



International Conference of the European Industrial Hemp Association (EIHA)

www.eiha-conference.org

1–2 June 2016

Rheinforum, Wesseling near Cologne (Germany)



++ Cultivation ++ Processing ++ Economy ++ Sustainability ++ Innovation ++



Source: Hempro, Hemcore, NPSP Composites (2), Hemp Technology

Don't miss the biggest industrial hemp event in 2016 – worldwide!

Applications

- Fibres & Shives
- Construction
- Hemp Seeds, Oil and Proteins
- Bio-Composites
- Pharmaceuticals (CBD)
- Insulation
- Textiles

Spectrum of Participants

- Natural Fibre Industry
- Cultivation Consultants
- Traders and Investors
- Pharmaceutical Industry
- Hemp Food and Feed Industry
- Engineers
- Research and Development

Organiser



Gold Sponsors



Silver Sponsors



Bronze Sponsors



Programme

1st Conference Day, 1 June 2016



10:00 – John Hobson

GW Research Ltd.

Opening

INTERNATIONAL HEMP INDUSTRY
Chairman: John Hobson, GW Research Ltd.



10:10 – Michael Carus

nova-Institut GmbH

Overview on the European Hemp Industry



10:30 – Rachele Invernizzi

South Hemp Tecno Srl.

Updates from Italian Hemp



10:55 – Patrick Collins

Azabu University

& Makoto Matsumaru

Hempfoods Japan

Progress Towards Updating Japan's (American) Hemp Prohibition Law



11:35 – Rohit Sharma

Indian Industrial Hemp Association (IIHA)

Progress Towards Updating Japan's (American) Hemp Prohibition Law



12:00 – Oana Suci

Hempflax Europe Srl.

Hempflax in Romania – Growing and Processing Hemp – the Revival of a Once Successful Industry Dormant for the Last 25 Years

12:30 – 14:00 Lunch Break

AGRICULTURAL – VARIETIES & HARVESTING
Chairwoman: Oana Suci, Hempflax Europe Srl.



14:00 – Marijn Roersch van der Hoogte

Hanfaser Uckermark eG

Results of the Crowdfunding Project for a Hempseed Harvesting Machine (H.E.M.P.) & Overview of Hempfibre Factory



14:25 – Anndrea Hermann

The Ridge International Cannabis Consulting

Industrial Hemp Performance in North Dakota



14:50 – Claire Thouminot

FNPC

Hemp Breeding at FNPC



15:15 – Prof. Gianpaolo Grassi

CRA-CIN, Industrial Crop Research Center

The Breeding Strategy in Italy to Solve the Critical Points of Industrial Hemp Production

15:35 Coffee Break



16:05 – John McKay

Colorado State University

Towards Research and Development of Hemp Genetics after US Prohibition



16:25 – Davide Calzolari

Università Cattolica del Sacro Cuore, (UCSC)

Cannabis Threshing Residue: A Source of High Added-Value Compounds

COMPOSITES & BIO-BASED PLASTICS
Chairman: Prof. Dr.-Ing. Jörg Müssig,
University of Applied Sciences



16:45 – Professor Dr. Jörg Müssig

Hochschule Bremen – University of Applied Sciences

& Dr. Hans-Jörg Gusovius

ATB Potsdam

The Importance of Hemp Fibre Quality for Industrial Composite Applications



17:10 – Pierre Rivard

Fibres Recherche Développement (FRD)

Influence of Hemp Fibers and Shives Preparation on their Properties and Correlations with Properties of Composite and Concrete



17:30 – Michael Verhoeckx

Avans University of Applied Sciences Breda

Hemp and Flax Fibers in Heavy Load Bearing Structures – Designing and Building the World's First Biocomposite Bridges



17:50 – Dr. Joachim Venus

Leibniz Institute for Agricultural Engineering Potsdam-Bornim

Valorization of Hemp Residues in Fermentative Lactic Acid Production

The Importance of Hemp Fibre Quality for Industrial Composite Applications

Hans Gusovius¹ & Jörg Müssig²

¹ ATB – Leibniz Institute for Agricultural Engineering Potsdam-Bornim, DE

² The Biological Materials Group, Biomimetics, HSB – City University of Applied Sciences, Bremen, DE

13th International Conference of the European Industrial Hemp Association (EIHA)



June 1st – 2nd 2016, Rheinforum Wesseling, Germany
nova-Institut (Organizer)



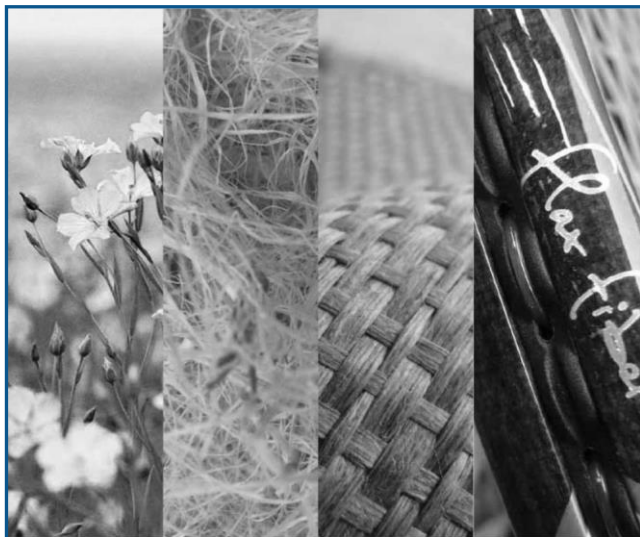
Content

The Importance of Hemp Fibre Quality for Industrial Composite Applications



- ✕ NF in composites
- ✕ Fibre properties and methodologies
- ✕ Selected results QM along production chain
- ✕ Conclusion

Natural fibres & composites



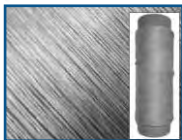
(JEC Conferences, 2012)

The Importance of Hemp Fibre Quality for Industrial Composite Applications / Gusovius & Müssig © HSB & ATB

2016-06-01

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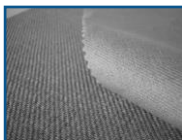
NFRC: optimised yarns & textiles for composite applications



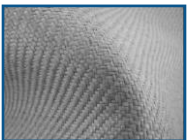
Roving



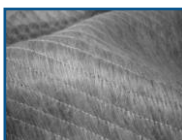
Pre-impregnated weaves



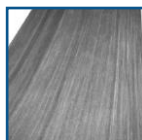
Weaves



Hybrid weaves



Non-crimp fabric

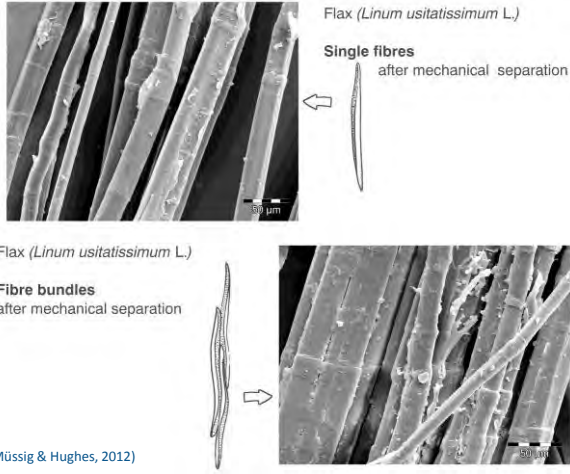


UD prepregs



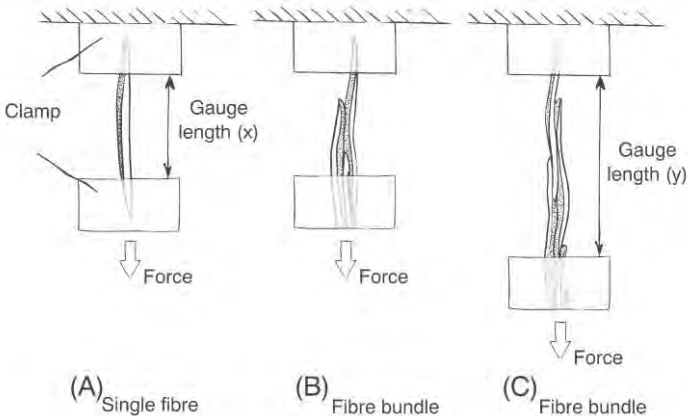
Complete
absence of twist
and crimp
(Baets & Pariset, 2012)

Fibres properties and NFRC



Scanning electron micrographs of single flax (*Linum usitatissimum* L.) fibres (upper image) and flax fibre bundles of variable width and a single fibre in front (lower image).

Fibres properties and NFRC

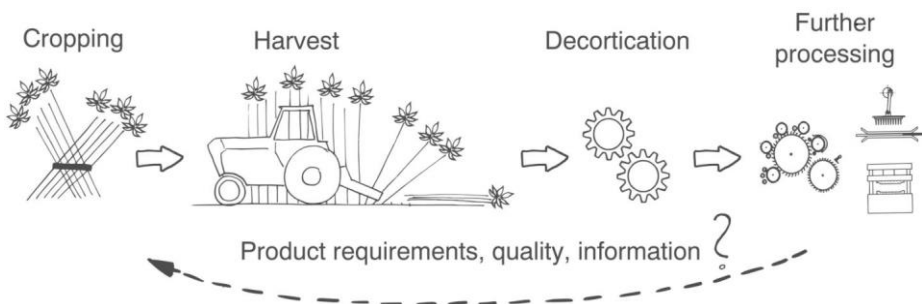


(Müssig & Hughes, 2012)



Various testing methods to determine the tensile properties of plant fibres and fibre bundles. (A) Single fibre fixed in clamps at a gauge length (x). (B) A fibre bundle prepared for tensile testing with the same gauge length (x) as the single fibre. (C) Fibre bundle with a greater gauge length (y).

Quality management along the production chain

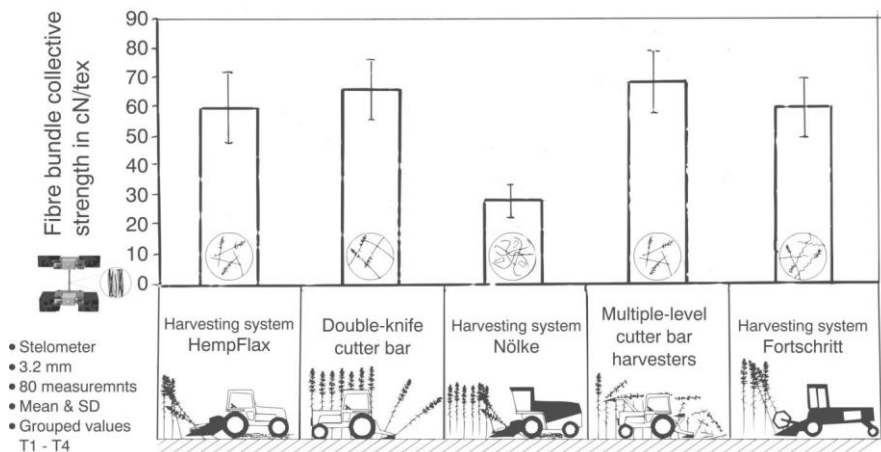


(Amaducci & Gusovius, 2010 – adapted from Müssig & Harig, 1997)



Information flow along the production chain.

Quality management along the production chain

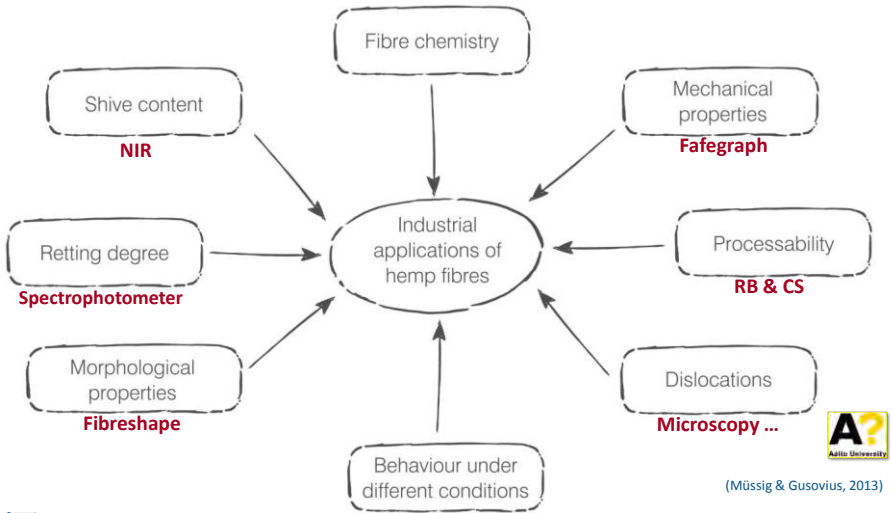


(Müssig & Harig, 2000)



Influence of different harvesting techniques on hemp fibre quality.

Quality management along the production chain



(Müssig & Gusovius, 2013)

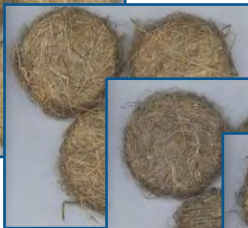


A selection of quality characteristics for the use of hemp in industrial application.

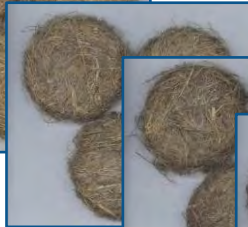
A selection of quality characteristics for hemp & flax: *Retting degree*



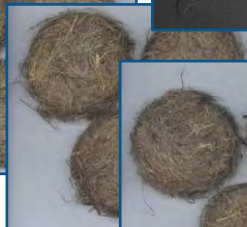
Hemcore 1



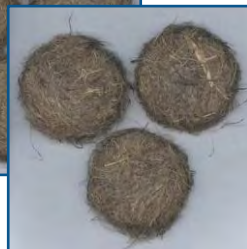
2



3



4



5



(Müssig, 2003)



Retting & quality control.

A selection of quality characteristics for hemp & flax: *Retting degree*

England

- Hemcore 1

$L^* = 63.31$

$a^* = 3.51$

$b^* = 21.85$

Germany

- AGRO - R1

$L^* = 66.54$

$a^* = 3.66$

$b^* = 21.29$

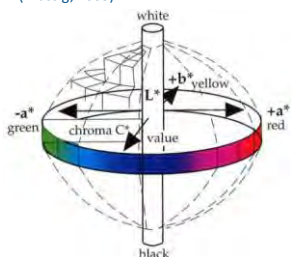
Difference

$\Delta L^* = -2.93$

$\Delta a^* = -0.15$

$\Delta b^* = +0.56$

(Müssig, 2003)



- ΔL^* = Hemcore 1 sample a little darker

- Δa^* = Hemcore 1 sample a little greener

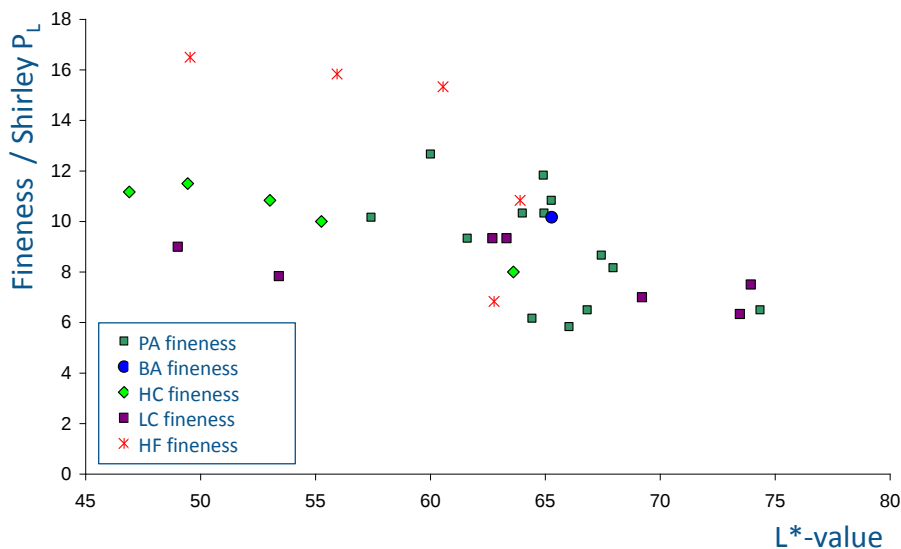
+ Δb^* = Hemcore 1 sample a little yellower



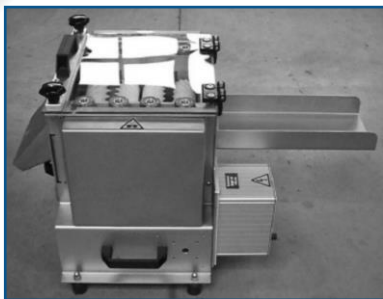
Communicating colour by number !

Solid $L^* a^* b^*$ Colour Solid (HunterLab, 2000)

Colour versus fineness



A selection of quality characteristics for hemp & flax: *Decortication*



(Müssig & Gusovius, 2013)

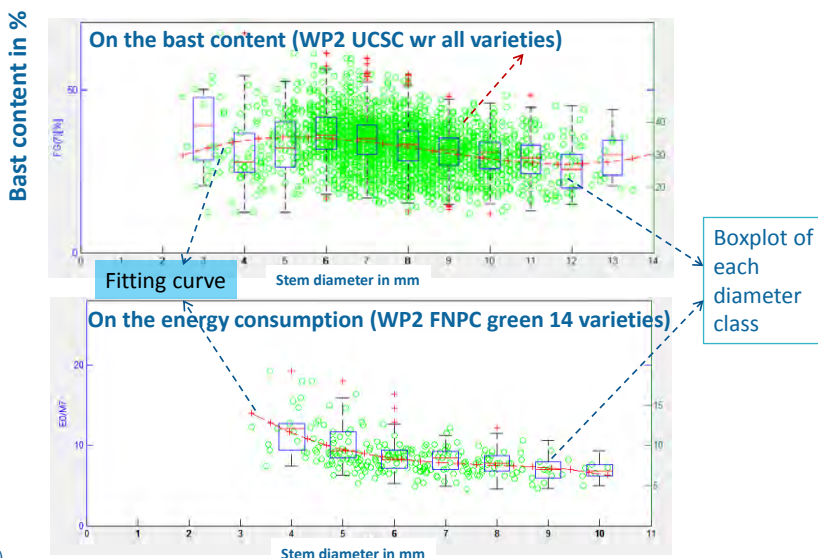


WORTHMANN
AUTOMATION

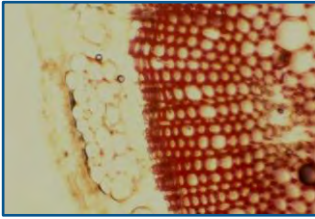


➡ Assessment of the processability of hemp stem within the **MultiHemp** project.

Decortication Parameters versus stem diameter



A selection of quality characteristics for hemp & flax: *Shive content*



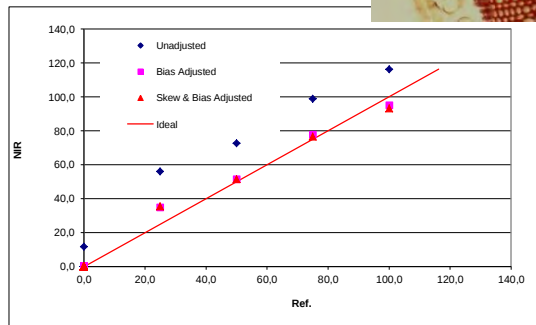
(Akin, 2013)



Near infrared spectroscopy; chemometric models. Standard test method for the measurement of shives in retted flax ASTM D-7076-05 (Akin, 2010).

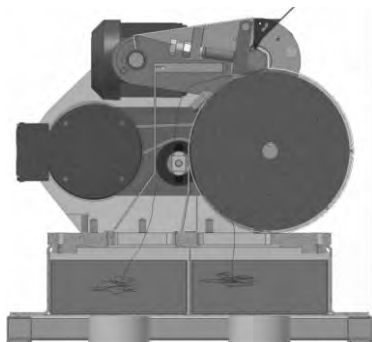
Adaption of method from LLS/D Akin:

- ✗ Sample preparation of hemp bast and hurd, milling and standard mixing
- ✗ Characterization by NIR and chemometric models
- ✗ Evaluation of existing flax models
- ✗ Preliminary test in Georgia (U.S.A.) promising



Comparison of standard flax model to retted hemp shive (milled) (Akin, 2013).

A selection of quality characteristics for hemp & flax: *Separation*

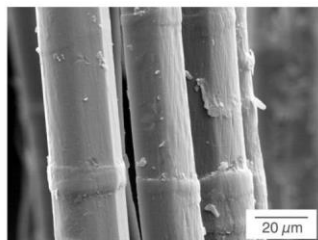


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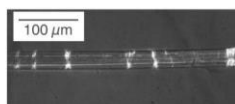


Assessment of the processability of hemp fibre bundles within the **MultiHemp** project. (Müssig & Gusovius, 2013)

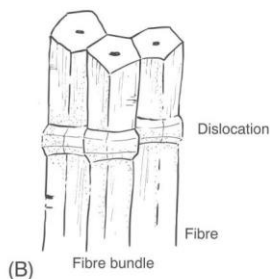
A selection of quality characteristics for hemp & flax: *Dislocations*



(A)



(C)



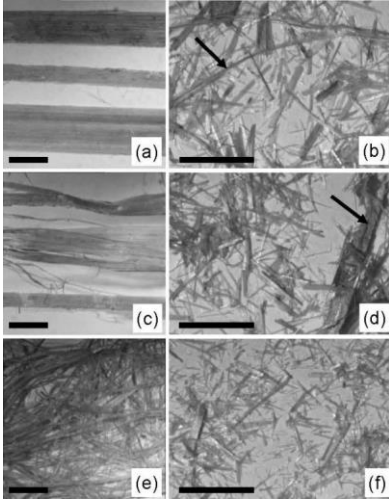
(B)

(Müssig & Hughes, 2012)



(A) Scanning electron micrograph of dislocations in a flax fibre bundle. (B) Schematic representation of dislocations in a flax fibre bundle. (C) Dislocations in flax, shown as bright zones crossing the fibre when viewed under polarised light in an optical microscope.

Quality control along the production chain – dislocations



Scale bars equal 5 mm.



Microscopy images of hemp fibres.

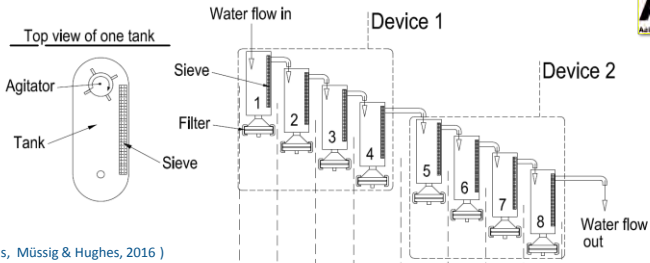
(a) fibre strips from the un-retted un-processed stems before acid hydrolysis, (b) un-retted un-processed fibres after acid hydrolysis - the arrow shows a long fibre still apparently intact after acid hydrolysis,

(c) decorticated fibres from un-retted stems before acid hydrolysis, (d) decorticated fibres from un-retted stems after acid hydrolysis - the arrow points a shive,

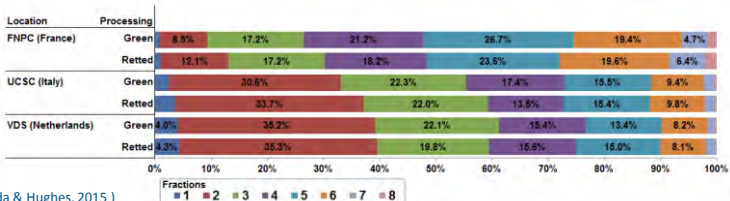
(e) decorticated and carded fibres from un-retted stems before acid hydrolysis, and (f) decorticated and carded fibres from un-retted stems after acid hydrolysis.

(Hernandez-Estrada, Gusovius, Müssig & Hughes, 2016)

Quality control along the production chain – dislocations



(Hernandez-Estrada, Gusovius, Müssig & Hughes, 2016)

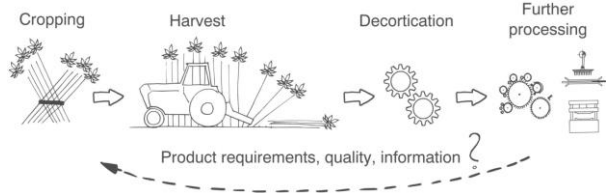


(Hernandez-Estrada & Hughes, 2015)

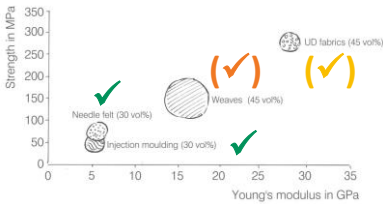


Bauer McNett set-up used in this current work. (The correspondence between the sieve number and the openings in mm are taken from Kuo and Acharya (2012) as also shown).

Conclusion: The Importance of Fibre Quality for Industrial Applications



- ✕ Quality management along the production chain!
- ✕ A consistent quality is very important!
- ✕ NFRC have the potential to be used as a structural material to replace technical polymers or glass fibre-reinforced plastics.



The performance playground for flax & hemp composites. (adapted from Verpoest & Baets, 2012)



Thank you very much!

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