been created in the main goal to develop innovation in the sector by way collaborative projects .
- Technical textiles are opportunities to introduce innovative to Moroccan companies. The technical textile market in morocco started to progress with a growing demand for coated and non-woven textiles.
- R&D ESITH is also involved on a daily basis in supporting companies in research, development and innovation projects.



# Thank you

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