



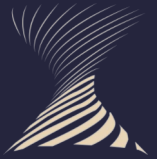
Speaker M. Pierre AMADIEU

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**Carded hemp fibres as a very competitive alternative to
fibres extracted from scutching/hackling approach**

ITC Dresden, 2023/12/01



HEMP, A RESOURCE FOR THE FUTURE

TO HELP HUMANITY FACE THE CHALLENGES OF THE 21ST CENTURY



Hemp feeds us, dresses us, houses us, provides goods for us... Hemp heals us!

A crop that needs **no pesticides** and reasonable fertilizing while hemp :

- saves water and resources
- regenerates the structure and the vitality of the soil,
- improves the yields of subsequent crops, and stifles the weeds,
- preserves and restores biodiversity



It is a hardy plant, **cultivable in many latitudes**



Regarding the studies : **Hemp stores**, as biogenic carbon, **10 to 15 tons CO2eq/ha/year**





OUR VISION FOR HEMP IN 2050

100 MILLION HA OF HEMP GROWN AROUND THE WORLD

A GAME CHANGER DESIGN

OUR PROCESS 100% DEDICATED TO HEMP & RESIZED FOR NEARSHORING

Based on 23 years of experience

Backed on a highly efficient heritage

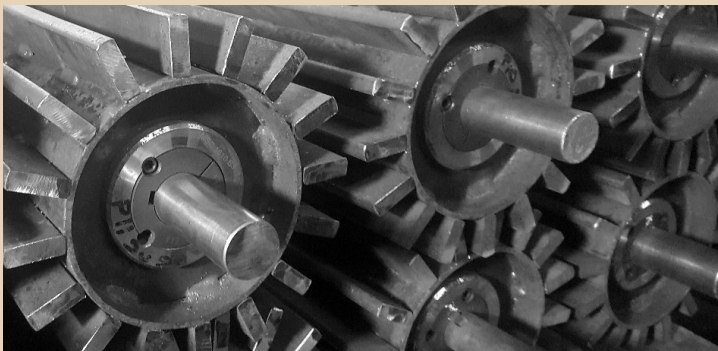
Designed simple to make it easy, and affordable

Designed profitable to make it desirable

Designed with very low investments at the agricultural stage => for easy access for farmers

Designed to be adapted by any agriculture in the world

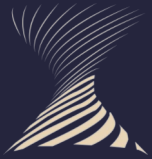
Designed to be massively and quickly adopted



IMBEDDED ADVANTAGES & UNIQUE POSITIONING

- The only alternative technology to linen scutching and hackling process to produce long and semi-long textile bast fibres and to preserve fibres mechanical properties
- Our tunable lines produce the entire range of fibers and shivs and process any range of straw
- Our modular decortivating lines fit any clients demand and stick to any fibres demand : textile or technical markets, local opportunities
- Affordable and reproducible decortivating lines to equip any size of project, to closely accompany our clients development





HD1300: A MODULAR SOLUTION

SOME TECHNICAL SPECIFICATIONS

Input

- Long retted hemp straw, dried and packed in round bales
- Textile retting requested for high grade quality

Output : full range of fibres

- **Long hemp fibres** 600/1000 mm
- **precarded/semi-long hemp fibres** 150/400 mm
- Technical fibres 50/100 mm
- shives for building, animal bedding and mulching

Yield

- Depending on retting and straw quality
- 1 ton of hemp straw input per hour
- 30 to 35 % of fibre with textile crop
- 50-60 % of shives

Operating means

- 2 operators per shift
- Electric power 130 kW installed / 400V 3 phase
- Building for decortication : 50 m x 10 m x 5 m high

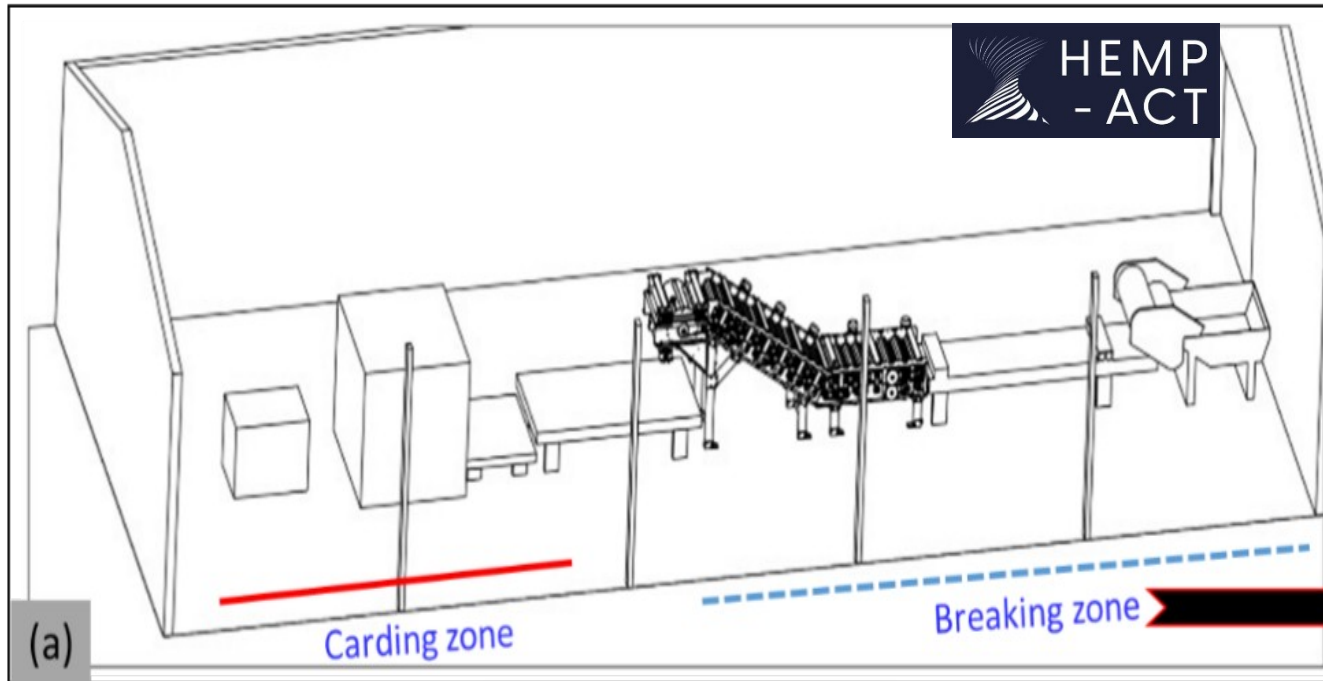
Size of your hemp business

- 1 ha of hemp crop produces a minimum of 5t straw/year
- 300 to 350 ha/year and per shift
- Up to 1000 ha/year when working 3 shifts

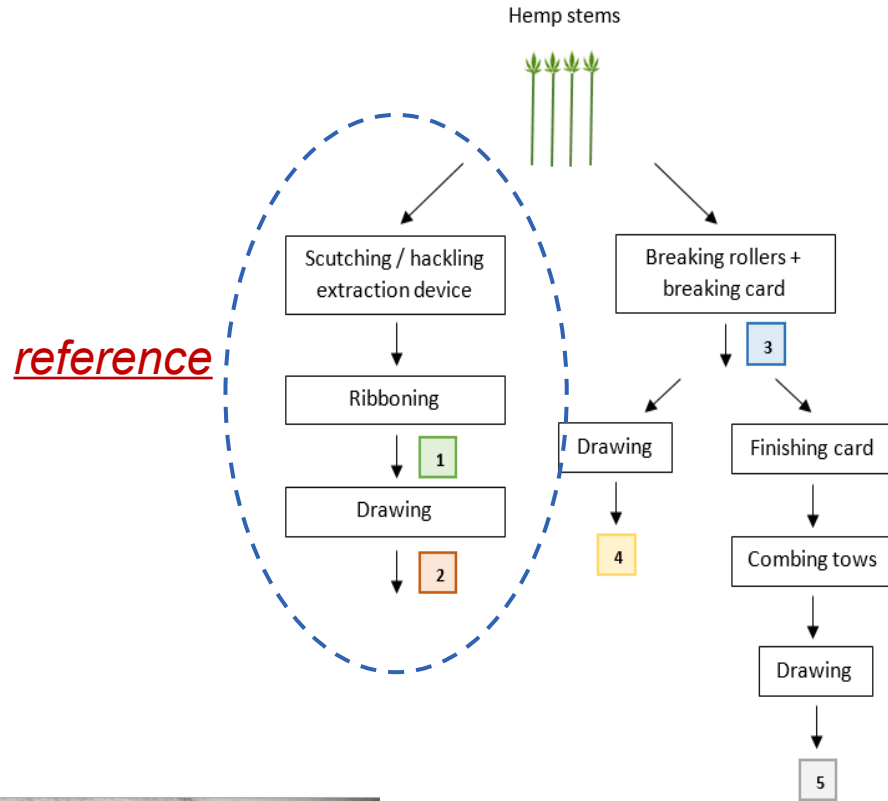


Fibres extraction devices and products

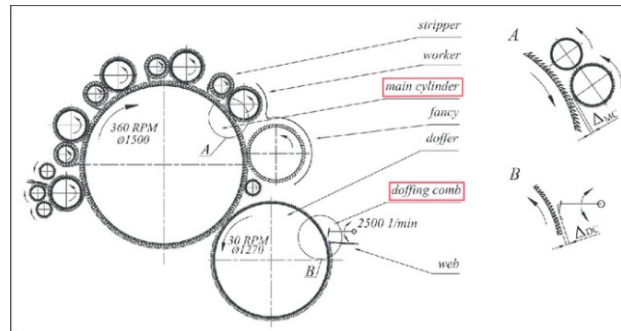
Breaking rollers/breaking card



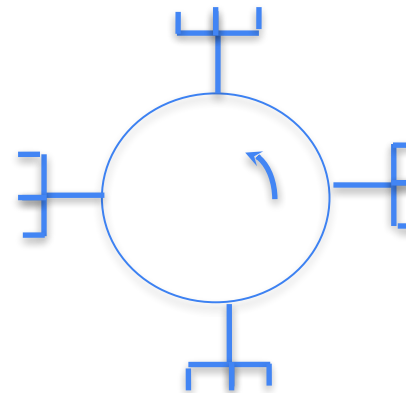
Fibres extraction devices



Breaking card slivers



Finishing card

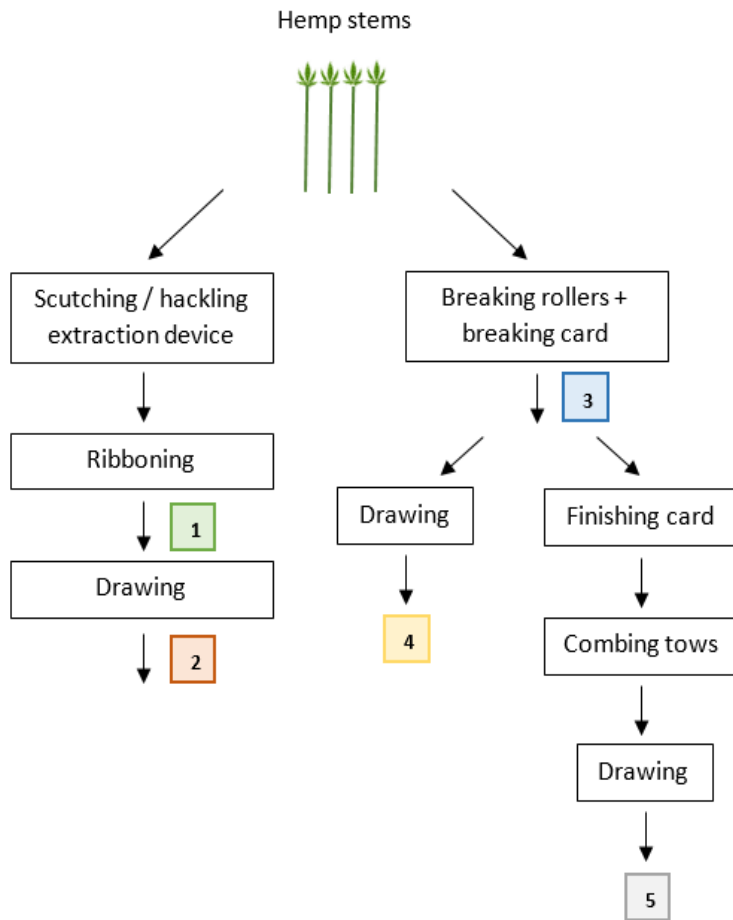


Rotating comb

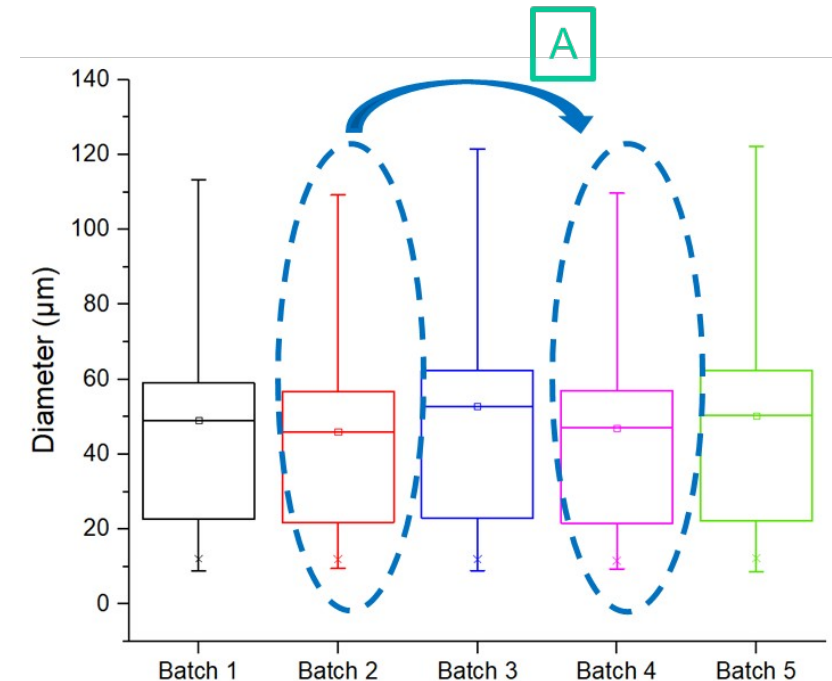
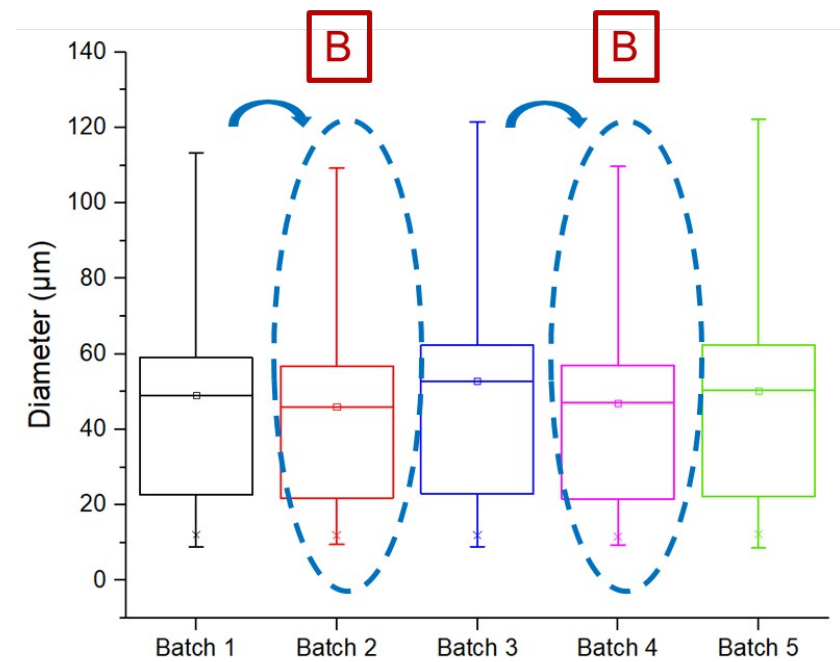


Combed sliver

Bundle diameters

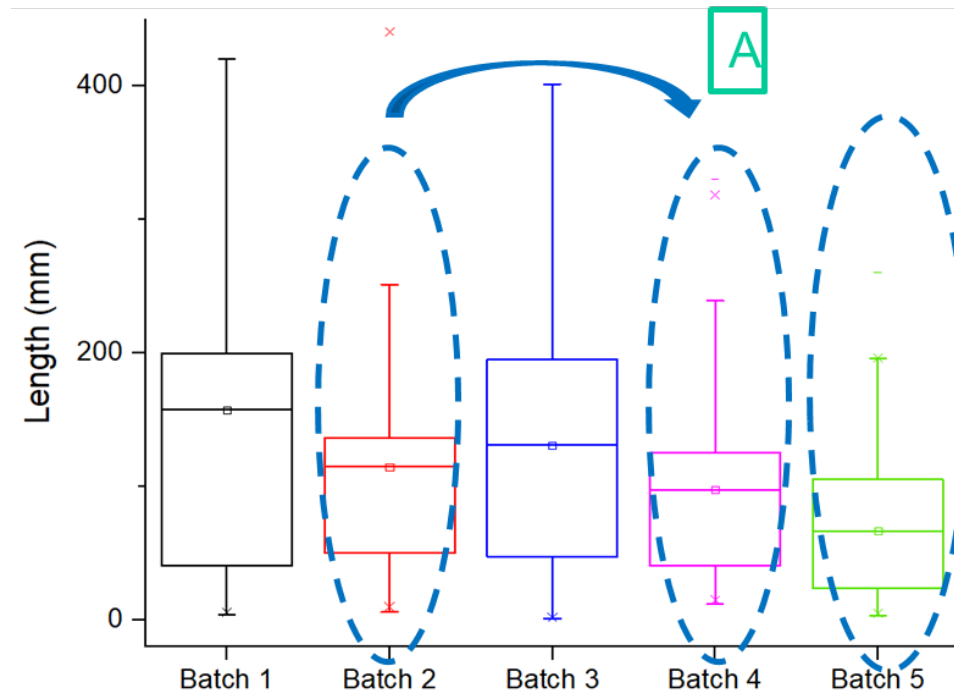
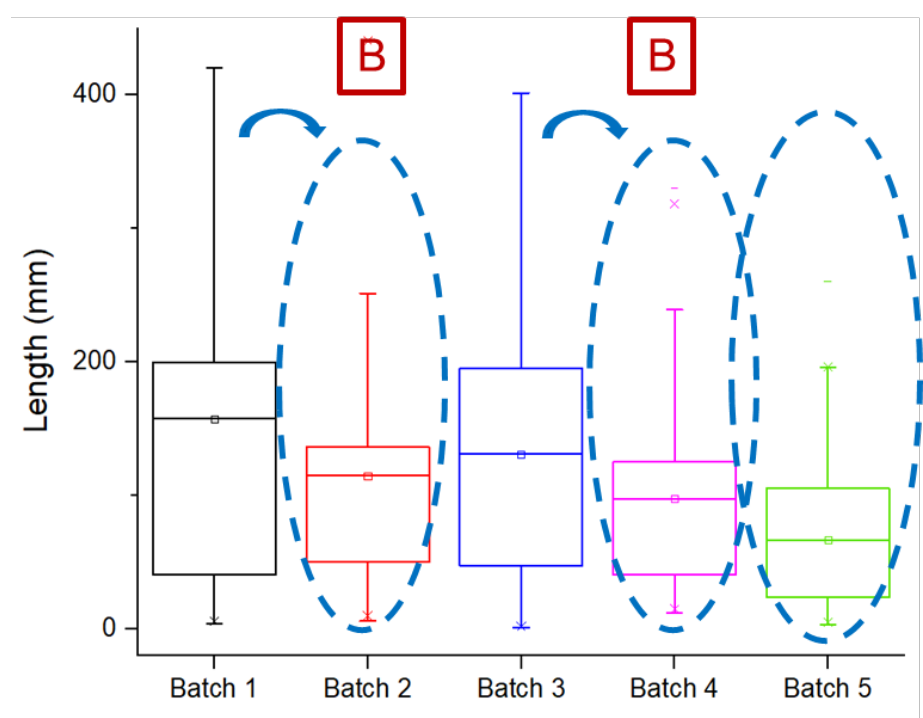
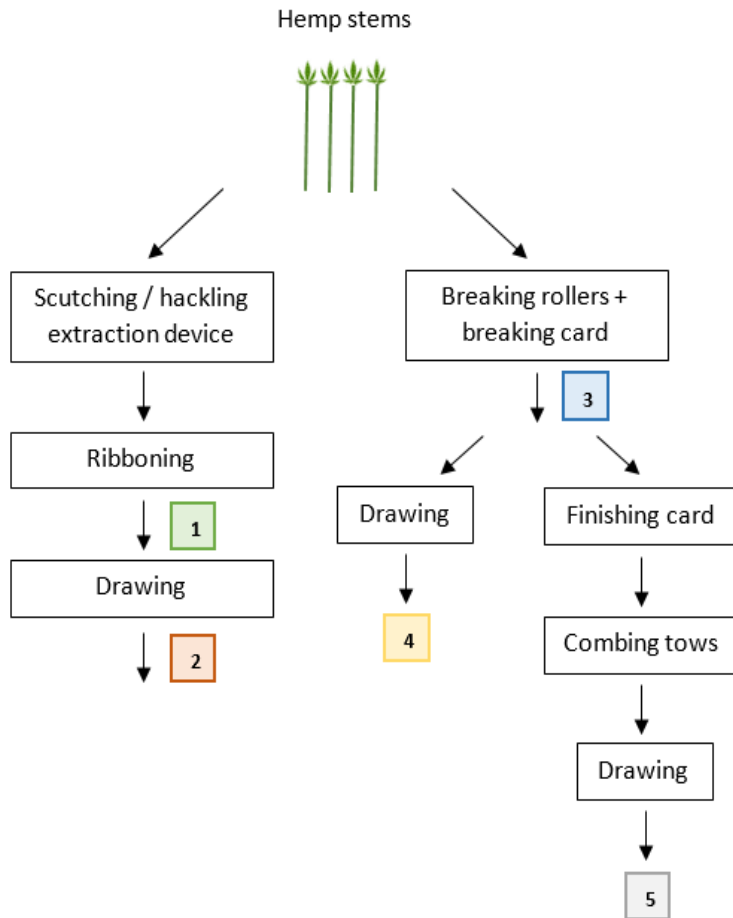


A No significant difference
B Significant difference



➔ **Breaking card extraction leads to sufficient levels of fineness to be achieved for roving manufacturing**

Bundle lengths

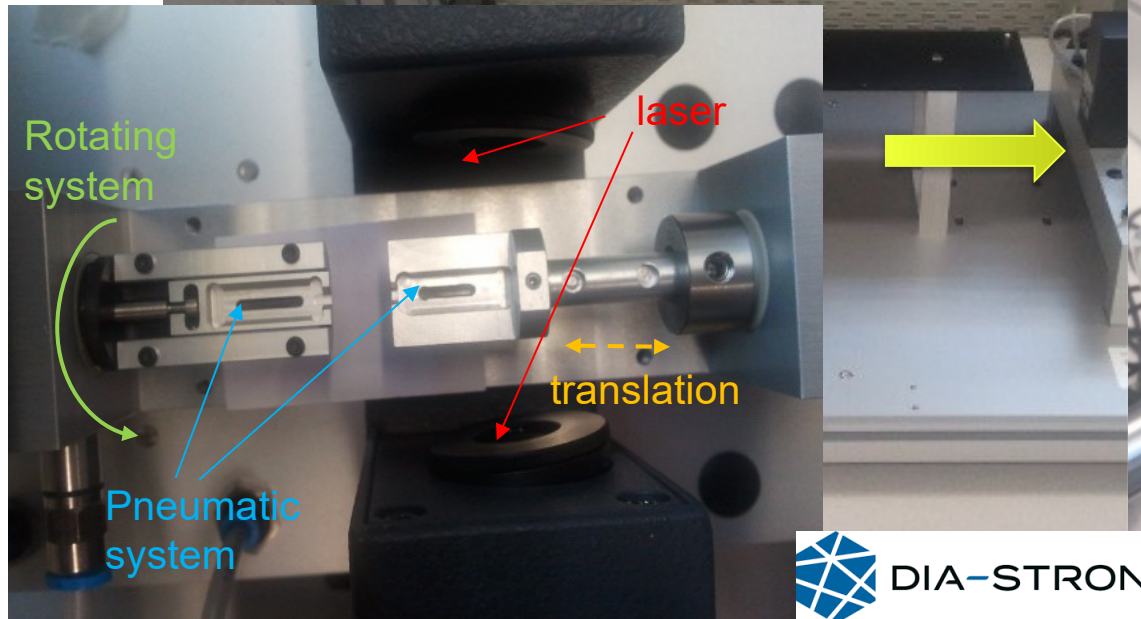


→ Breaking card extraction leads to sufficient bundle lengths for roving manufacturing

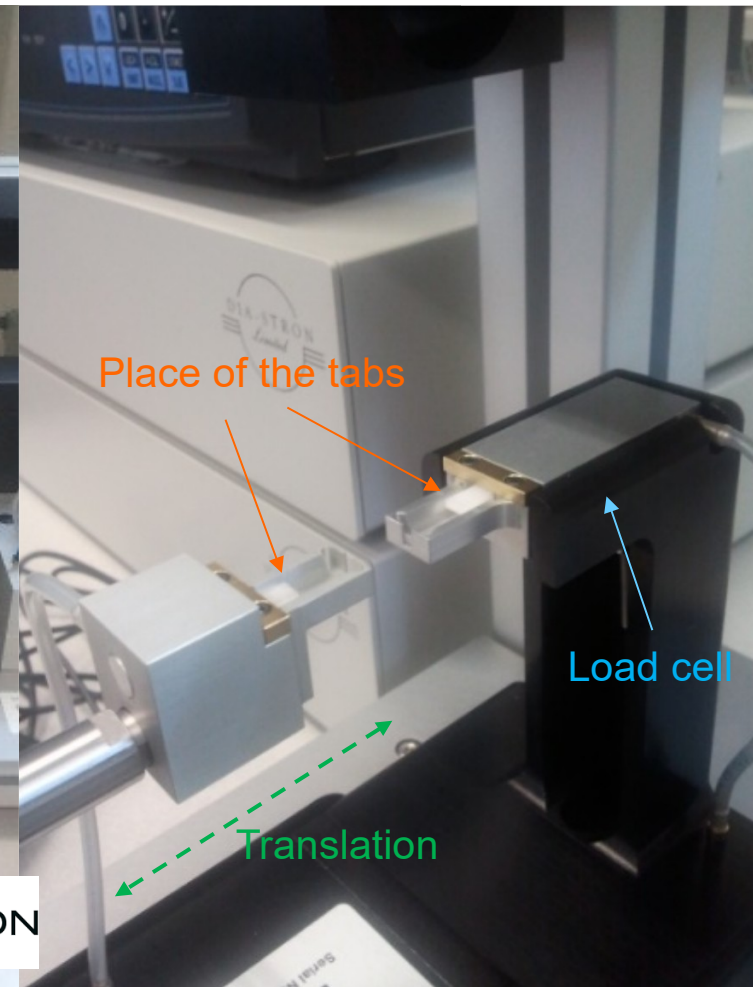
Mechanical properties of the fibres

1 Dimensional analysis :

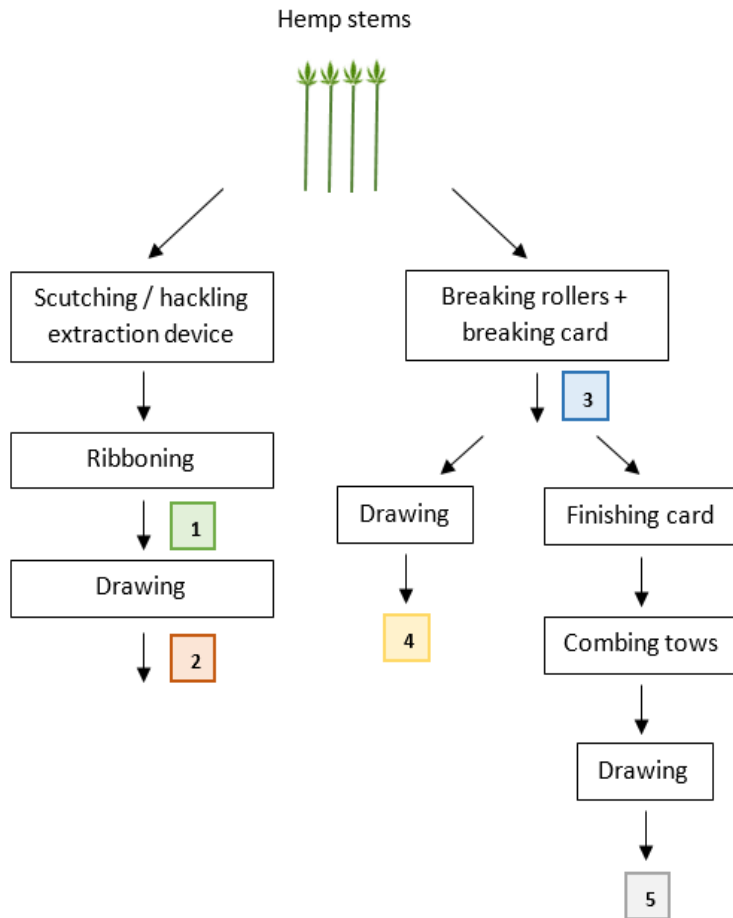
- Tests on elementary fibres
- Gauge length : 12 mm
- Standardized tests NF T25 – 501 – 2



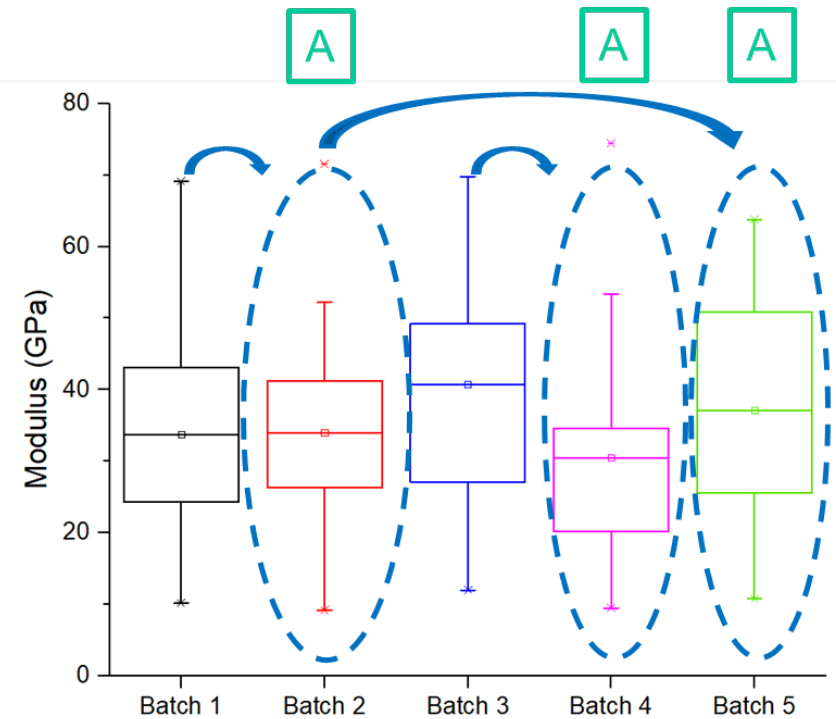
2 Tensile system:



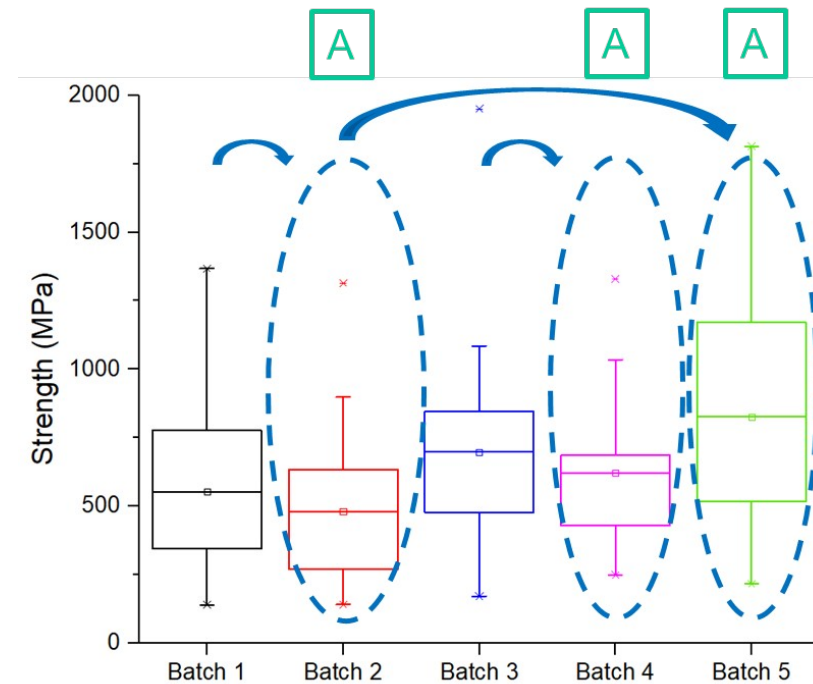
Mechanical properties of the fibres



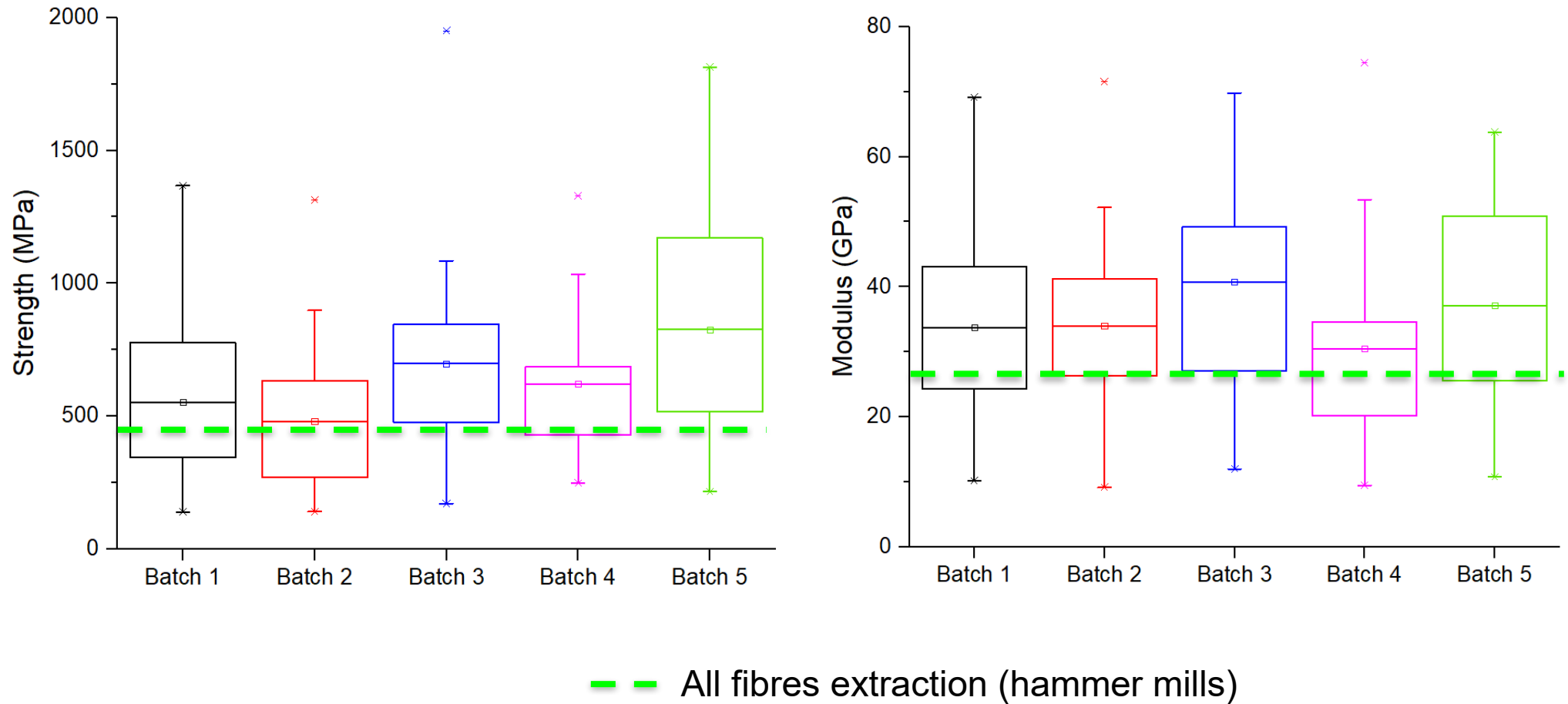
Modulus :



Strength :



Mechanical properties of the fibres



Placet, V., Trivaudey, F., Cisse, O., Gucheret-Retel, V., & Boubakar, M. L. (2012). Diameter dependence of the apparent tensile modulus of hemp fibres: A morphological, structural or ultrastructural effect? Composites Part A: Applied Science and Manufacturing, 43(2), 275–287. <https://doi.org/10.1016/j.compositesa.2011.10.019>

Impregnated Fibre Bundle Tests (IFBT)

- Determination of the mechanical performance of the fibres in the composite material

Preparation

- Drying of the fibres for 24 hours at 60°C
- Positioning of 20 cm long fibre sections in 200x 10 x 2 mm moulds and impregnation with GreenPoxy 56 resin.
- Curing of the mini-composites during 2 hours at 150°C and a pressure of 2 bars

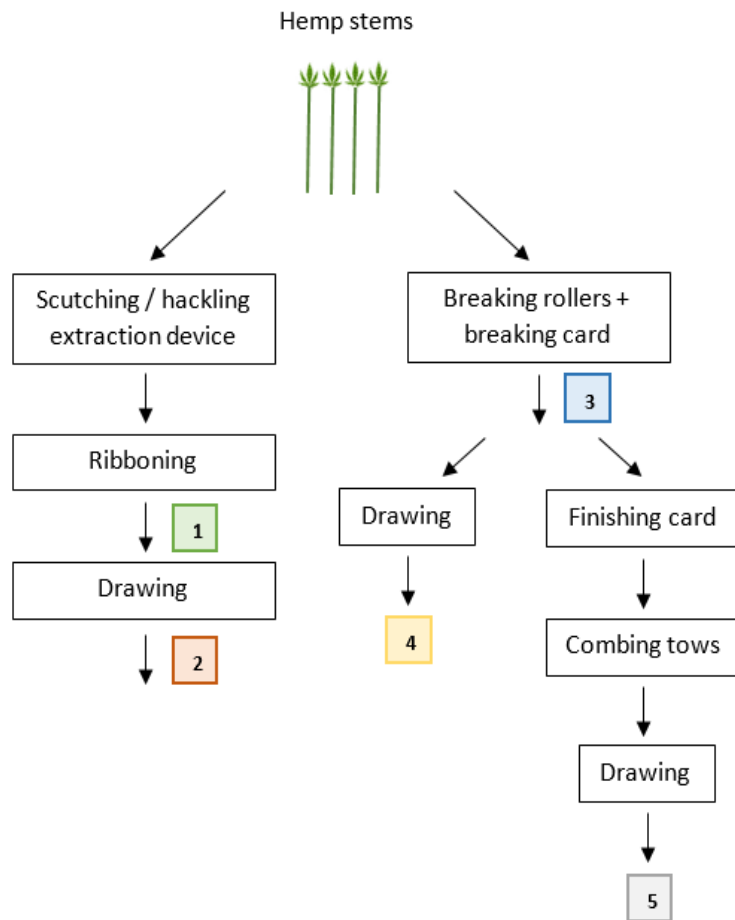
Test

- Stabilization of the samples in a climatic chamber at 23°C and 50%HR during at least 4 weeks
- Tensile test of the 6 IFBT samples per batch with a speed rate of 2 mm/min
- Determination of the effective mechanical properties of the fibres using rule of mixture

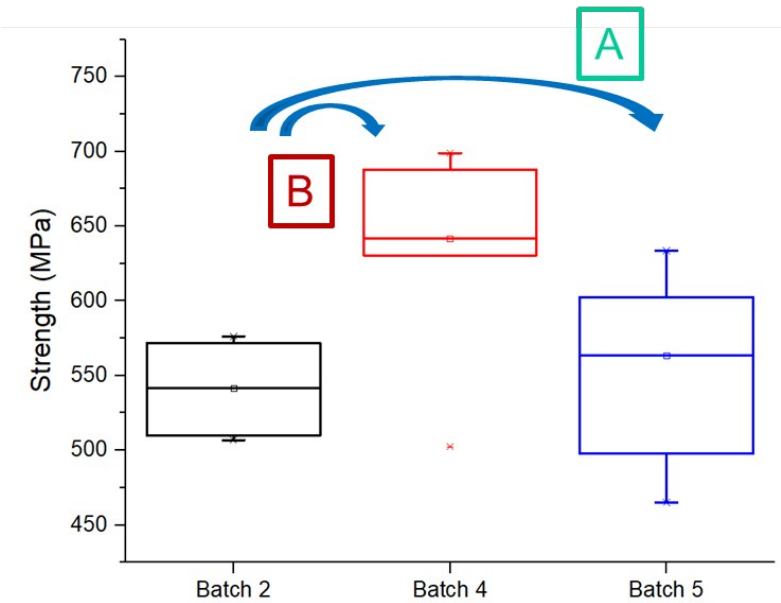
ISO 10618:2004. (2004). Carbon fiber - Determination of tensile properties of resin-impregnated yarn. *International Standardization Organization*.

Bensadoun, F., Verpoest, I., Baets, J., Müssig, J., Graupner, N., Davies, P., ... Baley, C. (2017). Impregnated fibre bundle test for natural fibres used in composites. *Journal of Reinforced Plastics and Composites*, 36(13), 942–957. <https://doi.org/10.1177/0731684417695461>

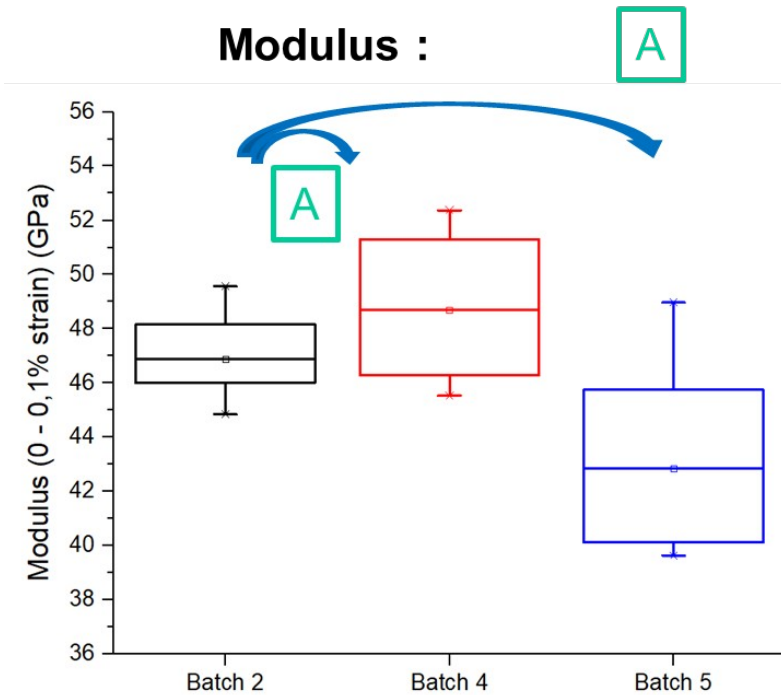
IFBT Tests



Strength :



Modulus :



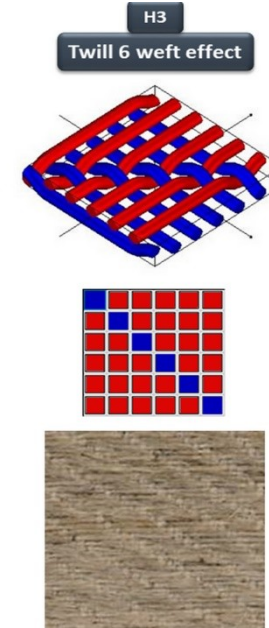
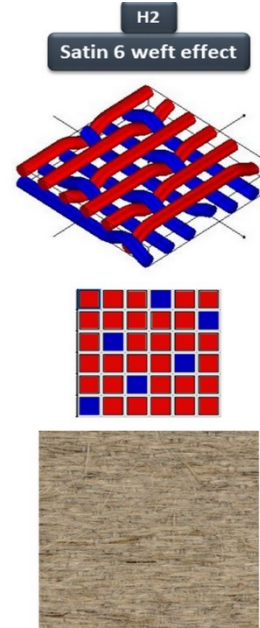
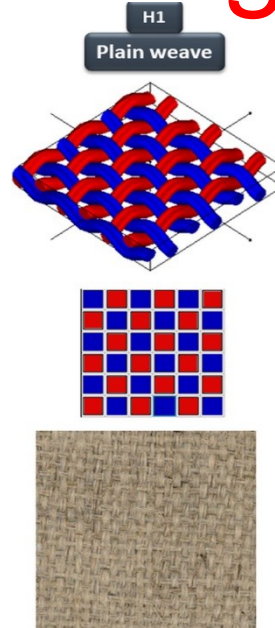
→ The carded route alone provides the fibres with the best reinforcement potential

Fabric manufacturing

□ Hemp woven fabrics

Made from scutching/hackling route

Carded rovings used for weft insertion.



Quasi-
unidirectional



Realistic for industrial applications ?

- **Price of long scutched fibres higher than 4.5€/kg.** In very large demand from the textile industry. Can be considered for niche applications but more kept for garment textile applications
- Price of scutching tows, or fibres from breaking rollers (1.1€/kg). More suitable for industrial applications. **Needs improvement** to obtain a fully woven fabric from carded rovings.
- If increase in the hemp cultivation and if multiplication of fibre extraction machines. Use of scutching tows, or use of mid length fibres extracted from breaking rollers/breaking card.
- **Composite industry should more look at medium length fibres extracted from breaking roller/breaking card route** as no real differences in terms of mechanical properties.



A COMPETITIVE & PROFITABLE SOLUTION

WITH PRECARDED FIBRES MARKETED FROM 2.5 €/kg

A PRE-PRODUCTION LINE, NEXT STEP ON SERIALISATION

- to integrate new solutions from the experience of our prototype line and from trials with complementary textile machinery
- to improve the design, to secure and prepare the serialisation
- **to showcase our technology and to run trials for new clients**

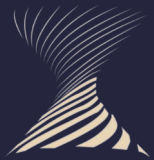
A 2 YEARS PROGRAM

- **To equip closely a client/partner**
- To run industrial production and to run a large range of trials

PREPARING THE FUTURE

- 2025 launching in series commercial offer
- 2026 delivering first in series lines



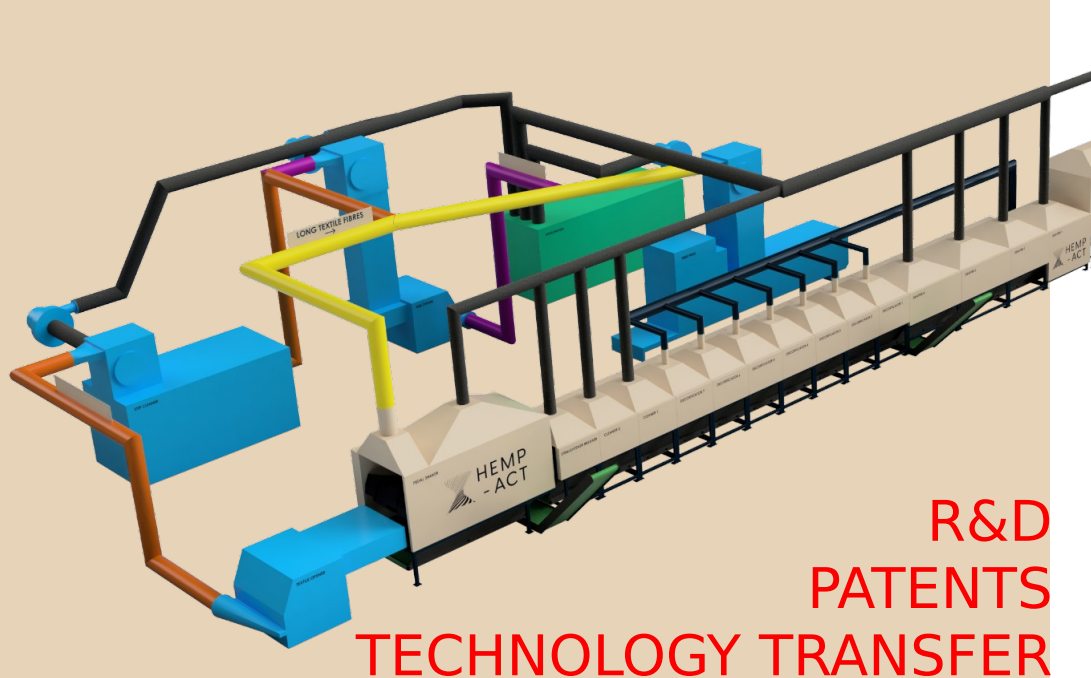


HEMP-ACT VISION FOR 2050

FROM LESS THAN 1M TO 100 M HA OF HEMP WORLDWIDE

UP SCALING

- **Fundraising and industrial partnership needs**
- to structure the company & its developments



- **As a second lever of growth**, backed on our vision and our breakthrough process and tools

PARTNERING WITH INDUSTRIES

- New demand for hemp textiles and bio-based composites. e.g. Automotive
- To design a **complete, efficient and cost effective value chain** for industrial applications
 - With textile machinery partners



CLIENTS & PROSPECTS

- Offering technical support to secure their hemp project with a reliable expertise
 - Offering decortication and further processings as a service to start their hemp business
- **Building a network of fibre supplier for a reliable industrial and global offer**

Thank you for attention



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