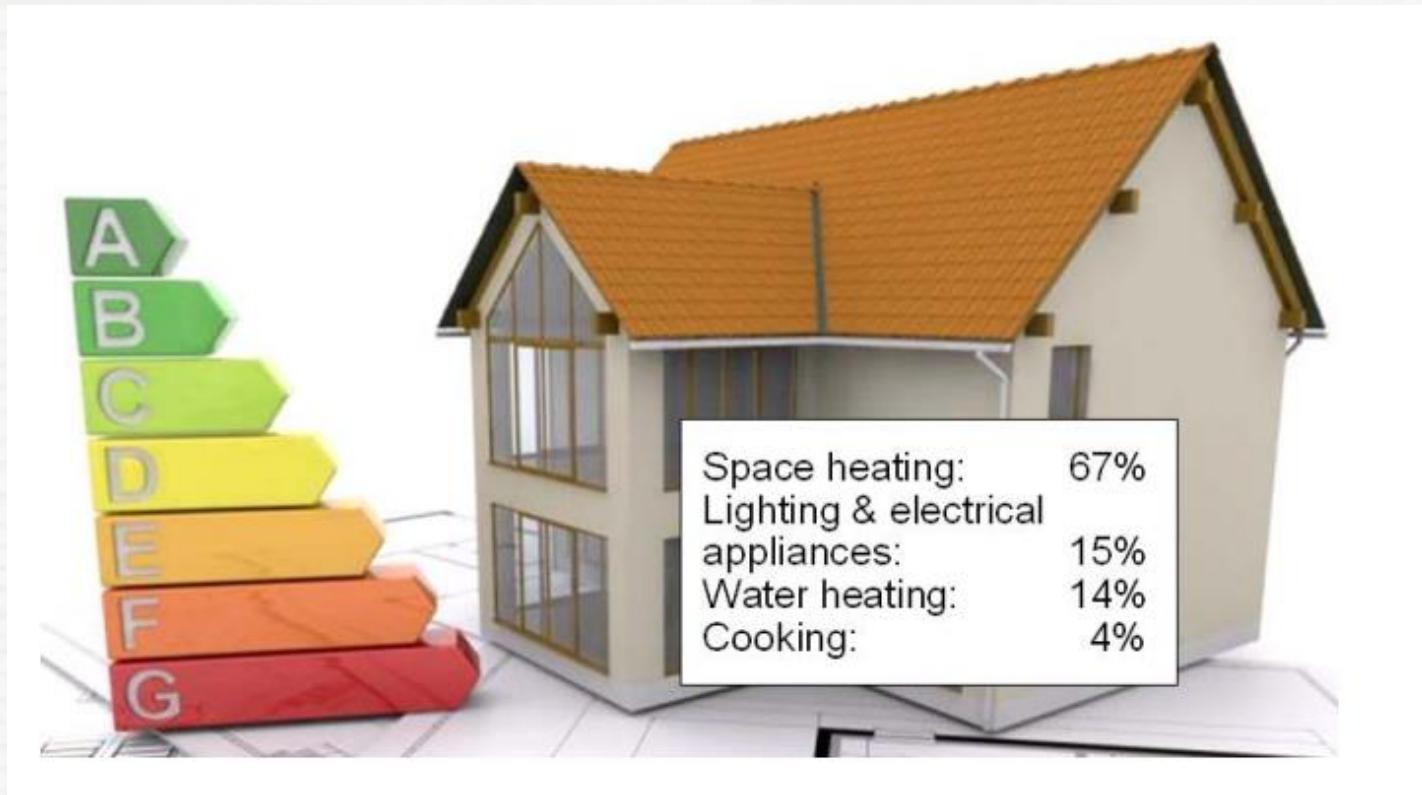


Fungicidal properties of ligno-cellulosic insulation and bio-building materials

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Energy consumption in buildings



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Bio-based building materials



Problems - water leakage



Problems - water leakage



Amount of moisture by convection

- Through vapour barrier $0,5 \text{ g/m}^2 \times 24 \text{ h}$
- Through crack **$800 \text{ g/m} \times 24 \text{ h}$**

1.600 x higher

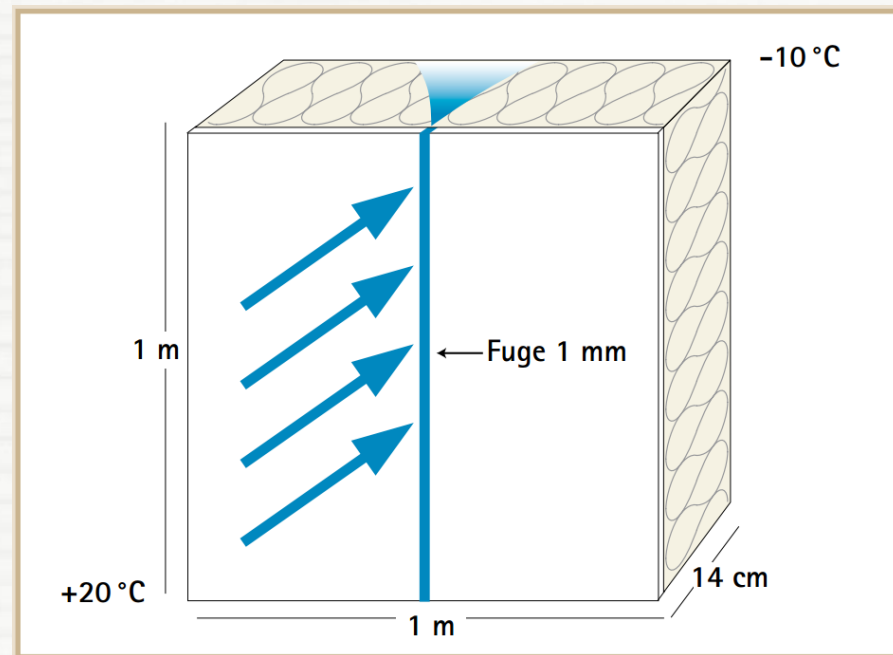
Boundary conditions :

Vapour barrier sd-value = 30 m

Inside temperature = $+20 \text{ }^\circ\text{C}$

Outside temperature = $-10 \text{ }^\circ\text{C}$

Pressure difference = 20 Pa



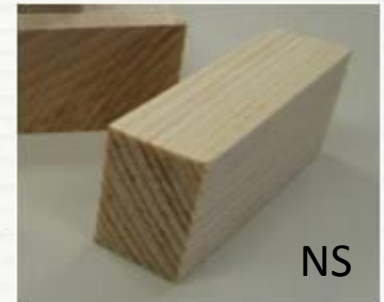
<http://proclima.com>

The aims of research

- To determine performance of bio-based insulating materials against wood decay fungi
- To determine thermal conductivity coefficient λ of cellulose loose-fill insulation produce in Slovenia depending on moisture content and density

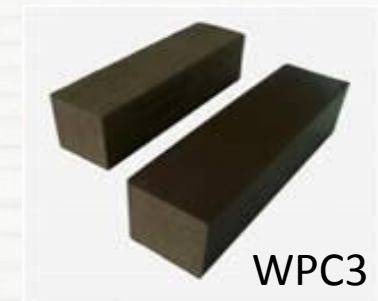
Materials

Abbrev.	Description	Composition
NS	Norway spruce	Norway spruce sapwood
BE	Beech	Common beech wood without discoloration
OSB	OSB/3 construction board, thickness 18 mm	Softwood, formaldehyde free adhesive
PL	Poplar plywood, thickness 18 mm	Poplar wood, adhesive



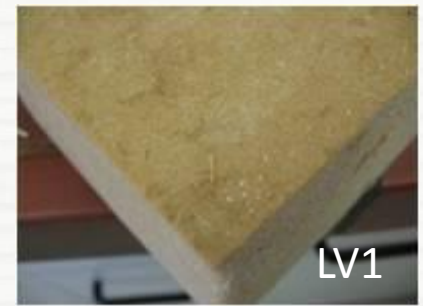
Materials

Abbrev.	Description	Composition
WPC1	Wood plastic composite	Wood particles, polyethylene
WPC2	Wood plastic composite	Wood particles, polyethylene
WPC3	Wood plastic composite	Wood particles, polyethylene
HEMP	Hemp fibre insulation	Hemp fibres, adhesive, NaHCO_3



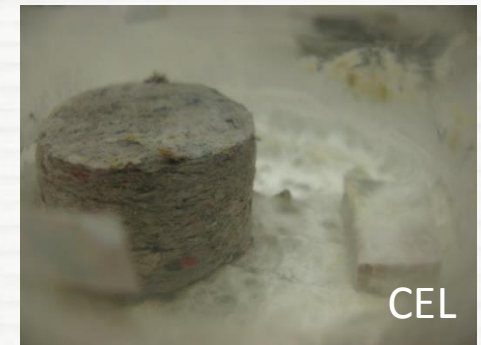
Materials

Abbrev.	Description	Composition
LV1	Wood fibre insulation	Wood fibres, aluminium sulphate, paraffin, sodium silicate, hydrophobic emulsion, adhesive
LV2	Flexible insulation made of wood fibres	Wood fibres, Polyolefin, aluminium phosphate
LV3	Façade insulation made of wood fibres	Softwood fibres, adhesives based on the natural resins, hydrophobic emulsion
LV4	Wood fibre insulation	Wood fibres, aluminium sulphate, paraffin, adhesive



Materials

Abbrev.	Description	Composition
LV5	Wood fibre insulation designed for sound insulation	Wood fibres, aluminium sulphate, paraffin, pigment
CEL	Cellulose loose-fill insulation	Disintegrated cellulose from paper, boron compounds cca 10 %
CEL1	Cellulose loose-fill insulation	Disintegrated cellulose from paper, light metal compounds 6 %, boron compounds 3 %



Methods – fungicidal tests

- EN 113 (16 weeks)
 - Three brown rot fungi
 - *Antrodia vaillantii*
 - *Serpula lacrymans*
 - *Gloeophyllum trabeum*
 - Three white rot fungi
 - *Trametes versicolor*
 - *Pleurotus ostreatus*
 - *Hypoxylon fragiforme*



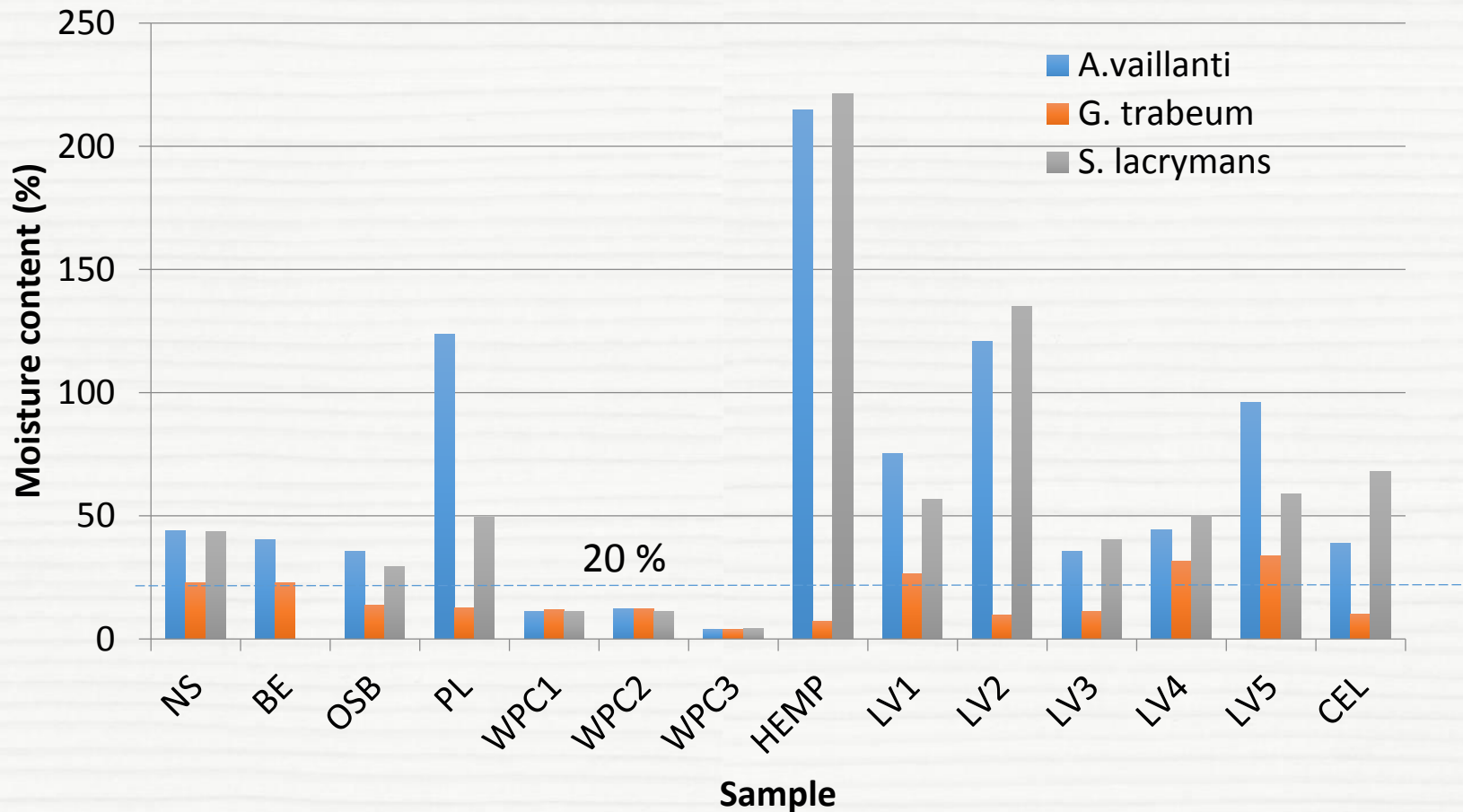
Methods - thermal conductivity of cellulose insulation

- Measurements according to EN 12667
- Influence of density
 - 25 – 100 kg/m³
- Influence of moisture content
 - 1,76 % – 9,85 %

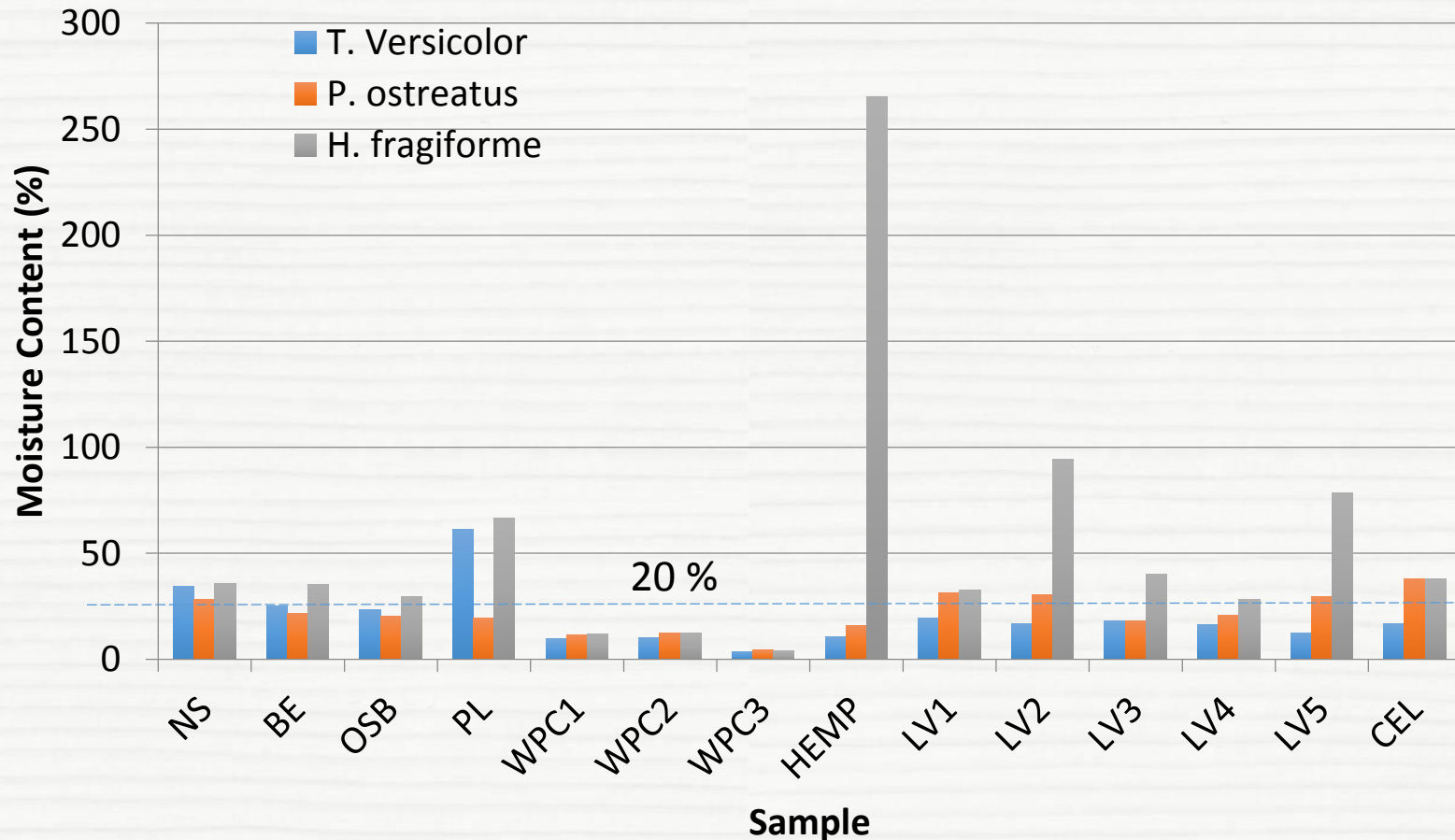


Results

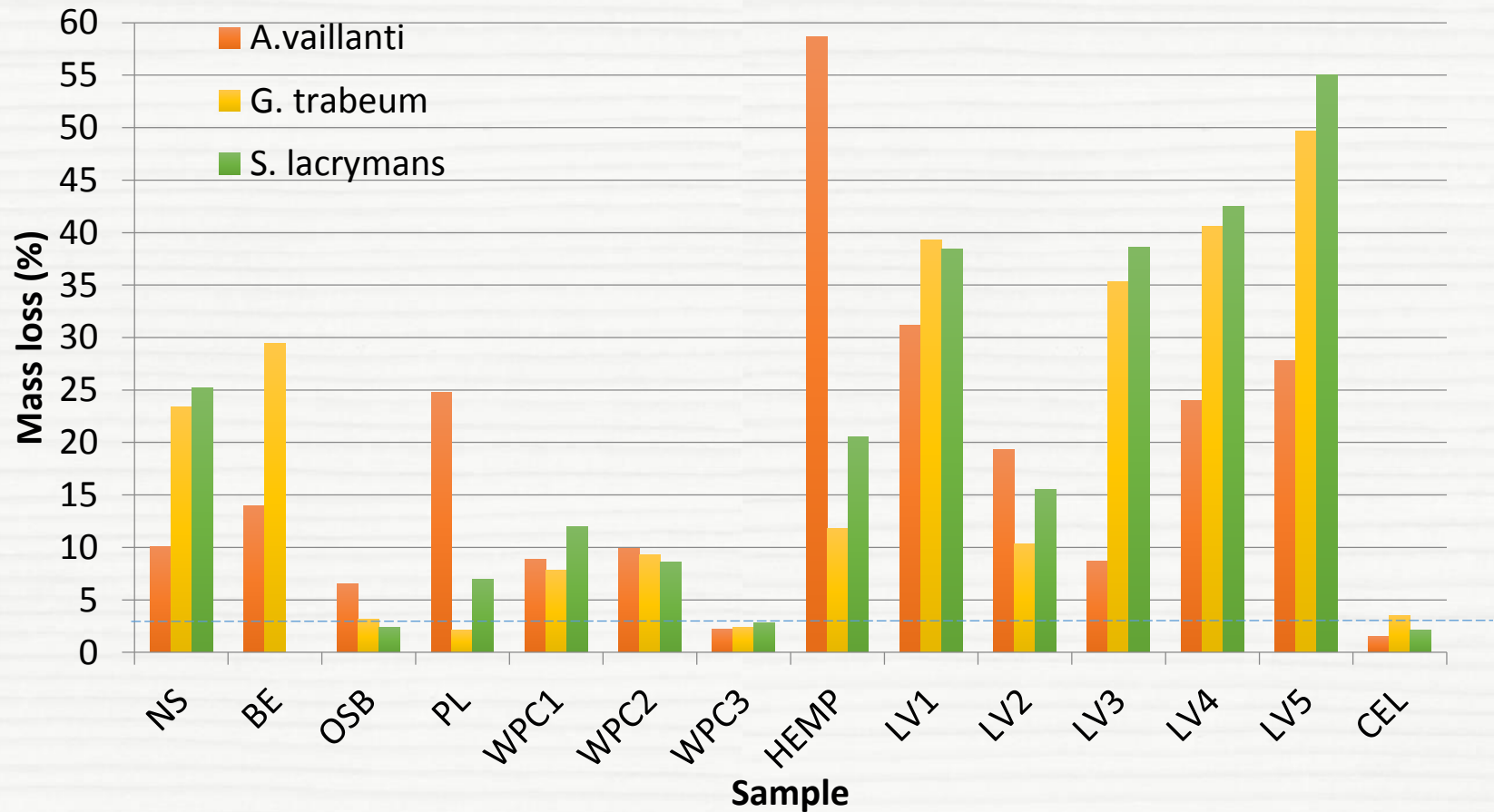
Moisture content – samples exposed to brown rot fungi



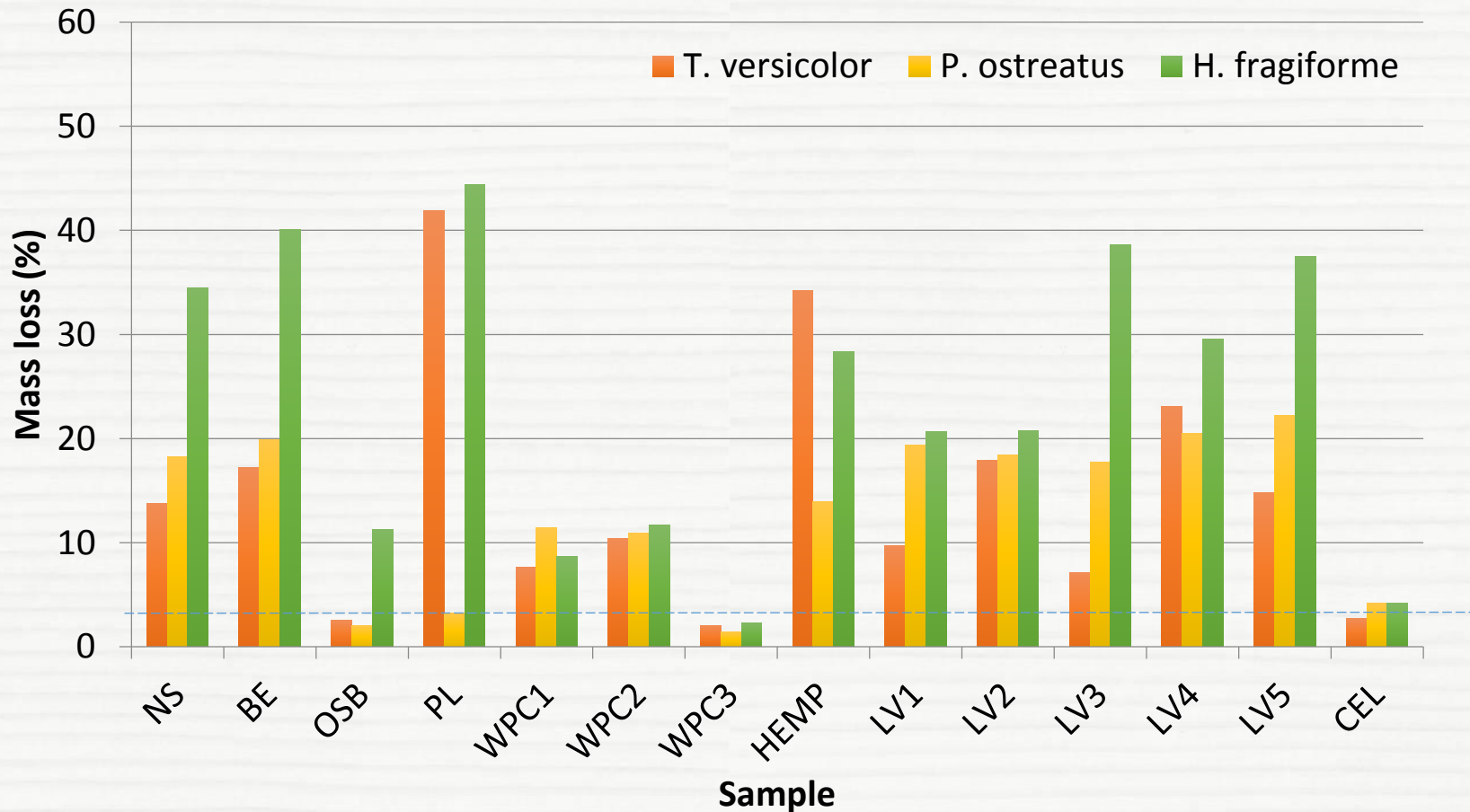
Moisture content - samples exposed to white rot fungi



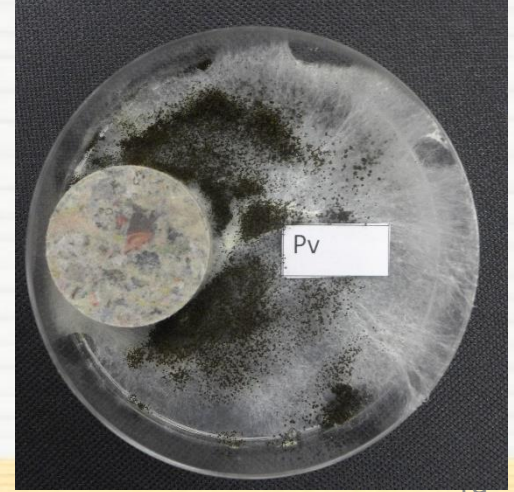
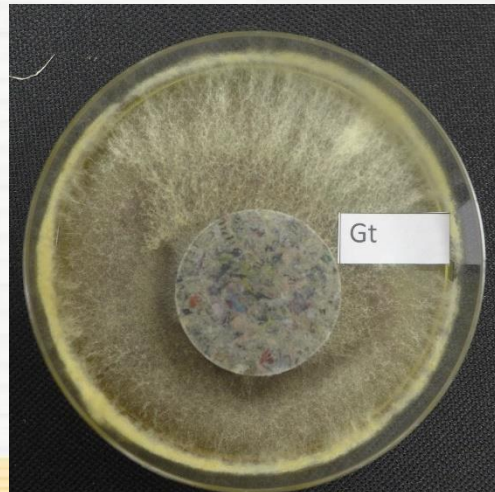
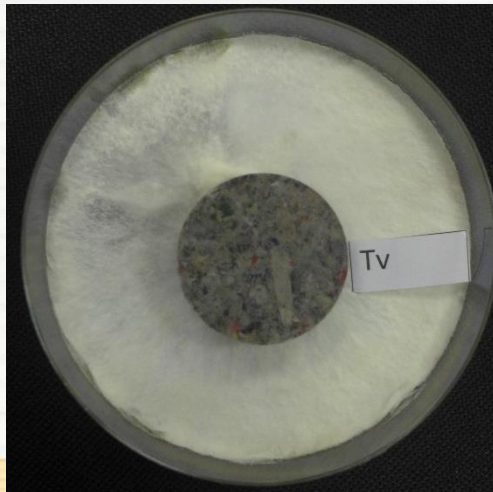
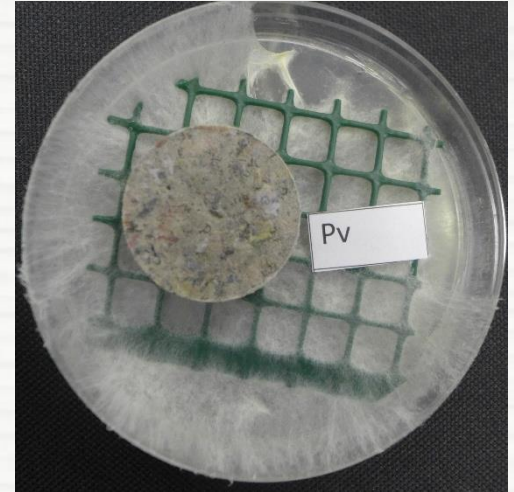
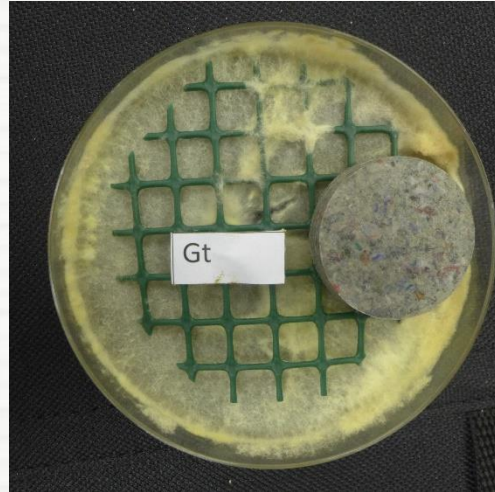
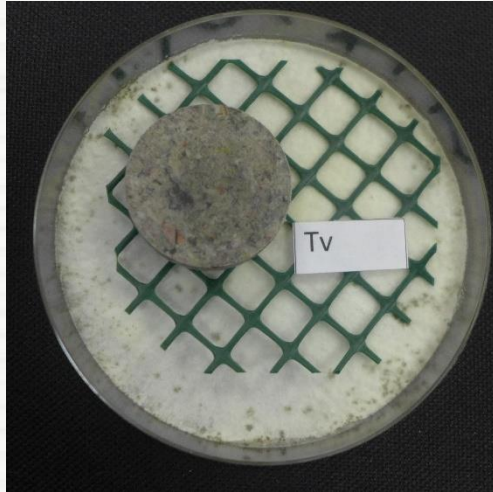
Fungicidal properties - brown rot fungi



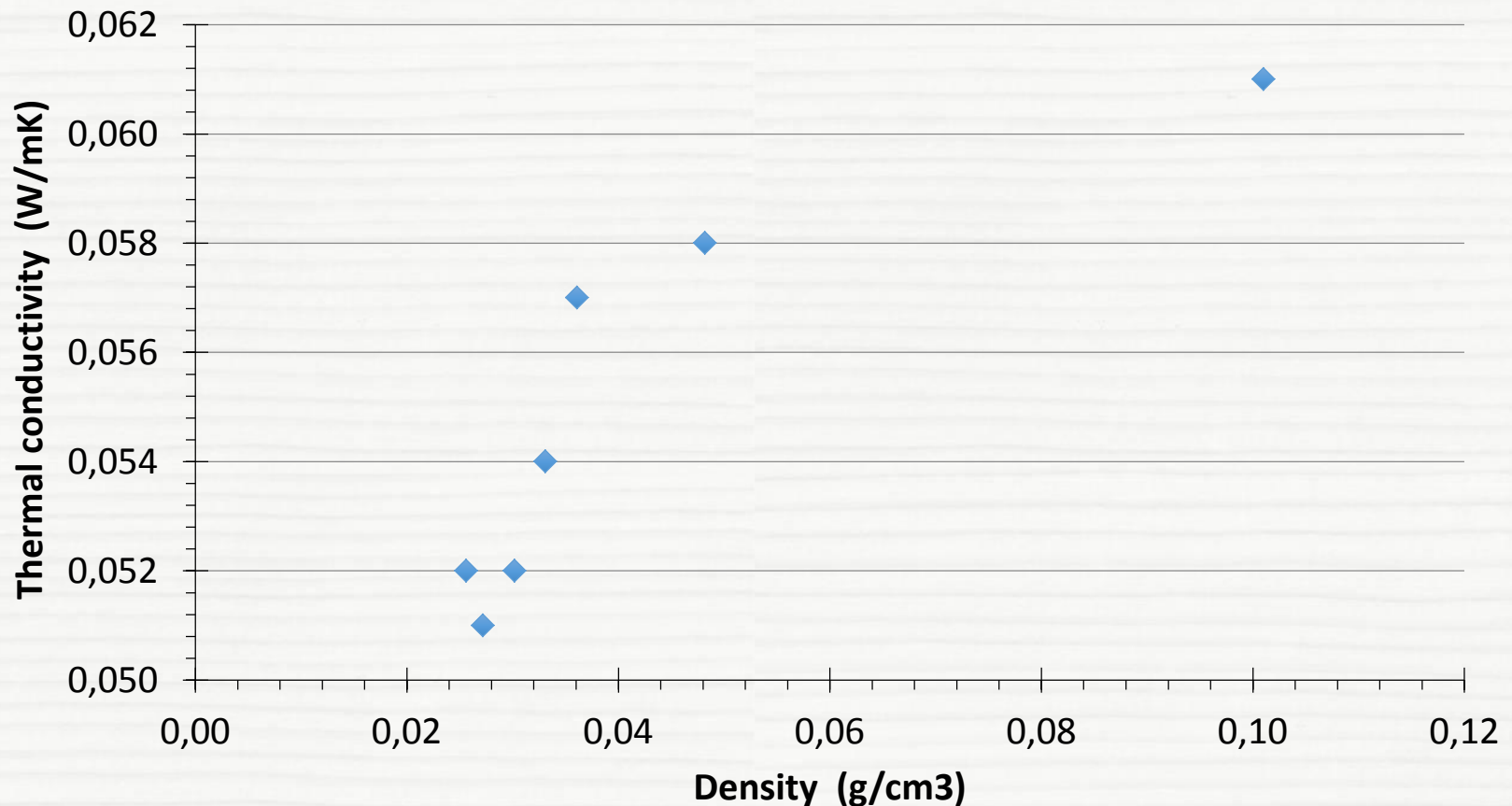
Fungicidal properties - white rot fungi



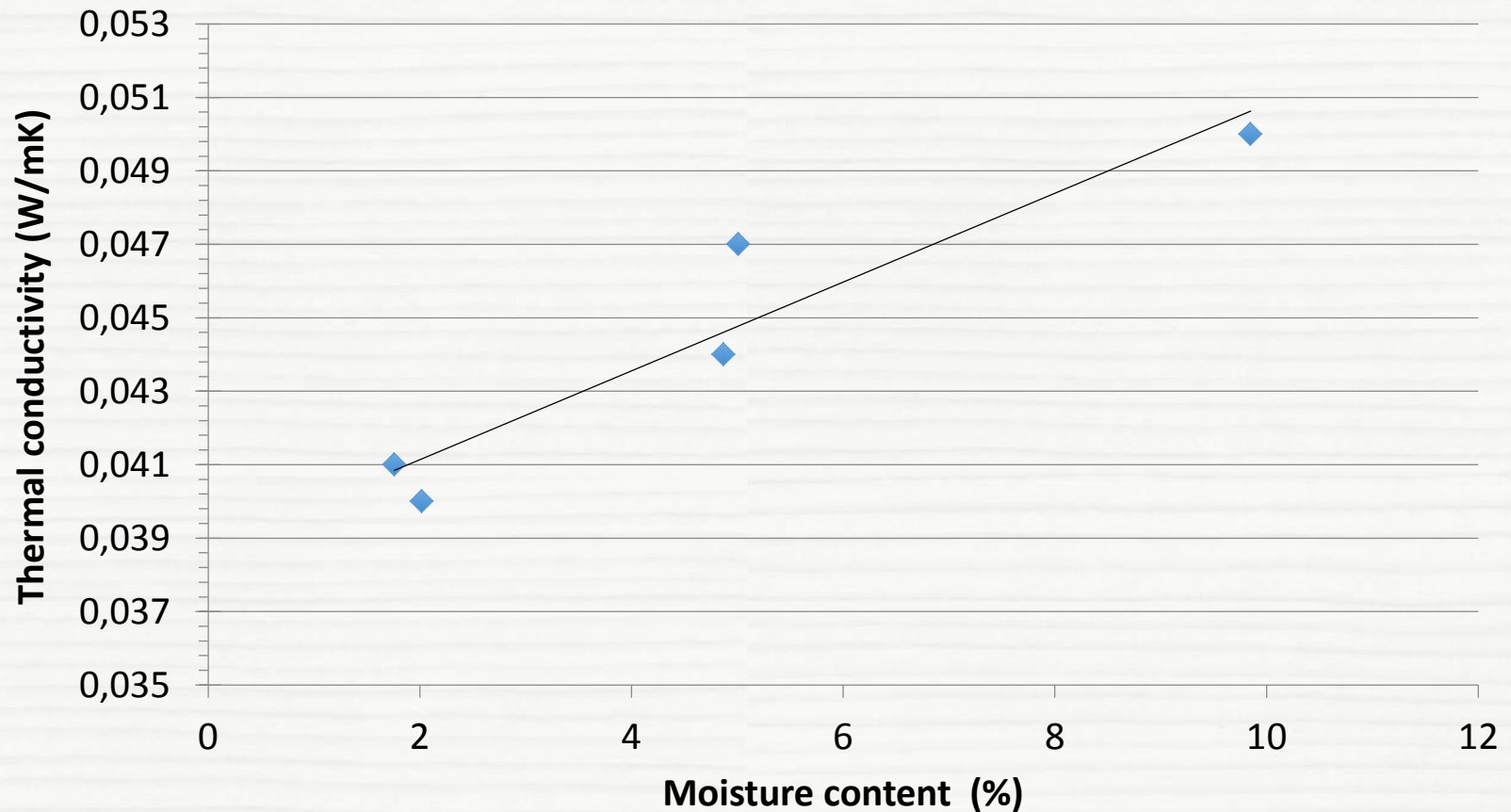
Decay resistance – CEL1



Thermal conductivity of loose-fill cellulose insulation (CEL1) vs. density



Thermal conductivity of loose-fill cellulose insulation (CEL1) vs. moisture content



Conclusions

- Fungicidal properties of the research materials depend on their physical and chemical composition.
- Durability of most of the materials tested, with the exception of cellulose insulation and some wood plastic composites, was lower than the durability of the reference materials.
- In order to limit fungal decay, their moisture content must be lower than 20%.
- Thermal conductivity of loose-fill cellulose insulation (CEL1) is highly influenced by density and moisture content.

Thank you for your attention!