Development of a laboratory testing concept for whole bio-based wall components against fungal colonisation

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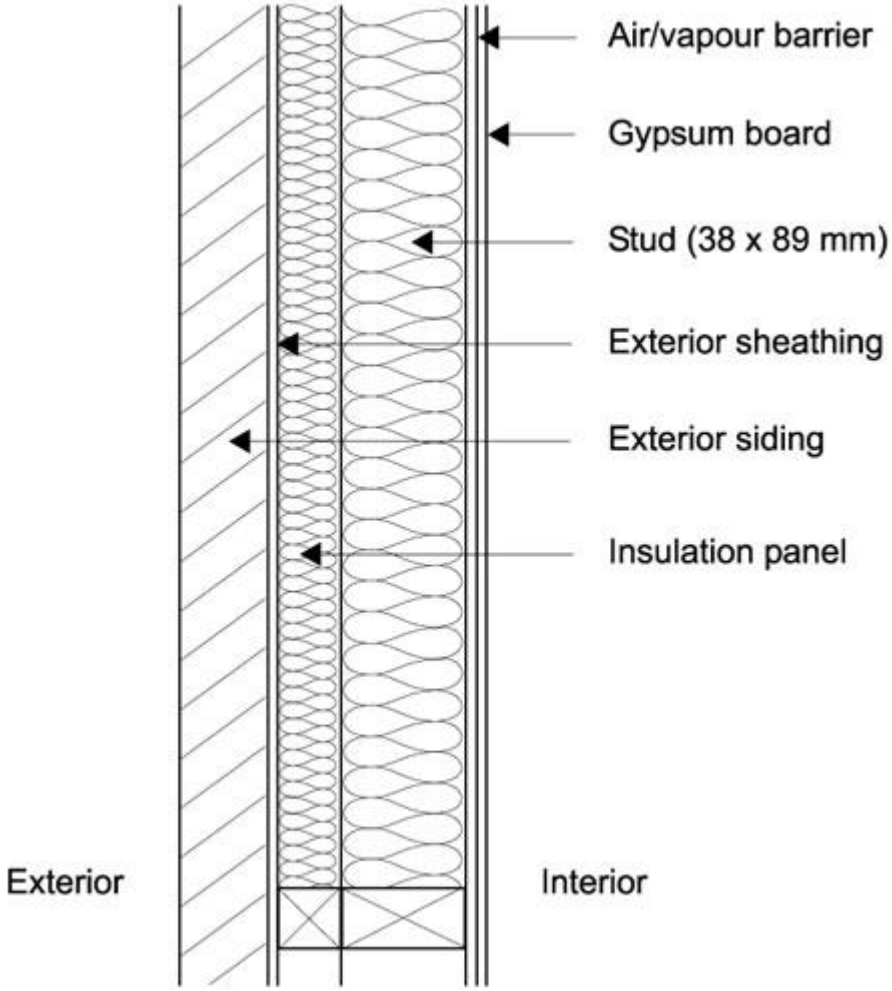
Introduction

- The use of alternative bio-based materials in building is on the increase.
- If a product is bio-based it runs the risk of microbial attack
- This may lead to structural, aesthetic or health problems.

Standard wall building

- A simple wall concept is the multilayer approach
  - Sheathing – e.g. wood/brick/blockwork
  - Structural elements
  - Vapour barrier
  - Cavity insulation
  - Ideally breathable but water resistant


Air/vapour barrier
Gypsum board
Stud (38 x 89 mm)
Exterior sheathing
Exterior siding
Insulation panel
Exterior
Interior

How do you stop microbial attack?

- Keep it dry!
- But need to plan for the worst case

Good design

A good design will use;

- Well tested / modelled components.
- Breathable and vapour permeable materials that prevent build up of water vapour in the cavity or on susceptible materials.
- Biocidal products to prevent attack.

Testing decay susceptibility

- Many standard methods for testing materials ranging from monoculture laboratory tests to outdoor exposure.
- Modelling of systems

Current study

- Investigated a number of insulation and wood panel products.
- Hygroscopic properties
  - immersion, liquid transport and vapour sorption
- Durability /decay resistance

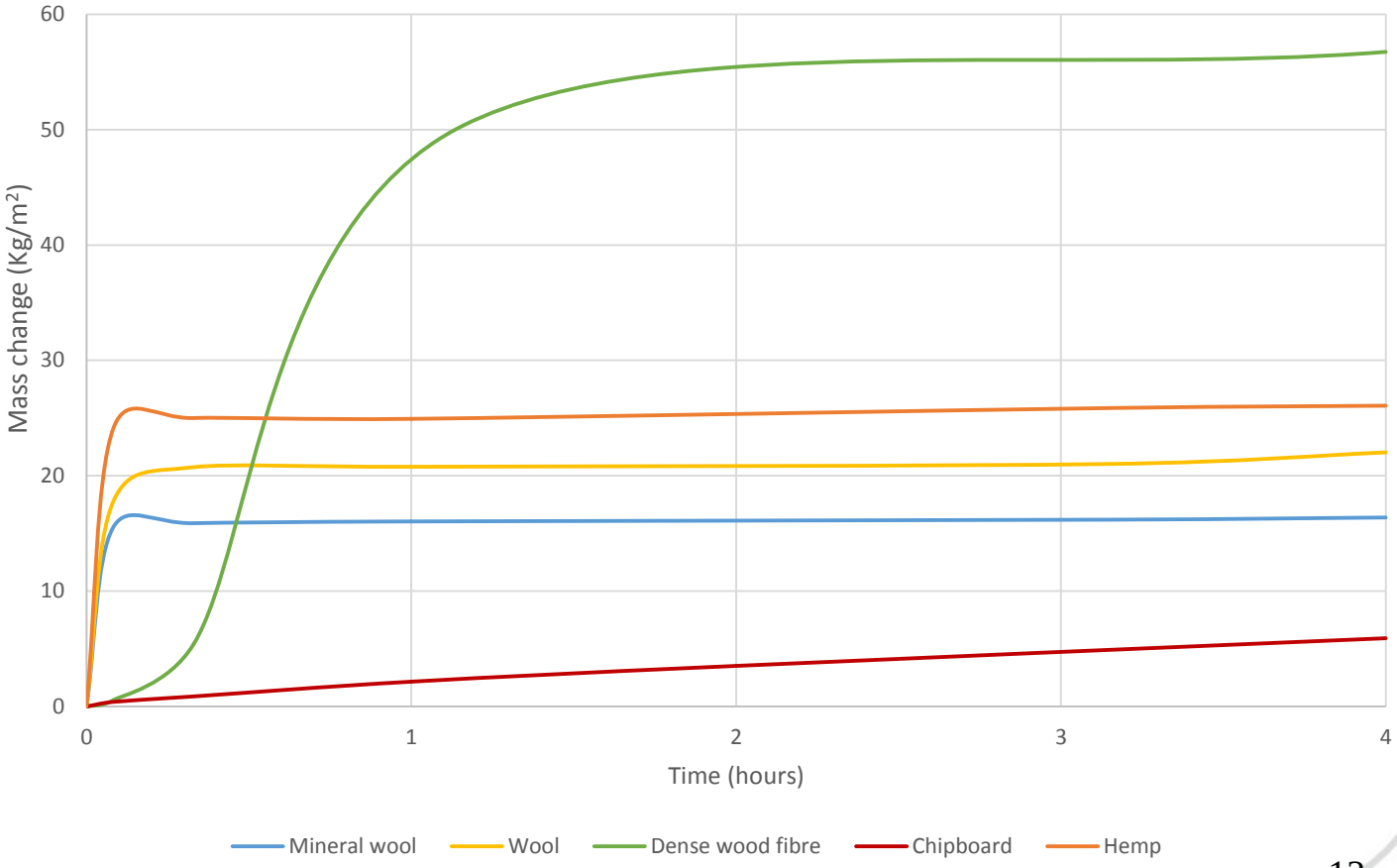
Materials

- Sheep's wool
- Mineral wool
- Dense wood fibre insulation
- Hemp insulation
- Chipboard/Particleboard

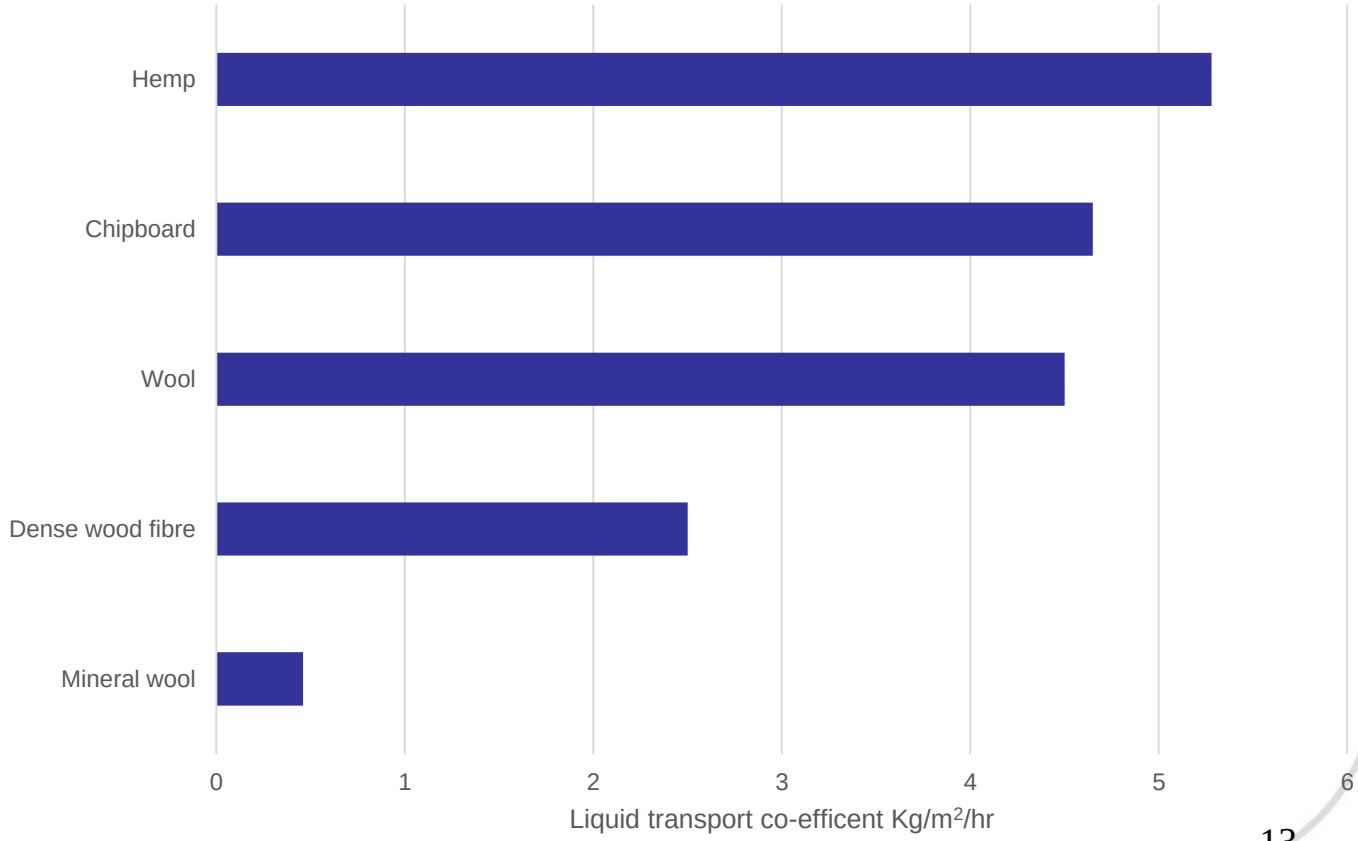
Hygroscopic properties

- Water absorption - partial immersion: EN 15148
- Liquid transport co-efficient: EN15148
  - Bottom of sample (>5mm) immersed into water
  - Uptake of water determined by mass change over time

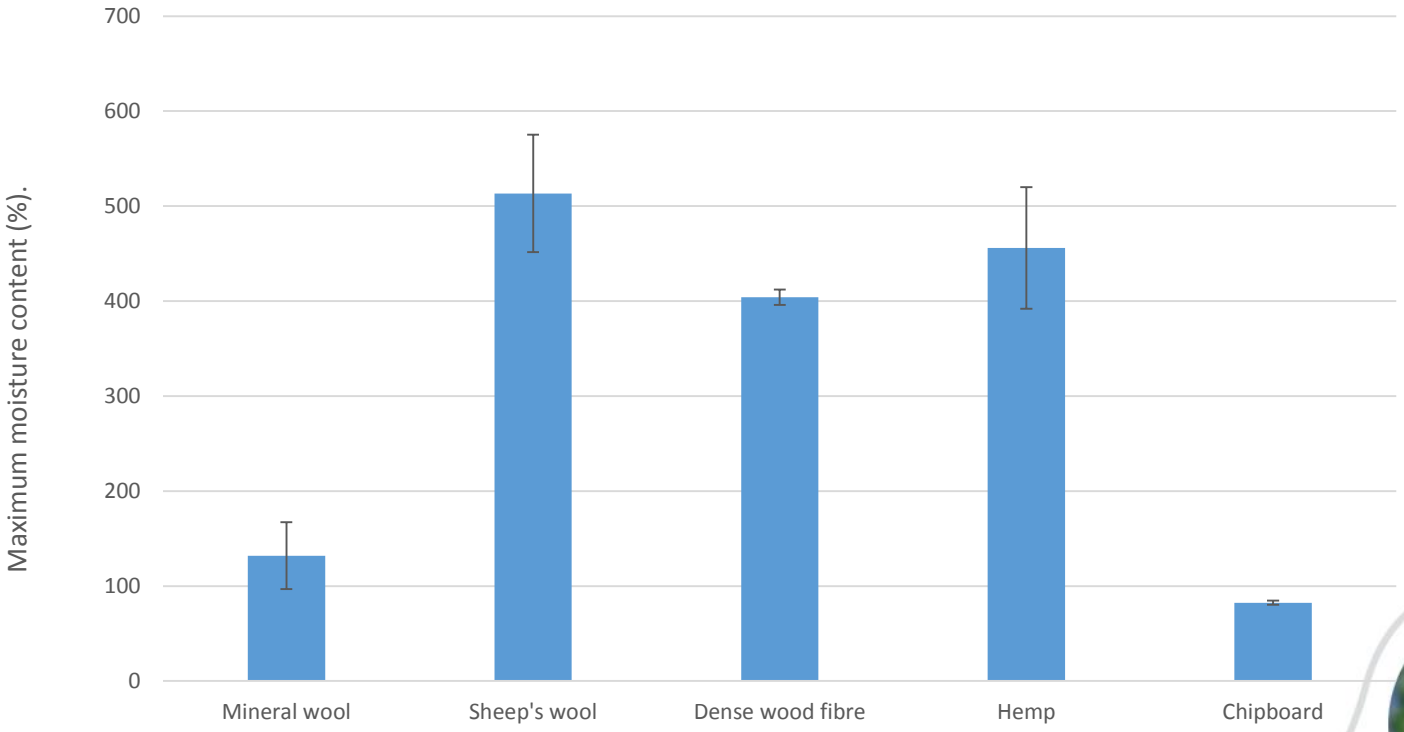
Water absorption by partial immersion



Liquid transport co-effcient



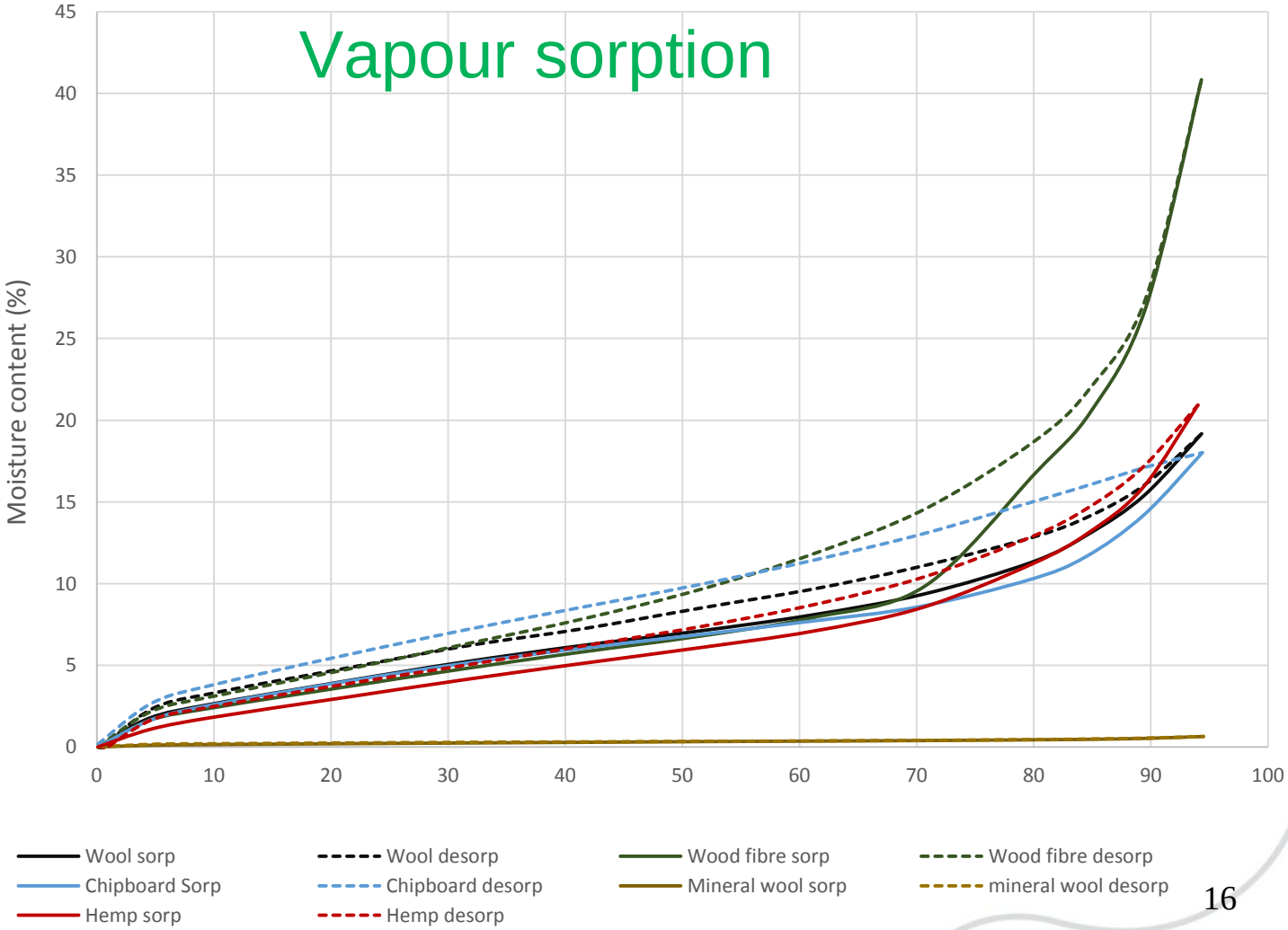
Maximum moisture content obtained



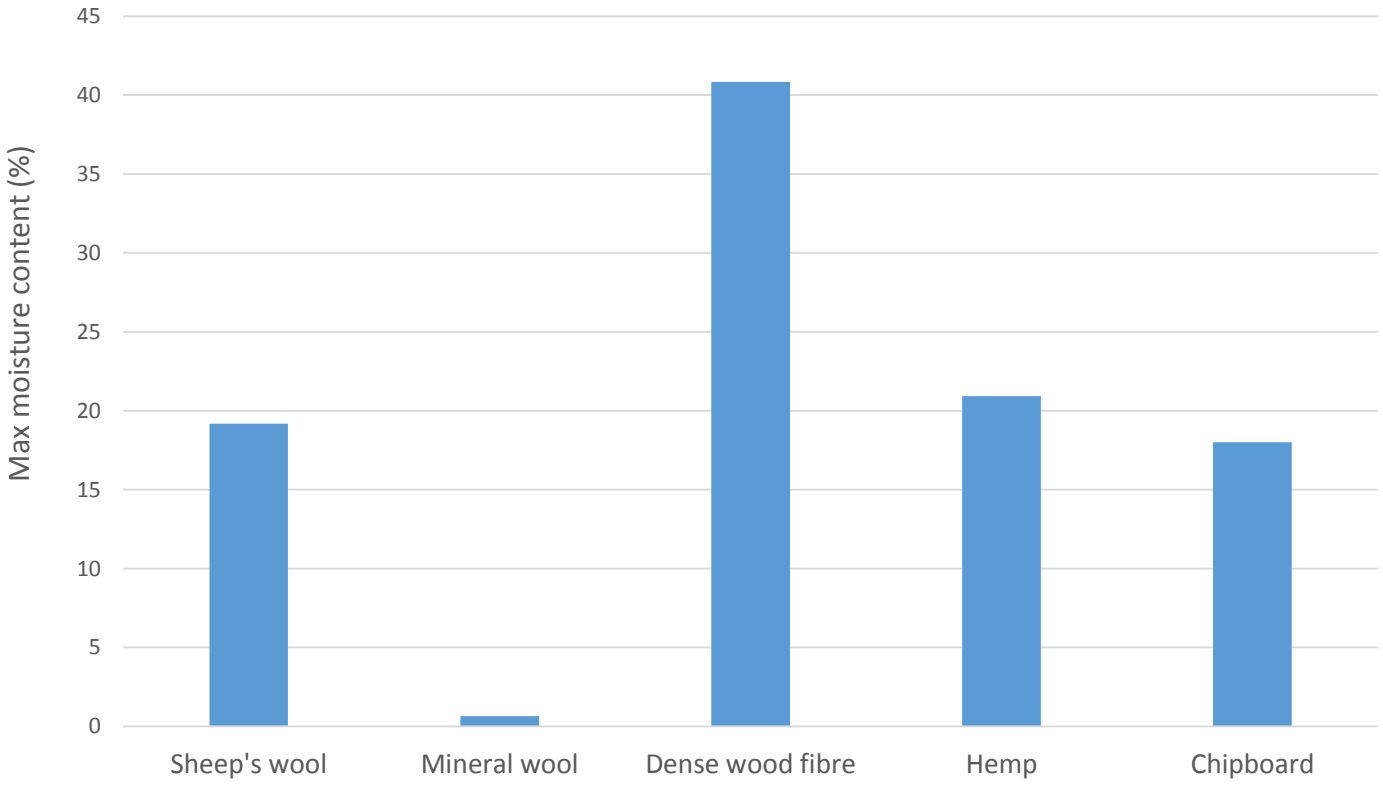
Dynamic Vapour sorption

- Small samples of material exposed to differing RH conditions
- Water absorption determined by mass change
- Isotherm developed from sorption/desorption curves.

Vapour sorption



Max moisture content obtained



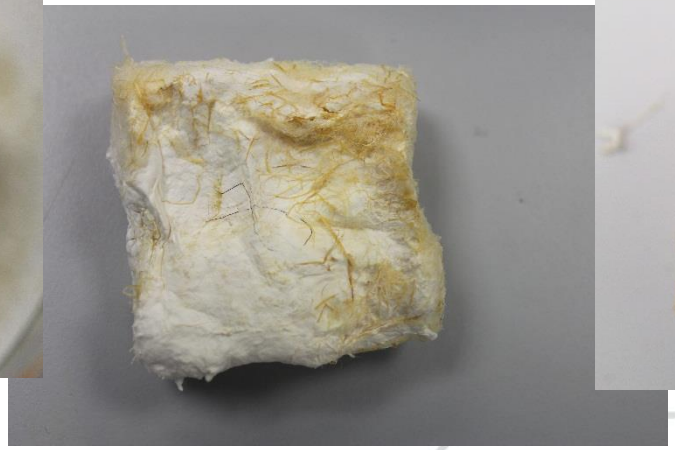
- The materials can all absorb enough water by contact that would raise the moisture content to levels high enough for microbial growth.

- The bio-based materials may also be able to absorb enough water via vapour sorption at high RH values.

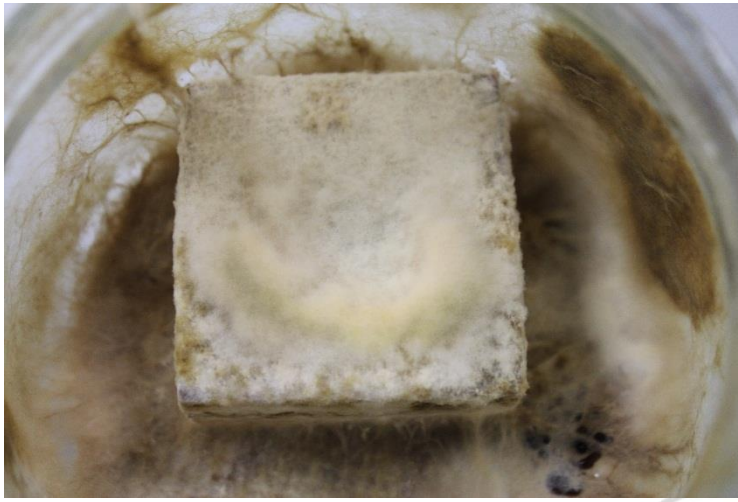
Decay susceptibility

- Modified EN113/ EN12038
- Recorded a visual assessment of fungal cover and normal weight loss criteria
- 16 week exposure to brown (*C.puteana*) and white rot (*C.versicolor*) causing fungi

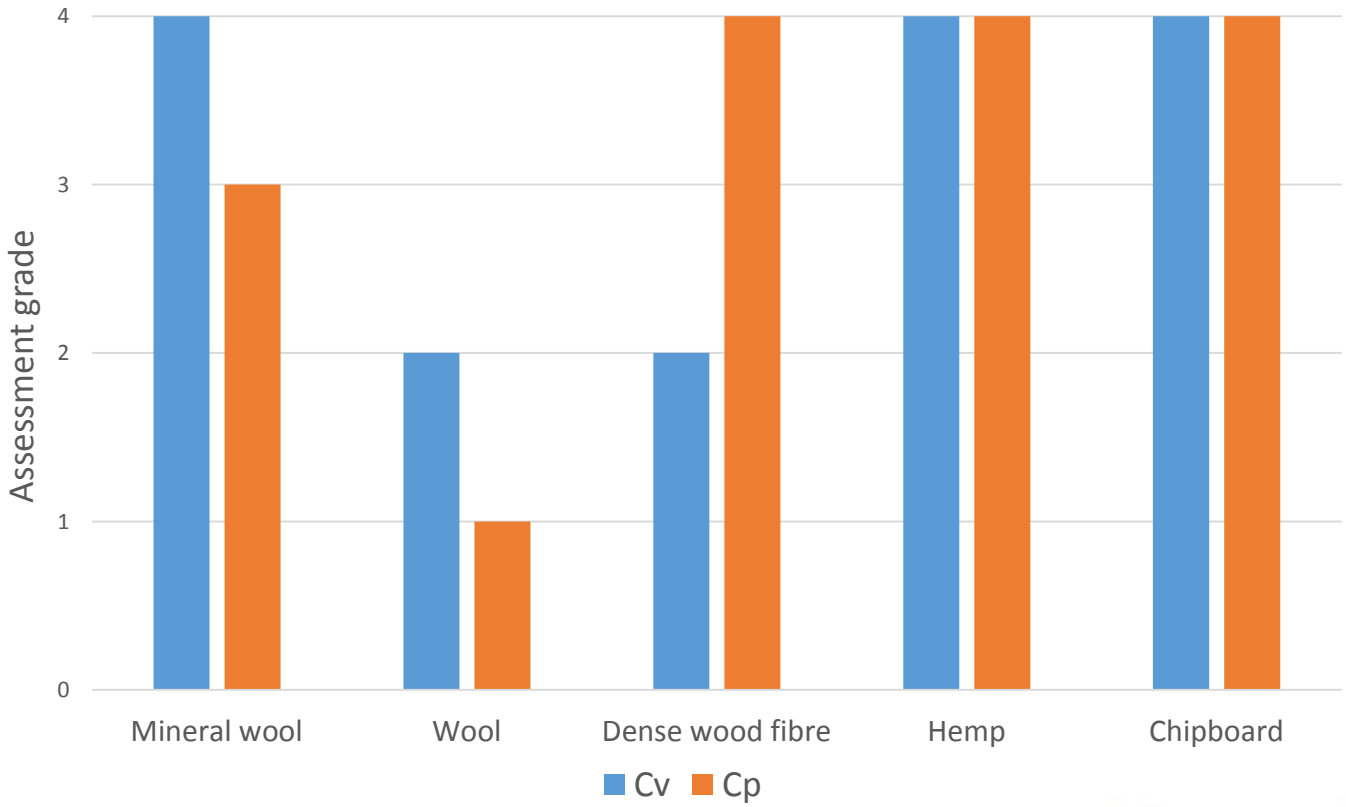
White rot



Brown rot



Fungal growth

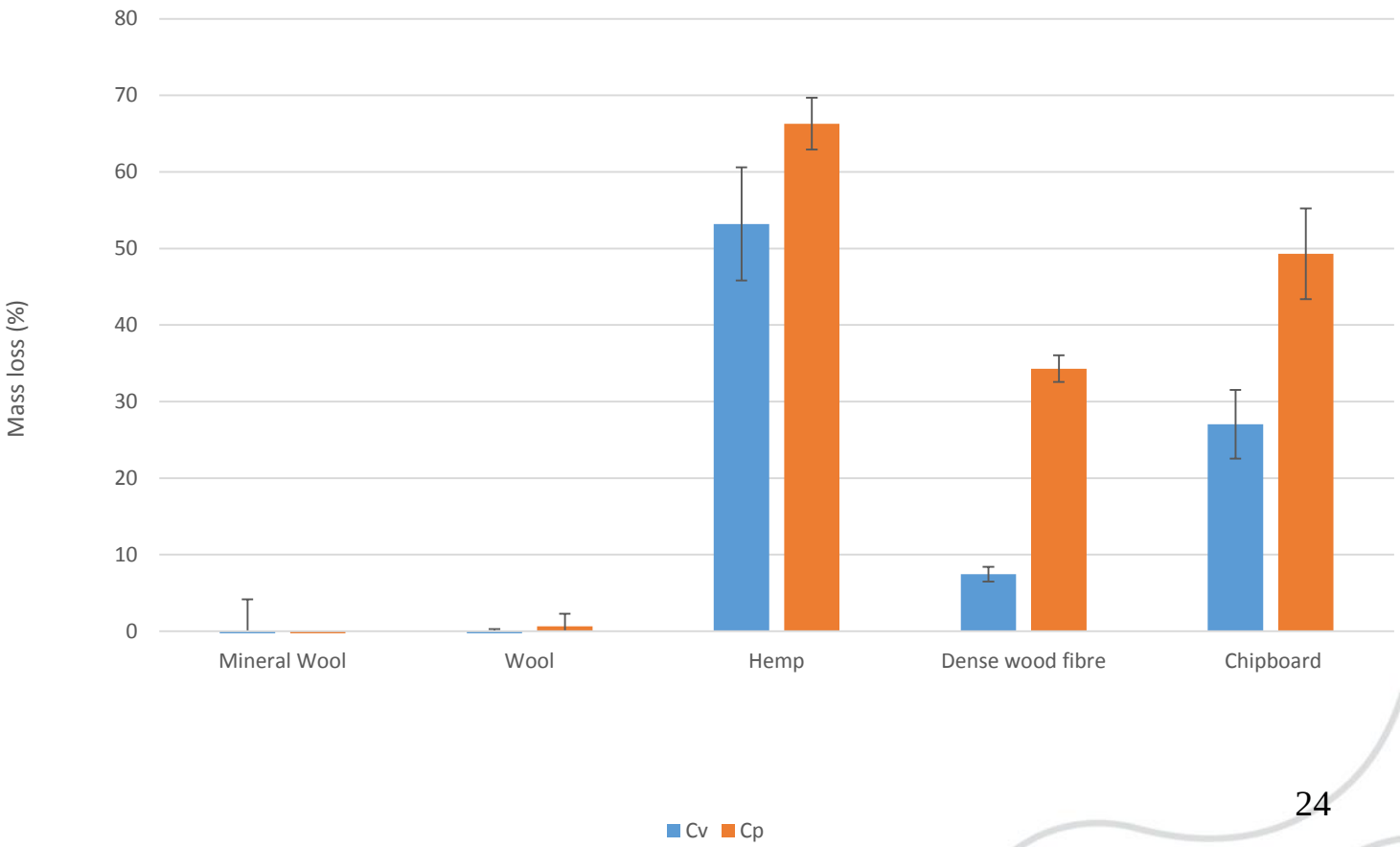


Assessment
0 = no coverage
4 = complete coverage

Fungal growth

- The fungi are able to grow throughout the plant/wood based materials
- Also able to grow very well on the mineral material
- Able to grow to some extent on the sheep's wool as well.

Mass loss


80
70
60
50
40
30
20
10
0
Mass loss (%)
Mineral Wool
Wool
Hemp
Dense wood fibre
Chipboard
Cv
Cp

Summary

- The bio-based materials are highly water absorbent to both liquid and vapour water. With mineral wool also highly absorbent in contact.

- The fungi are able to grow through or on all of the materials, though only the wood and plant based materials are actually degraded.

In case of failure…

- How will the materials act if there is a failure that lets water/vapour in?
- Could be beneficial – acting as a buffer before slowly allowing material to dry
- Could be detrimental - providing a moisture reserve and growth path for microbial organisms.

How will the materials interact?

- Service life inspection?
- Modelling?
  - Based on previous data of known materials
  - Novel materials and /or construction methods?
- Testing?

Testing – work in progress!

- Developing a method to test effects of material interactions on decay susceptibility.
- Stage 1 is to use feeder strips to determine whether cross inoculation will occur using a variety of methods.
- Aim is to eventually develop a lab exposure test that will test a whole wall component. E.g. for preformed modular components.

Acknowledgements

ECO-SEE

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Thank you for listening

- Any questions