Biobased Coating systems:

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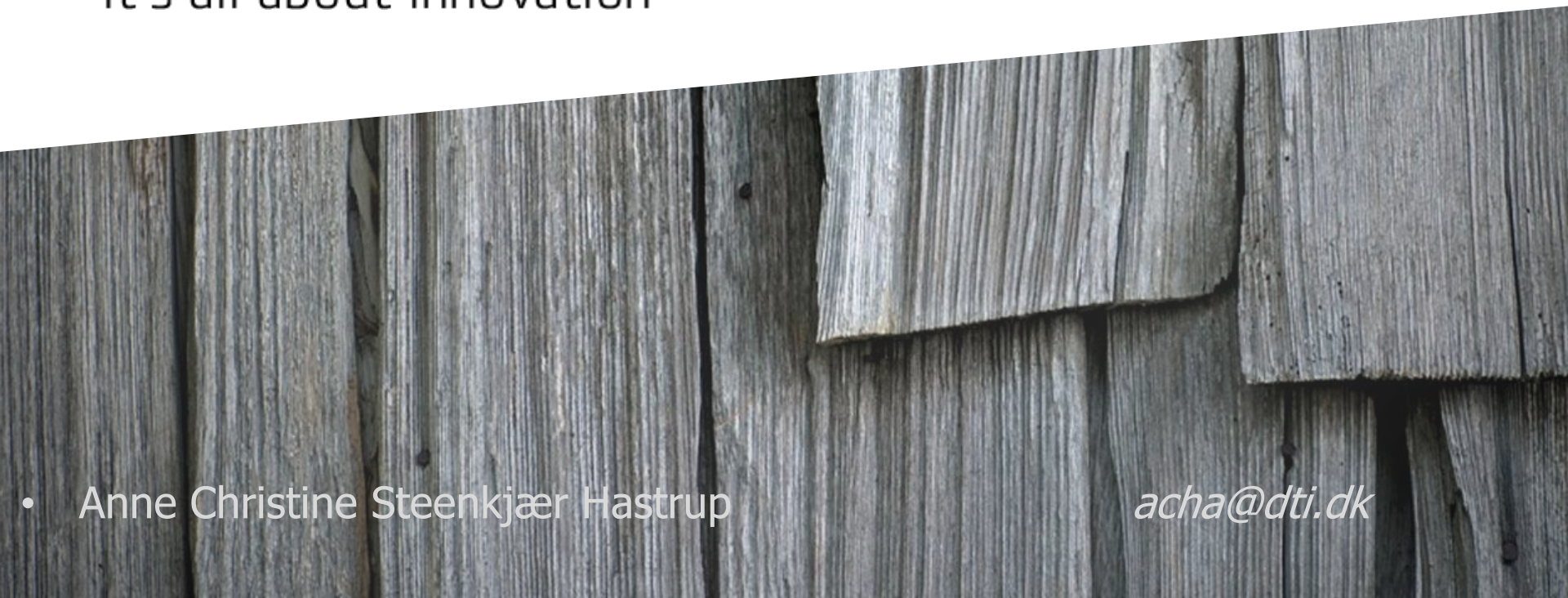
Wood Technology and Bio-based Materials

it's all about innovation



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Biobased Coating systems:
- Enzymatically modified alkyd for Bio-based Coating System

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Biobased alkyd coating systems

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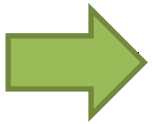
- International chemical regulations
- Interest for sustainable products
- More sustainable production methods



Larges interdisciplinary research project w. Universities, RTOs and industry partners

Objective of the project:

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Fully bio-based alkyd formulation

- Binder
- Filler
- Emulsifier
- Biocide

Binder: Alkyd

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- Traditionally prepared industrially at elevated temperatures from up to 50% fossil-based raw materials.

- The alkyd is a large polydisperse structures

- Cause the formation of a strong and continuous film that binds the remaining components and conceal the wood.

Binder: Alkyd

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- Objective was to prepare binders at reduced temperatures and with higher control over branching during synthesis

- Enzyme catalyzed bulk polymerization method
  - Is being patented

- Prepare alkyd from natural oils
  - Initial tests with rapeseed oil
  - However, insufficient branching of the alkyd
  - Other bio-based polyol were chosen

Binder: Alkyd

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- The advantage of applying an enzymatic catalyst for the reaction is that the reaction temperature can be lowered from the traditional 220-280°C to 90°C

- The enzymatic method is
  - Simple to perform
  - Robust
  - Allows more specific preparation of alkyds
  - Preventing the premature gelation

- Higher degree of control over the polymerization process
  = optimize binder structure to specific degree of branching

Binder: Alkyd

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- As a result of variations in chemistry:
  - Enzymatically produced alkyd had
    - significantly lower glass transition temperatures
      - - 60 °C for the enzymatic alkyd vs Tg -40°C for the traditional alkyd due to more uniform chemical structure.
  - Selected alkyds showed photostability beyond 350 hours in QUV tests
  - Improvement of hydrophobicity and photostability was achieved by increased branching level of alkyds, resulting in an optimized composition.

Binder: Alkyd

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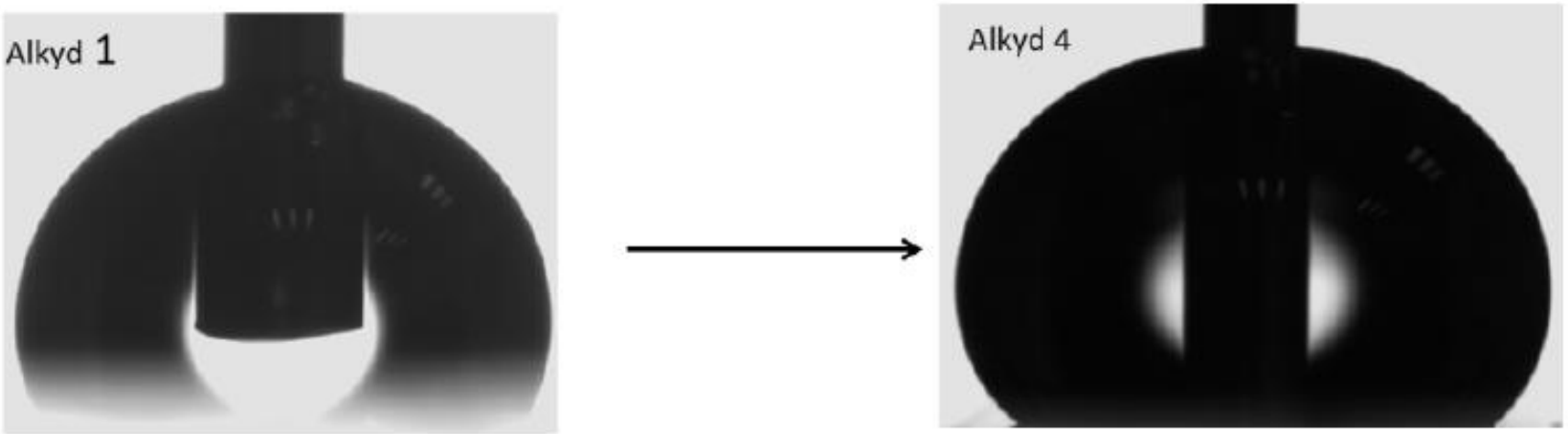
- The coating produced based on the enzymatic alkyd was observed to have outstandingly improvements regarding hydrophobicity, with an advancing water contact angle (WCA) of 109° vs. 70° in traditional alkyd

Reduces water absorbance during rainfall



Binder: Alkyd

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- The next important step for the commercialization of products from enzyme catalysed processes
  - Successful industrialization
  - Upscaling and economic feasibility of the reaction.
    - Enzymes must be reused many times
    - Up-scalable method for separation of the enzyme particles from the viscous alkyd after synthesis

Filler

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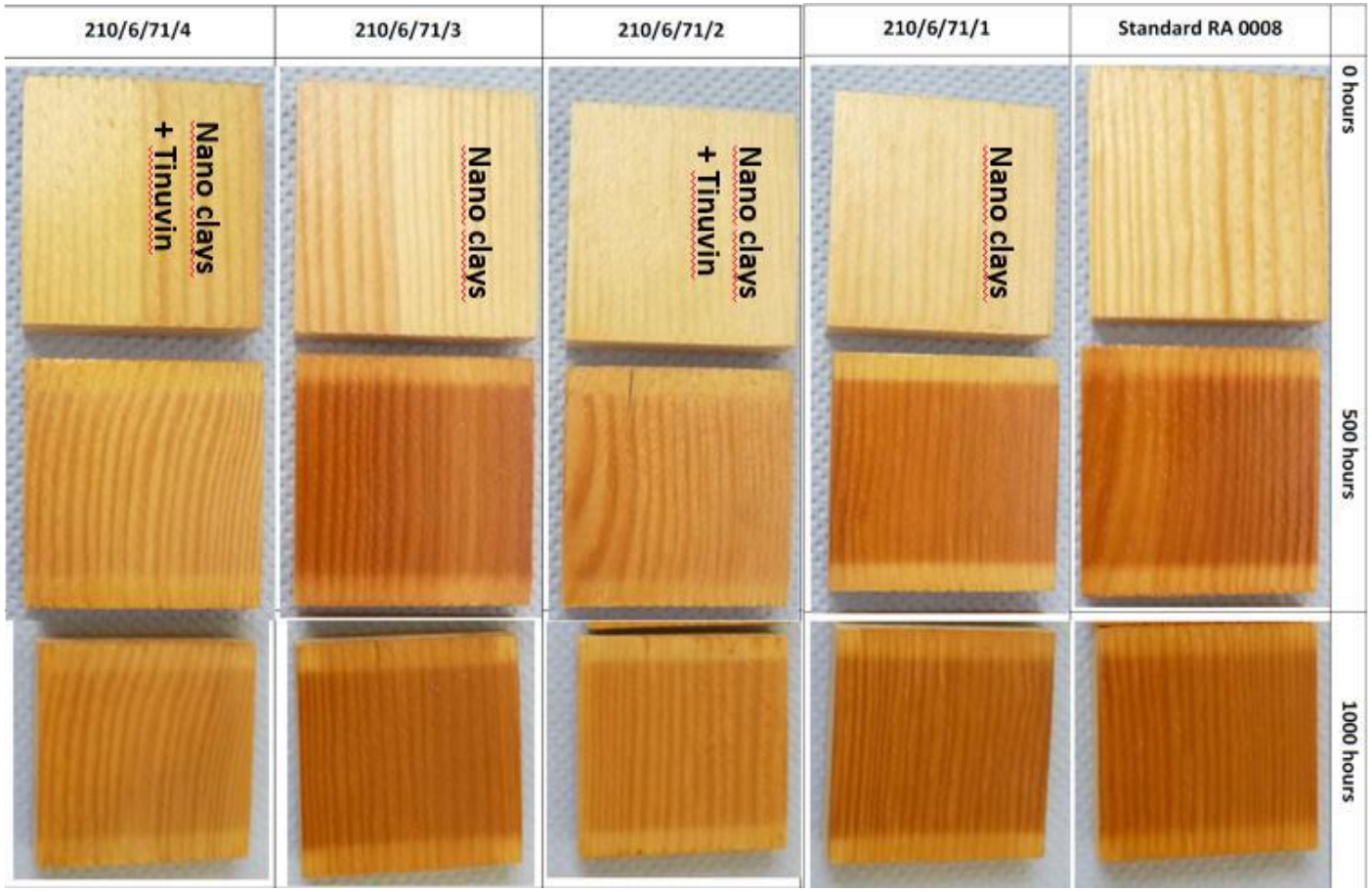
- Nanoclay
  - For better UV resistances



QUV test on treated wood panels

Filler

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- Nanoclay
  - Hydrophobic modified nano-particles
  - Showed higher tensile strength and stiffness
    - However not too much loos in flexibility
  - Help in crack resistance with outdoor exposure
  - Nano silica may lead to improved polymer stability due to increased resistance to water
    - Outdoor test are running

Emulsifiers

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- Fatty-acid based, vegetable oil
  - to obtain a water based product

- SLR: An anionic polymeric emulsifier based on vegetable oil
  - contains chemical functionalities, which may enable it to react with the alkyd during curing
  - Thus the emulsifier could end up being an integral part of the coating.

⇨ Improving hydrophilicity to the dry film.

Emulsifiers

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- Further advantages as biocide:
  - show good indications for the use as in-can preservative as a replacement for DIT/MIT.
  - The control of bacterial and fungal seemed to be related to simply disrupting the cell membrane.
  - The potential as wood protection agent was regarded inadequate.

Biocide

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- The enzymatic approach
  - Choosing organism-specific attacking points like pullulanases (breaks down the conidial glue, pullulan, produced by *Aureobasidium pullulans*, blue stain fungi)
  - Chitinases (breaks down the chitin in all fungal cell walls)

- Test with encapsulated enzymes (proteases encapsulated in silica powder)
  - Successfully substitution for IPBC when not in the formulation
  - Low effect was observed when in the film

CONCLUSION

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- More work is needed to incorporated these components in the final coating formulation
- The individual components needs to be scalable and commercialized
- Long term durability testing, leaching and fungal testing is needed

Nordic network on biofibers

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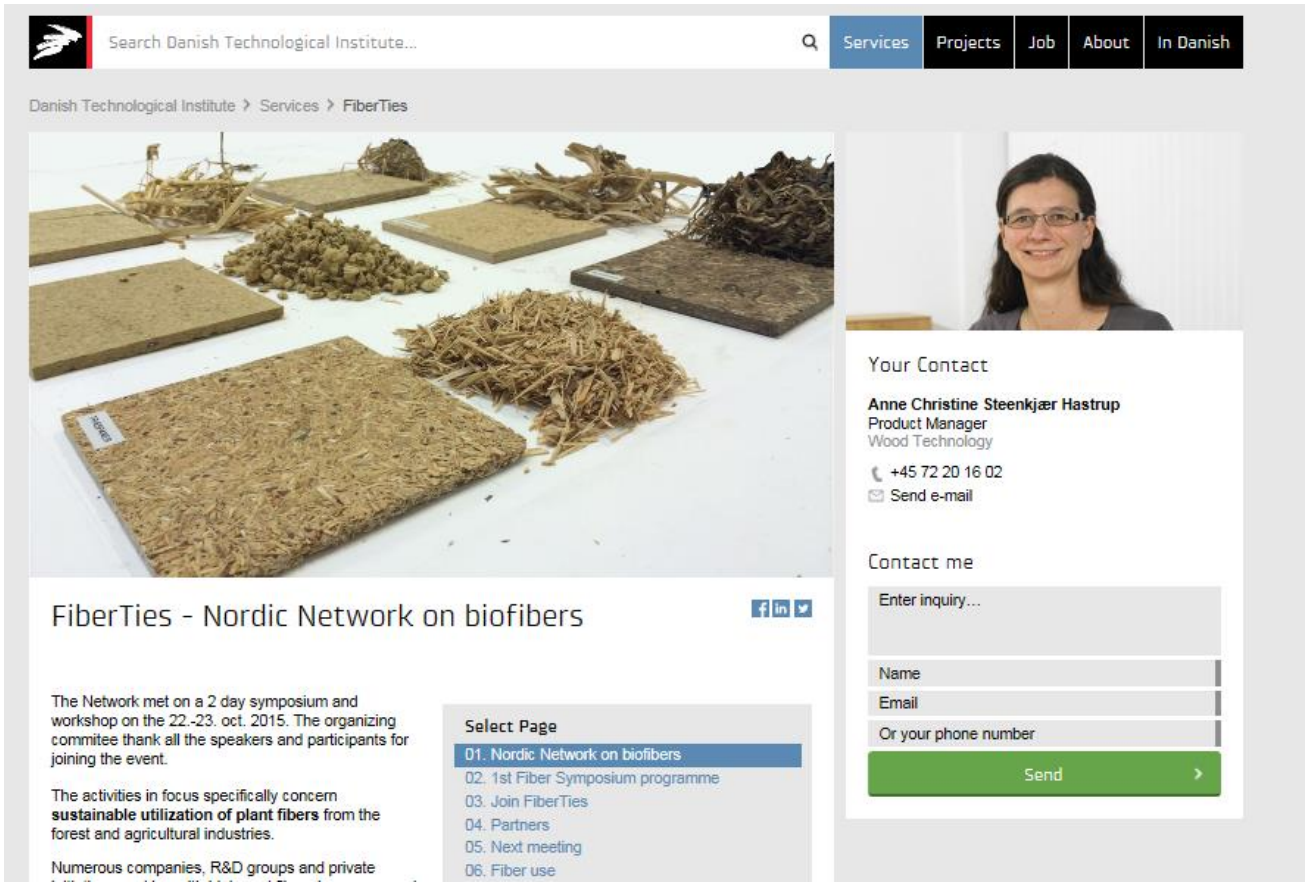

FiberTies

Participating partners

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Norwegian University of Life Sciences (NMBU), **NO**
Norwegian Forest and Landscape Institute, **NO**
Swerea IVF, Sweden, **SE**
SP Technical Research Institute of Sweden, **SE**
Aalto University, Wood Material Technology, **FIN**
JCH Industrial Ecology limited, Bangor, **UK**
University of Wales, Bangor University, **UK**
Danish Technical University, **DK**
Agrotech, **DK**
University of Copenhagen, **DK**

FiberTies

Next meeting

DANISH TECHNOLOGICAL INSTITUTE

28. – 29. November 2016:

Day 1: **Fiber Composites**

Day 2: **Extraction of fibers and pulping processes**

At the Danish Technological Institute in Taastrup, Denmark

For more information …

www.fiberties.dk

FiberTies


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Thank you for listening
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