



Residential fire solutions in the building sector

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Residential fire solutions in the building sector

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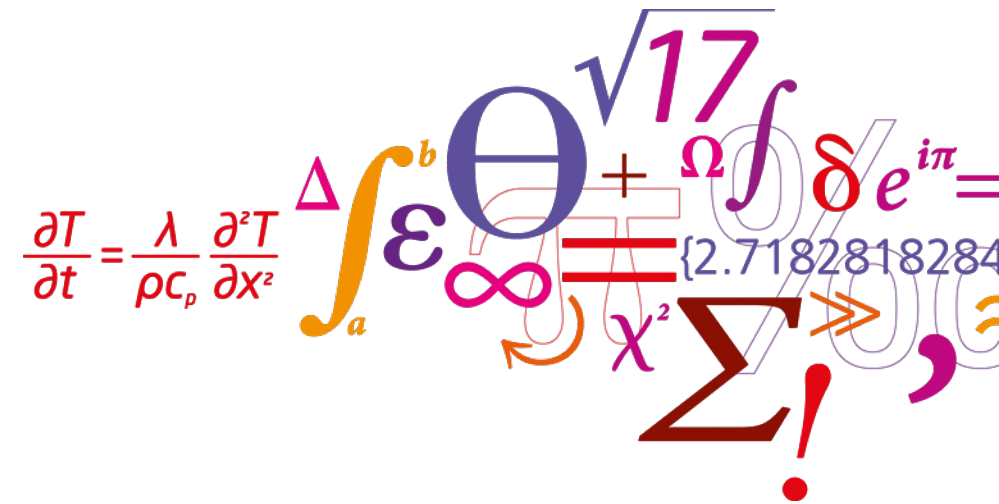
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Biomaterials and residential fires

- **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 ?

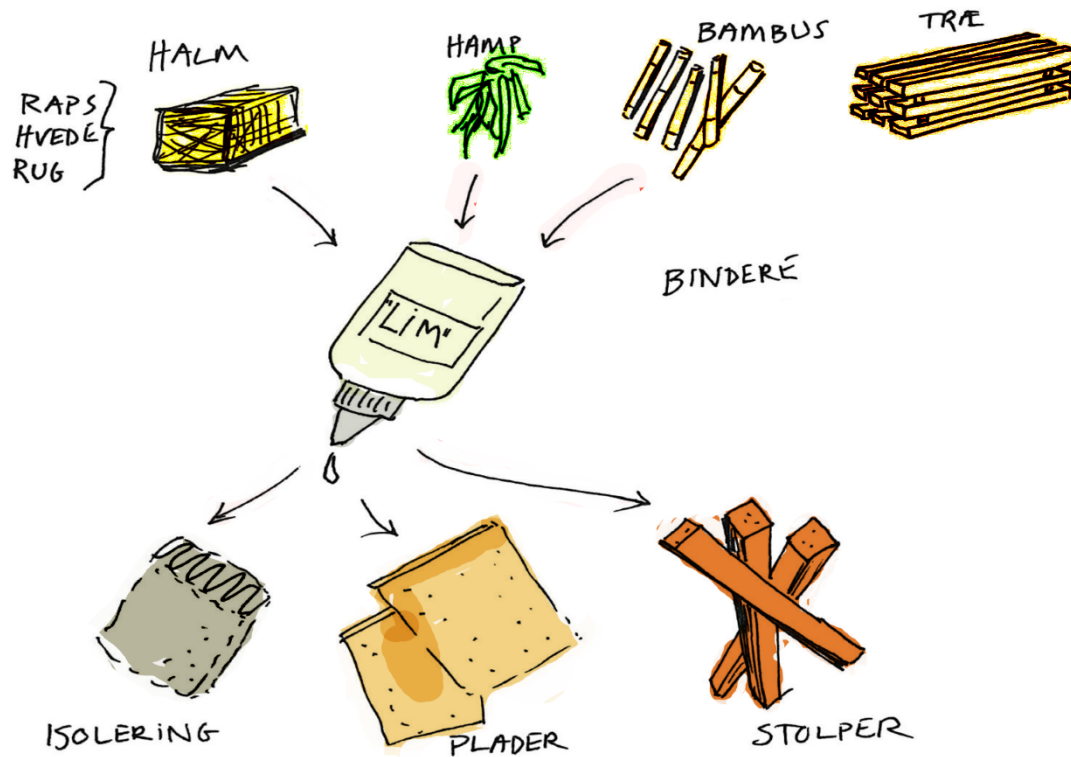
- What is the area of application of the new building material?
 - Indoor, outdoor ?
 - Shall it be reusable within circular economy?
- Is it possible to protect by shielding or intumescent paint?
- Fire resistant building materials:
 - What present FR system shall be used?
 - Boron based ?
 - Aluminium hydroxide ?
 - Ammoniumphosphate based ?
 - Other protection ?

Fire retardants

- **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



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:

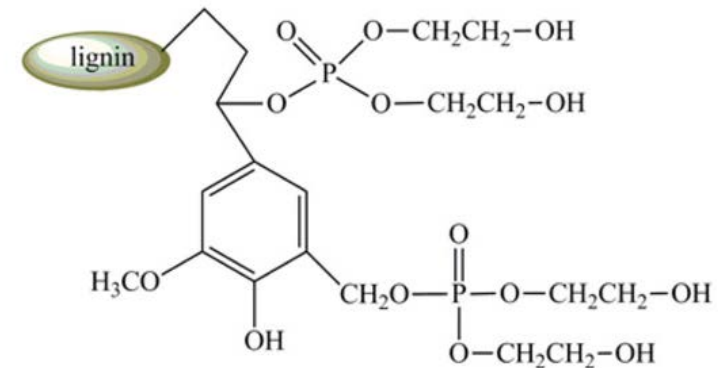
Preparation, thermal stability, fire performance and mechanical properties. *Journal of Polymer Research*, 20(9), pp.1–12.

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

<i>FR by mass percent fraction.</i>				
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

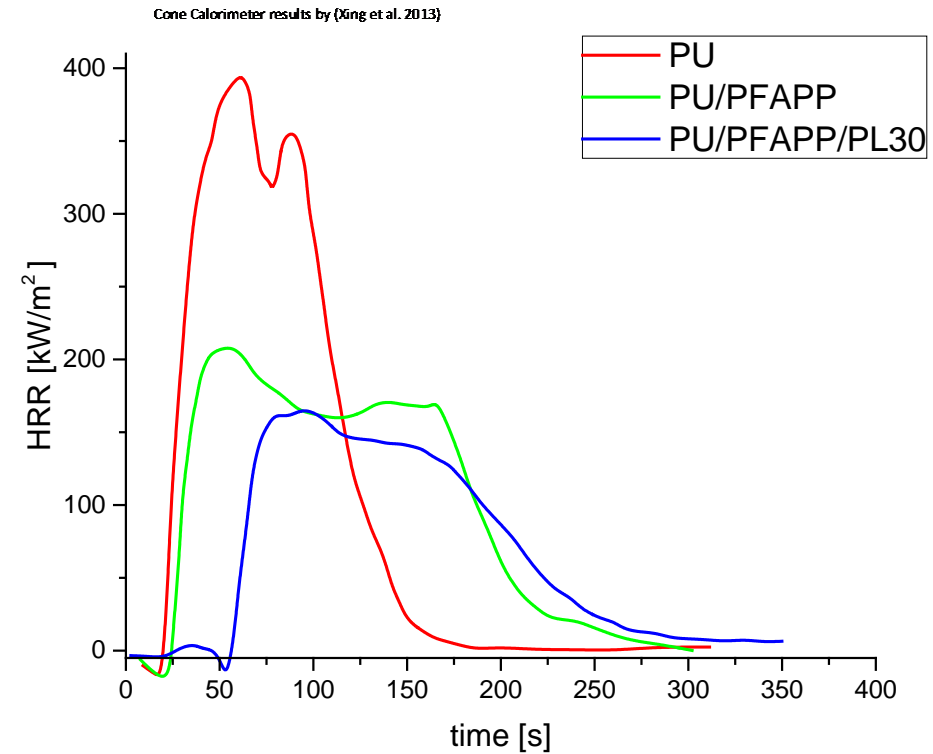
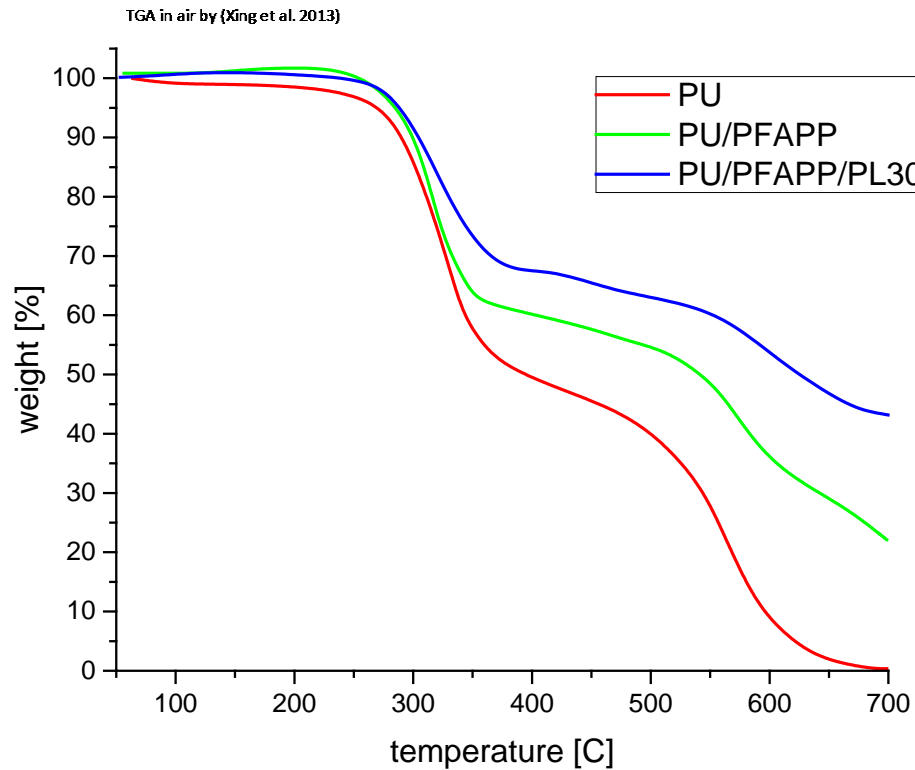
PFAPP - Microencapsulated APP



Lignin-POH (Xing et al. 2013)

Made from wheat straw alkali lignin

Flame retarded Polyurethane



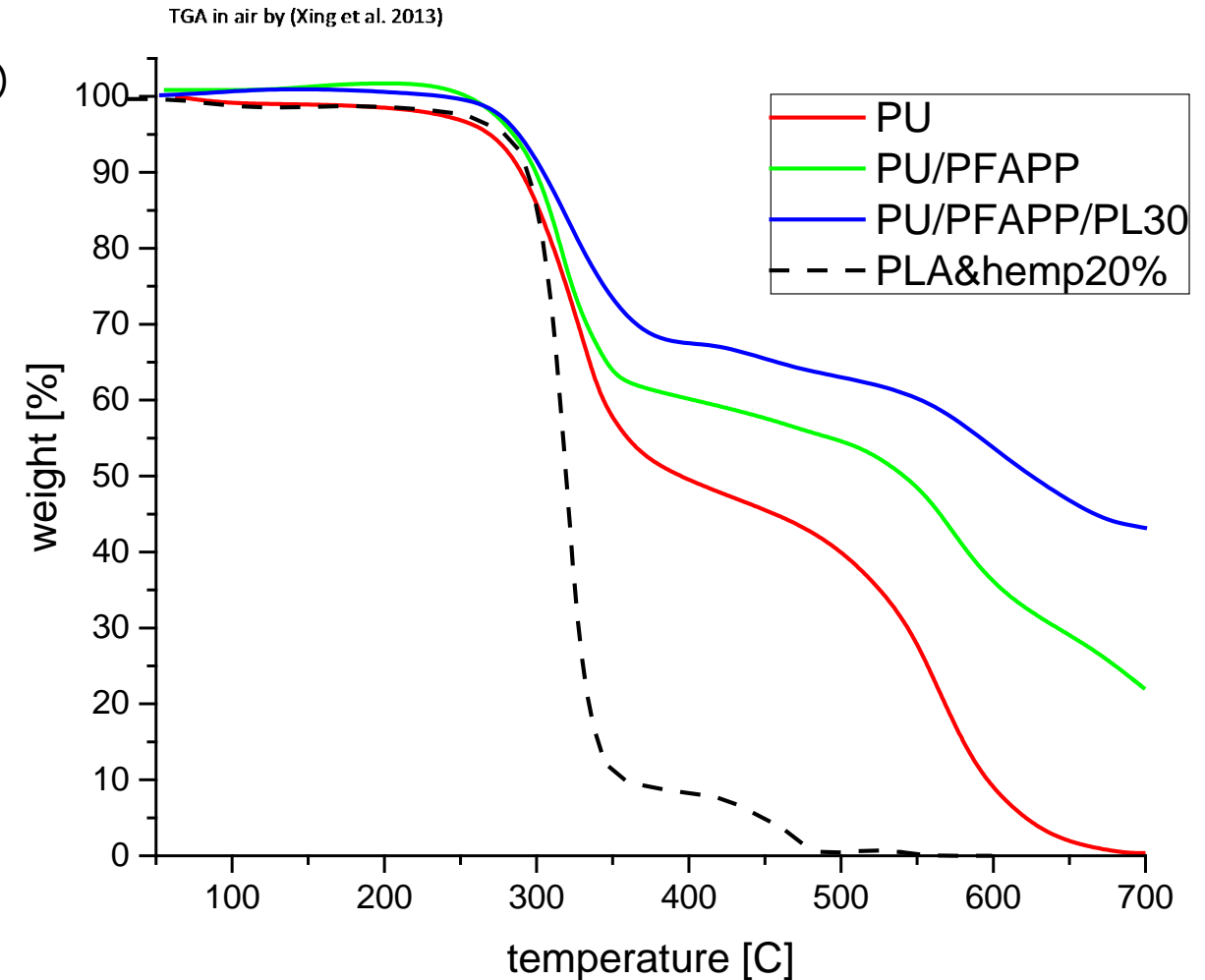
FR – PFAPP encapsulated (phenol-formaldehyde) ammonium polyphosphate

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

Potential for improvement?

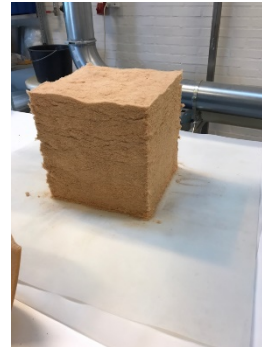
Composites of hemp fibers & poly(L-lactide) acid (PLA)

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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