Residential fire solutions in the building sector

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Residential fire solutions in the building sector

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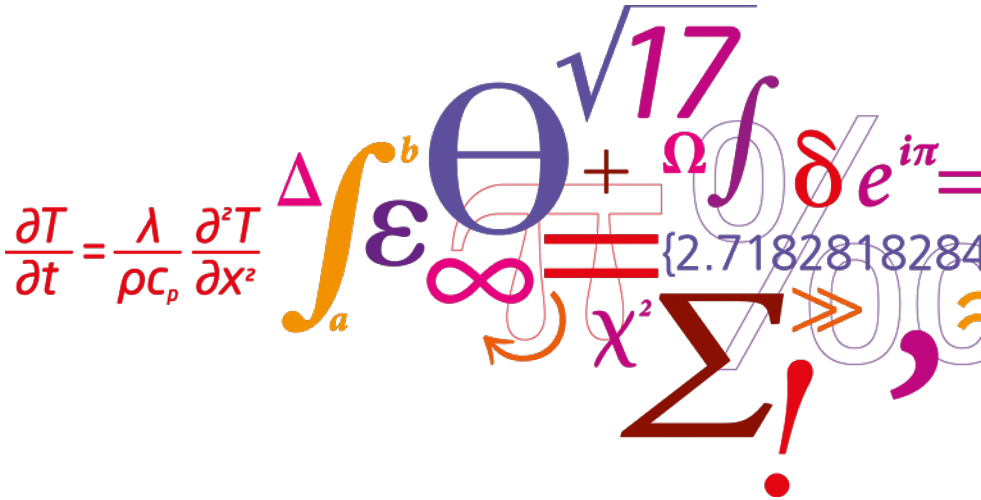

Biomaterials and residental fires

- **the current work on biomaterials and composites intends to find**:
  - sustainable solutions using biomaterials in construction with a focus on fire safety
  - Different methods for production and fire testing of bio-based materials and composites will be reviewed
  - Hereunder, the fire properties of bio-based resins as lignin is investigated.

Biomaterials and residential fires ?

- **There is a (new) demand for alternative sustainable construction materials**
  - New material combinations to reach new technical and commercial targets
  - Wish for “natural” surfaces, facades, structures
  - Materials with high insulation
  - Healthy indoor climate

- **Materials need to fulfill certain demands**, as:
  - Emissions: e.g. minimum VOC
  - Physical- mechanical properties, similar to wood-based products
  - Demands from Fire Safety Engineering

Sustainable buildings

Improved properties concerning:

- **Energy reduction** –> better insulation
- **New Energy systems** -> production: solar panels, fuel cell systems; energy storage: batteries, heat storages
- **Circular economy** -> construction materials need to be reusable

- **Sustainability** versus **fire safety engineering -> both need to be assessed**
  - **maybe not sufficiently considered in practise?**
    - **->** the recent accidents Grenfell tower fire, gigantinum, Rødovre etc.

How to protect ?

- What is the area of application of the new building material?
  - Indoor, outdoor ?
  - Shall it be reusable within circular economy?

- Is it possible to protect by shielding or intumescent paint?

- Fire resistant building materials:
  - What present FR system shall be used?
    - Boron based ?
    - Aluminium hydroxide ?
    - Ammoniumphosphate based ?
    - Other protection ?

Fire retardents

- **The application of flame-retardants is a common solution**,

- but
  - many flame-retardants have adverse effects to human health and the environment..
  - An example are boron compounds, which are widely used as flame-retardants to reduce the ignitibility of biomaterials,
  - a number of these compounds are on the ECHA list, because of toxic concerns
  - borates tend to wash out, and may impact the surrounding environment.
  - Therefore, its application may become questioned in the future.

Development of new biocomposites

Potentialer / muligheder

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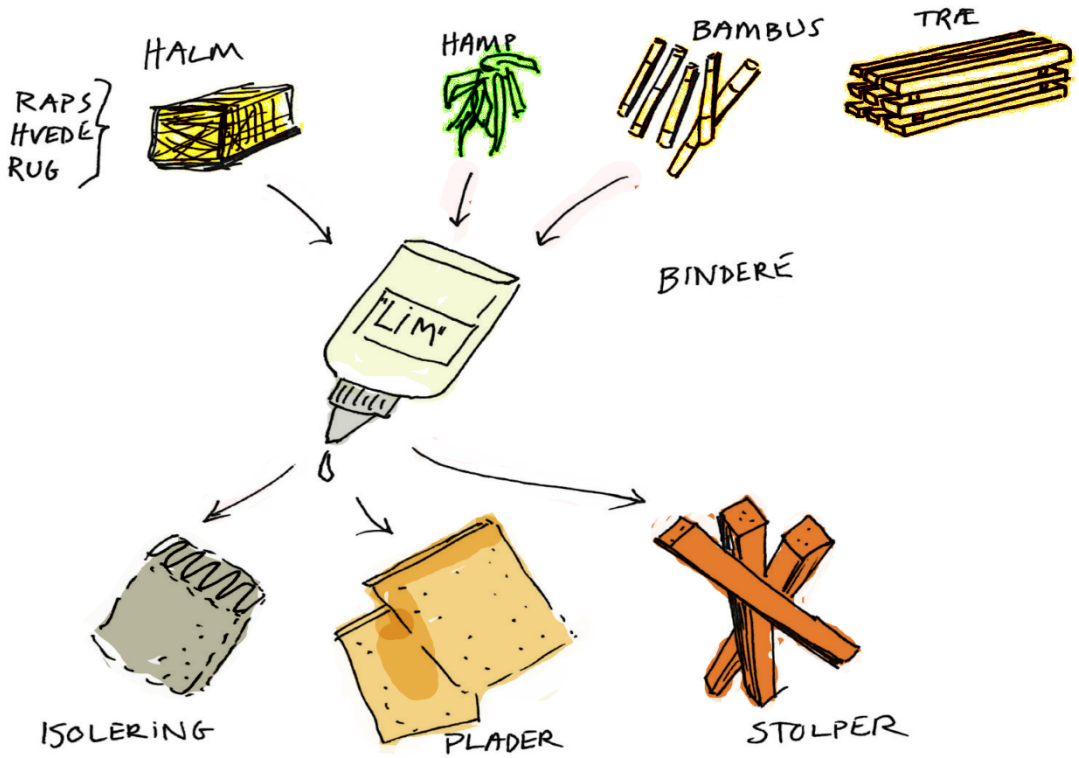


Separation in components

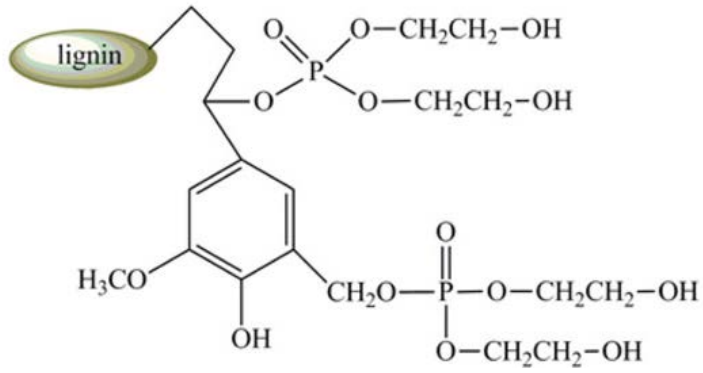
Pressing to plades

Literature example: Using Lignin in FR systems for polyurethane

Xing, W. et al., 2013. Functionalized lignin for halogen-free flame retardant rigid polyurethane foam: Preparation, thermal stability, fire performance and mechanical properties. Journal of Polymer Research, 20(9), pp.1–12.

Table 1 Formulations of PU composite foams based on Lignin-POH and

FR by mass percent fraction.				
Sample	MDI	Polyol	Lignin-POH (wt.%)	PFAPP (wt.%)
PU	150	100	0	0
PU/PFAPP	150	100	0	15
PU/PFAPP/PL30	150	70	30	15



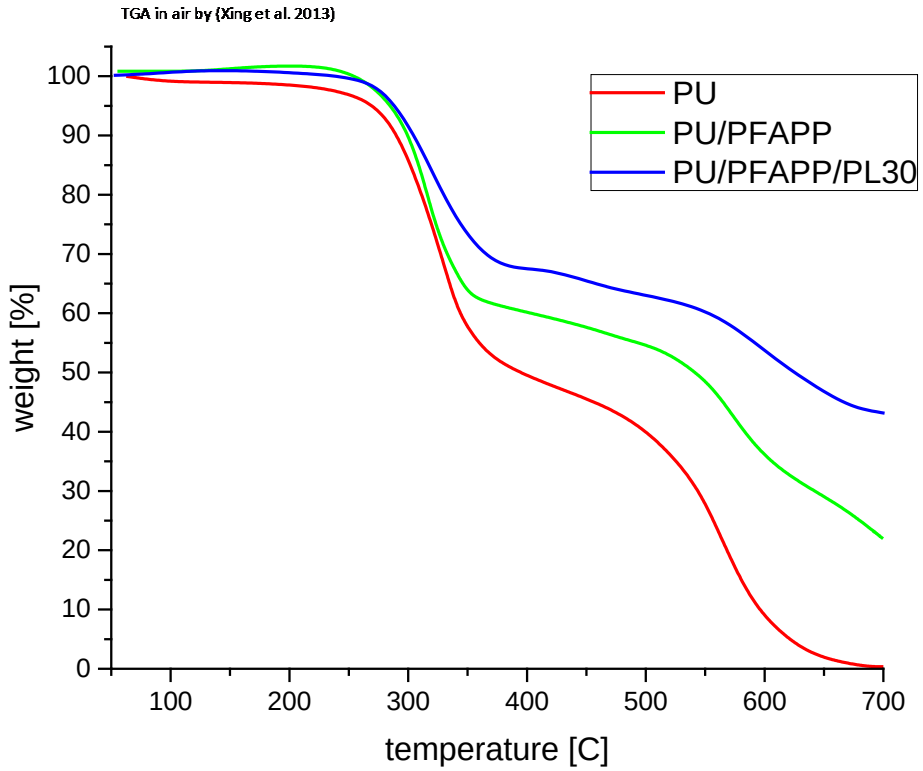
MDI – Methylene diphenol diisocyanat

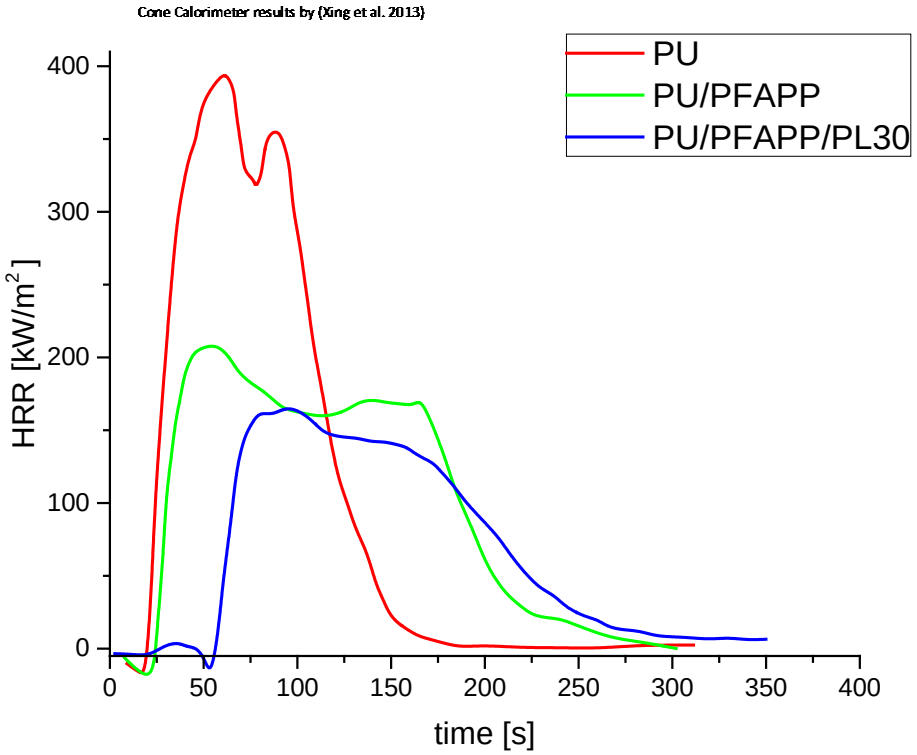
PFAPP - Microencapsulated APP

Lignin-POH (Xing et al. 2013)

Made form wheat straw alkali lignin

Flame retarded Polyurethane





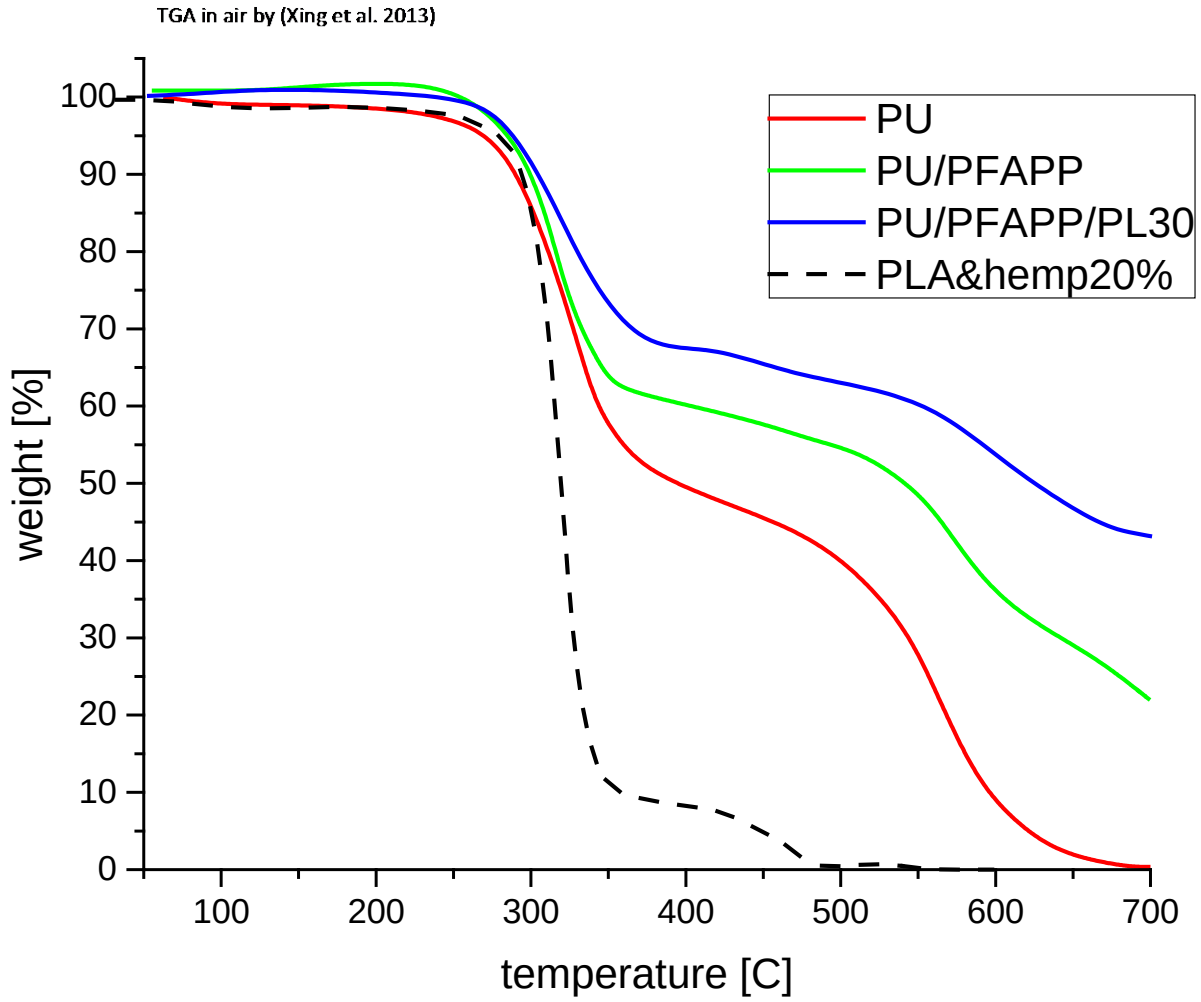
FR – PFAPP encapsulatet (phenol-formaldehyde) ammonium polyphosphate

PL30 – functionalized lignin replaces polyol by 30 %w/w

Potential for improvement?

Composites of hemp fibers &poly(L-lactide) acid (PLA)

Oxidative TGA results



Journal of Applied Polymer Science
Volume 105, Issue 1, pages 255-268, 10 APR 2007 DOI: 10.1002/app.26090
http://onlinelibrary.wiley.com/doi/10.1002/app.26090/full#fig11

Status of activities and next steps

First Plantfiber-lignin biocomposites are produced. The next step is to investigate the thermal properties using TGA and DSC and reaction to fire using cone /bomb calorimetry

THAT's ALL FOR NOW

THANK YOU

QUESTIONS ?

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