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An alternative processing route for hemp and other natural fibres for economical viable products

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ATB - Alternative Processing route for natural fibre plants

Objectives

Developing an alternative process line for conditioning and processing of wet preserved fibre plants, characterised by:

- reduction of processing costs,
- reduced investment in plant for fibre processing,
- higher raw material flexibility
- simplicity of the processing plant coupled with reliable operation,
- securing of product quality,
- reduction of energy and raw material consumption,
- processing of the whole plant mass without losses.

☞ **Alternative for bad seasons, bad climate regions, different products**

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Raw materials

Raw material:
Fresh harvested
plant material

Raw materials:
- chopped wood
- milled bamboo
- …

Raw material:
wet preserved flax

Raw material:
wet preserved hemp

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Process Chain




harvest → preservation → plastification → defibration →




→ drying → binder-application → fleece-forming → pressing

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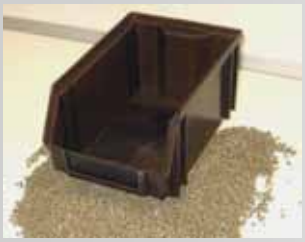
End products



NFC for low quality applications
(granules made of PE & w.p. hemp)

Fibre board (test sample) from hemp silage fibres with lactic acid and glucose as binder

Door panel made of wooden fibres produced in ATB

FUTURE: NFC (automotive door panel)
(Source: Flake 2003)

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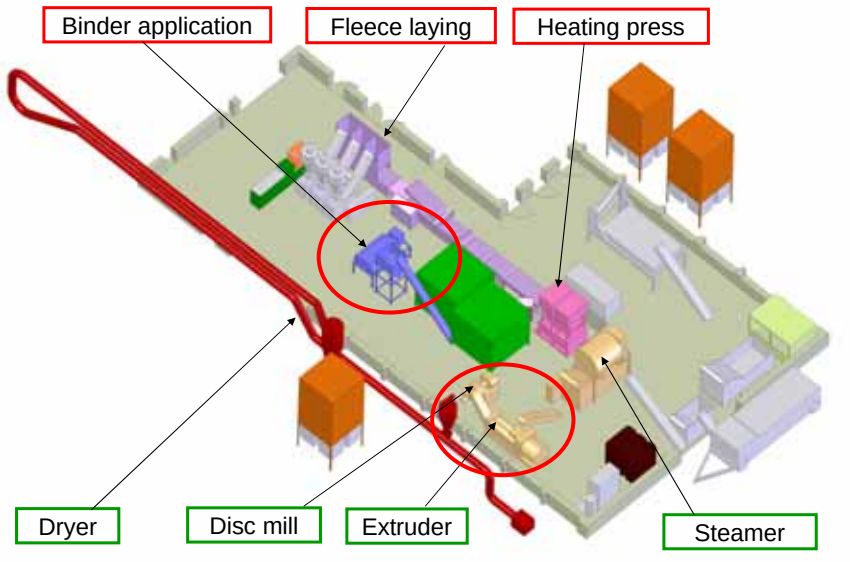
Pilot plant – scheme



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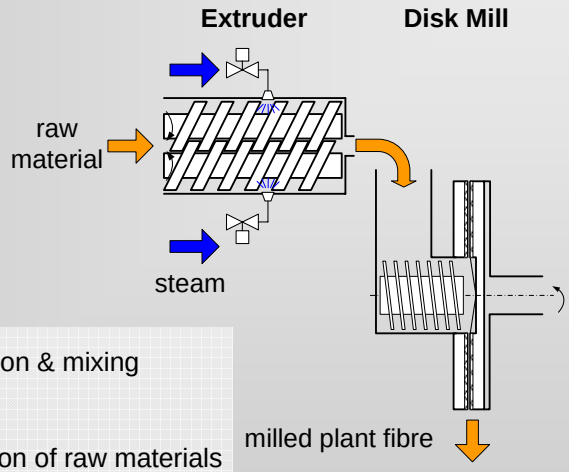
Fibre Milling / Defibration



- Raw material variation & mixing
- Moisture content
- Chemical composition of raw materials
- Particle morphology
- Reduction of energy demand

Binder application

The mixing machine for binder application (ATB)

- Material morphology
- Reduction of binder quantity
- Binder application:
  - size of the droplets
  - revolution of the mixing bars
  - different binders
  - mathematical modeling
- Application of natural binders
- Quality of the end product: strength, water resistance

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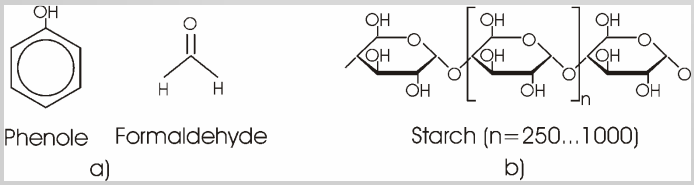
Binder application

- Not optimized binder quantities (distribution, dissipation, mixing)
- Use of synthetic harmful binders
- Particles and binder agglomeration
- Influence of the moisture
- <u>For natural binders:</u> dissolving in water, water content, viscosity, adhesion



Binder molecules: a) synthetic b) natural

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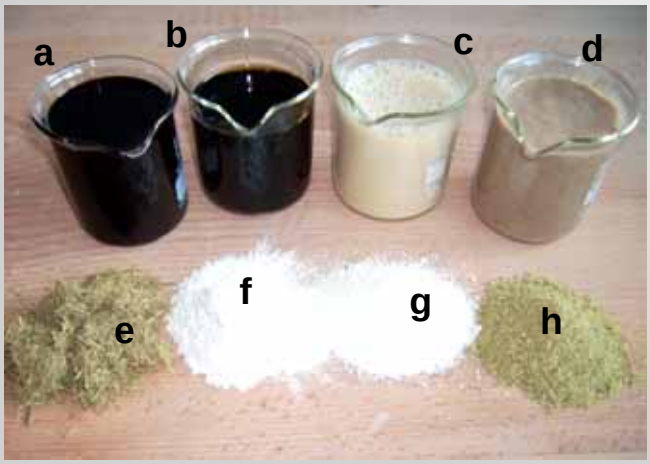
Binder systems in research/use



a) Phenol-Formaldehyde Resin, **b)** Solution of lactic acid, Glucoses, **c), d)** Plant rests of Glucoses production, **e)** Hemp fibres, **f)** Starch, **g)** Celluloses, **h)** canola press cake

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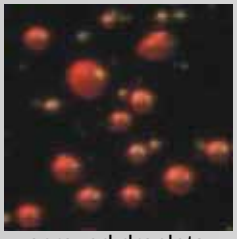
Binder application

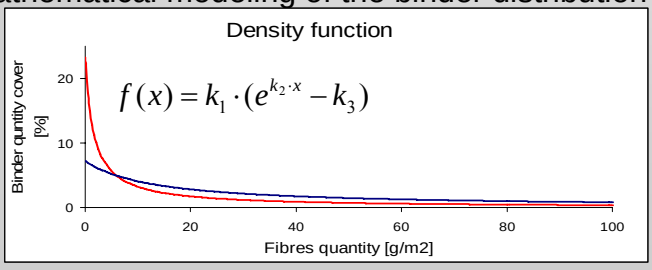
Binder distribution (1x1mm sections):


sprayed droplets


droplets distribution


picture analysis

Mathematical modeling of the binder distribution



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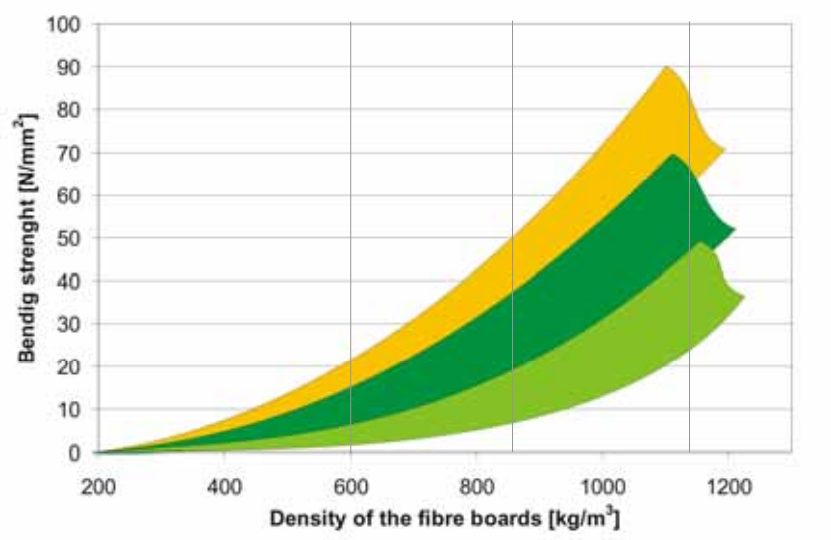
Results



The bending strength of the fibre boards:
wood (10% PF), hemp (6-10% PF), hemp (natural adhesives)

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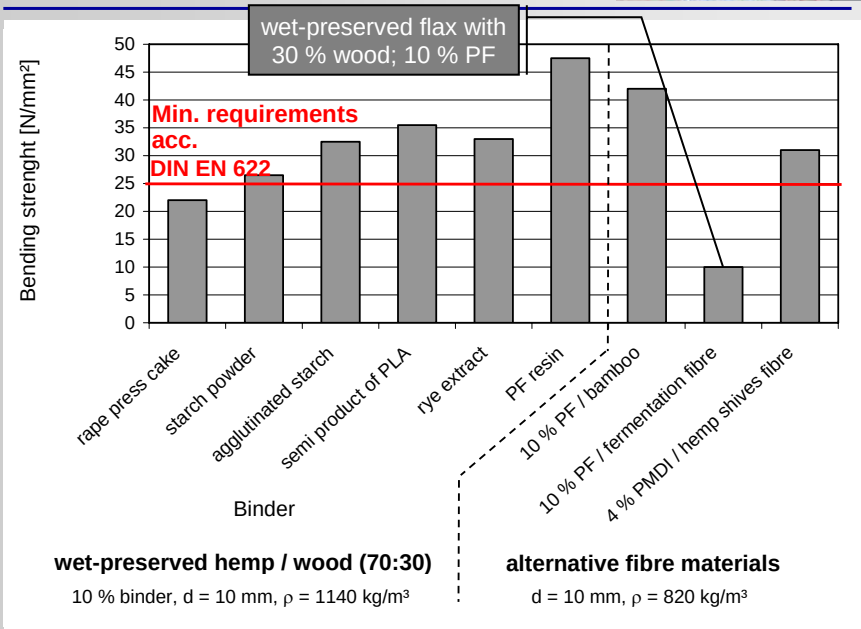
Results



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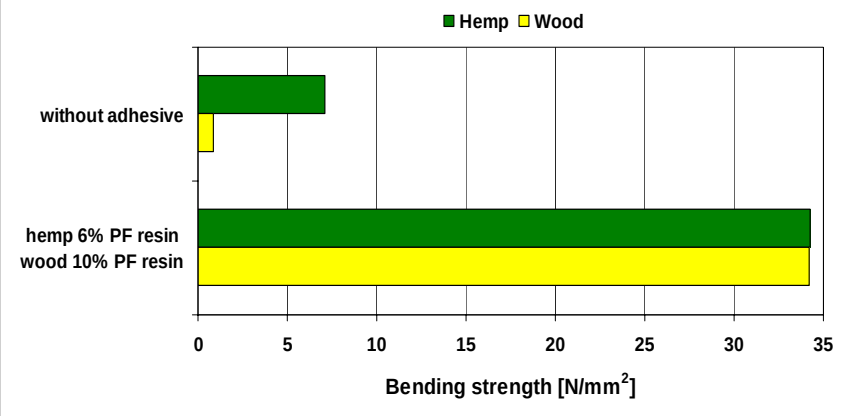
Results



The bending strength of selected fibre boards made of hemp and wood fibres (thickness 10 mm, density 790 kg/m³, pressing 6 min. on 200°C)

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Chemical Analysis

Parameter	Unit	Hemp silage (Sample 1)	Hemp silage (Sample 2)	Hemp shives (dry)	Wood chips (dry)	Milled hemp with 30 m% shives	Milled hemp with 30 m% wood chips
		Raw materials				Products	
DM 105°C	%	25.89	26.24	90.03	85.90	93.94	93.26
pH-value	-	4.36	4.19	6.29	4.96	4.90	4.61
Crude fibre	% DM	47.37	47.64	57.47	70.69	48.79	50.99
Lactic acid	% DM	10.74	9.33	n.n.	n.n.	0,58	2.23
Ethanol	% DM	0.49	0.43	n.n.	n.n.	n.n.	n.n.
Propanol	% DM	n.n.	n.n.	n.n.	n.n.	n.n.	n.n.
Acetic acid	% DM	7,29	7,78	0,08	0,02	0,26	0,67
Propionic acid	% DM	0,46	0,49	n.n.	n.n.	0,03	0,05
Butyric acid	% DM	n.n.	n.n.	n.n.	n.n.	n.n.	n.n.
Valerian acid	% DM	n.n.	n.n.	n.n.	n.n.	n.n.	n.n.
Capron acid	% DM	n.n.	n.n.	n.n.	n.n.	n.n.	n.n.

Process Heat

n.n. not detectable

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Conclusions and Outlook

Conclusions:

- Novel processing technology for hemp reduces weather risk for harvest
- First test samples from production in a pilot plant
- By processing of wet preserved fibre plants the requirements regarding product quality can be met
- Production of fibre boards at competitive prices from wet preserved hemp is possible

Outlook:

- Investigation of different raw materials mixtures and natural binders
- Optimisation of all process stages to improve the product quality and reduce production costs
- Product development

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Deutschland
Land der Ideen

Thank you for your attention !

… and feel welcome in Potsdam.