



Cost Action Training school

Standard methods of assessment of
mould growth





Measuring mould

- Seen how to sample for moulds
 - Materials
 - Environment
- And how to grow them to help identify them
 - Culturing





How to use the information

- For developing materials
 - Mould proof!
 - coatings
- For developing methods of stopping growth
 - Biocides





From what we know

- We can make sure the environment is not mould friendly
- Target their physiology
- Eventually need to know
 - Does it work!
- Need to model or test the material





There are a number of tests available falling into two main categories

- Physical testing –
 - Expose material to fungi
- Modelling
 - Determine likelihood of attack based on material properties





Modelling

- Coincides with moisture properties
- Improve resistance properties
- Simulate growth
- Develop potential trends
- Predict susceptibility





Specific models will not fit all materials

Model purpose

- Material / property specific
- Product purpose – food industry
- Mould species specific





Critical variables

- Water activity / moisture content
- Temperature
- Relative humidity
- Mould and material interaction **all vary**
with mould species





If models aren't the complete answer

- Physical testing
 - The ultimate challenge!
- There are a number of standardised methods.





Standard testing of materials and products

- Two ways of looking at the issue
- Does the material allow mould to grow
- Does the material kill moulds
 - Applicable to biocides etc





Standards

- BS 1982 -3 (1990) Fungal resistance of panel products made of or containing materials of organic origin. Methods for determination of resistance to mould or mildew
- EN 927-3 (2006) Paints and varnishes. Coating materials and coating systems for exterior wood. Natural weathering test
- EN 152 (2011) Wood preservatives. Determination of the protective effectiveness of a preservative treatment against blue stain in wood in service. Laboratory method
- EN 15457 (2007) Paints and varnishes. Laboratory method for testing the efficacy of film preservatives in a coating against fungi
- BS EN ISO 846: 1997 Plastics – Evaluation of the action of micro-organisms
- ASTM D 4445-91 : 1991, Standard Method for Testing Fungicides for Controlling Sapstain and Mould on Unseasoned Lumber (Laboratory Method)





Outdoor or lab based methods?





Outdoor

- Effect of weathering
 - Rain, UV temperature changes
- Durability
- Is the material naturally resistant to mould?





Laboratory

- Only tests a few species
- Artificial
- Fast
- Usually uses a spores suspension as the inoculum





Assessment

- Usually visual but can in some circumstances use mass loss
- In terms of material properties
 - looking at ability and intensity of growth
- In terms of biocides
 - Threshold concentrations





Visual ratings (ISO 846)

Intensity of growth	Evaluation
0	No growth apparent under a microscope
1	No visible growth to the naked eye but visible under a microscope
2	Visible growth, up to 25% coverage
3	Visible growth up to 50% coverage
4	Visible growth up to 75% coverage
5	Heavy growth, covering more than 75% of sample surface



What do the values mean?





Can the visual assessment be improved

- Training via COST action!
- Photographic/image analysis methods





Testing disadvantages?

- Can be substrate specific
 - Wood
 - Coating
 - Plastics
- May not suit all construction materials
 - Insulation
 - Modular construction





Non standard methods?

- There are a number of methods in use or development that are not “Standardised”
- These may be of use in non conventional investigations

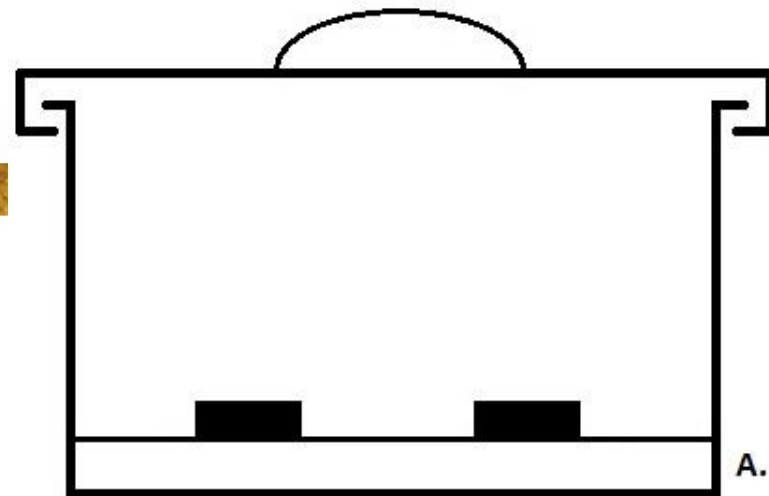
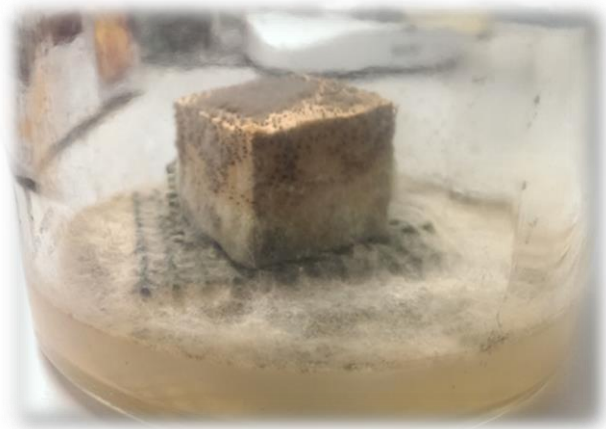




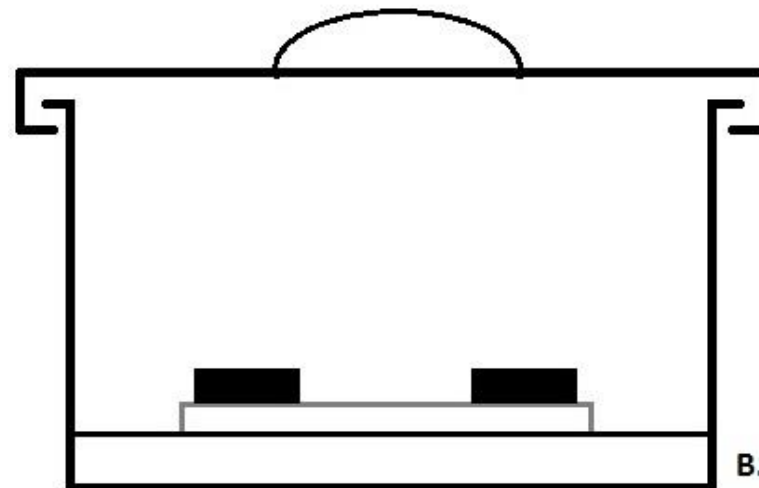
Modified test method

(as per B.Stefanowski *et al* 2015)

- 600ml volume vessels
- Aluminium lids with cotton plug
- Mineral salt agar
- Sterile conditions



Contact



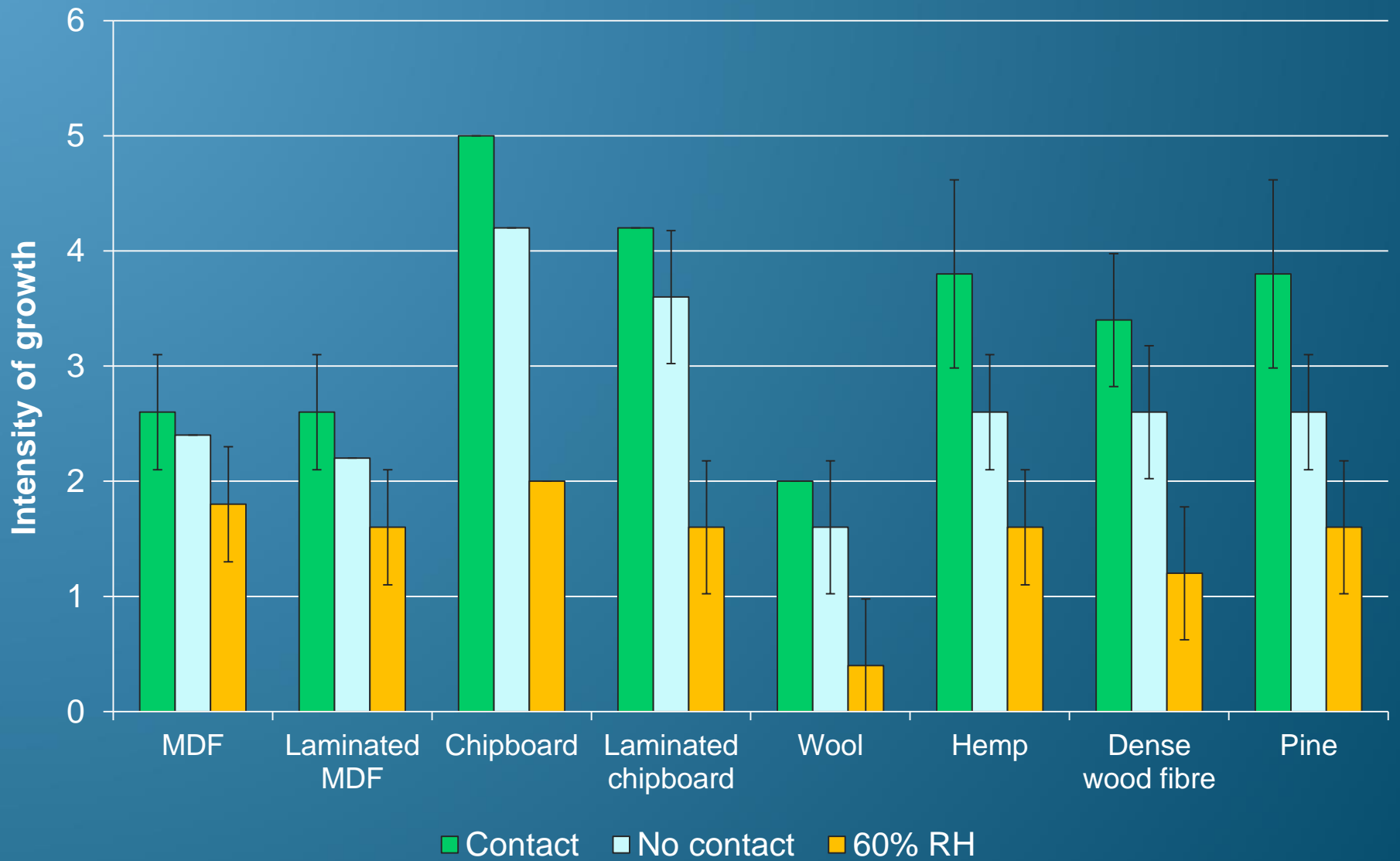
Vapour sorption



Assessment

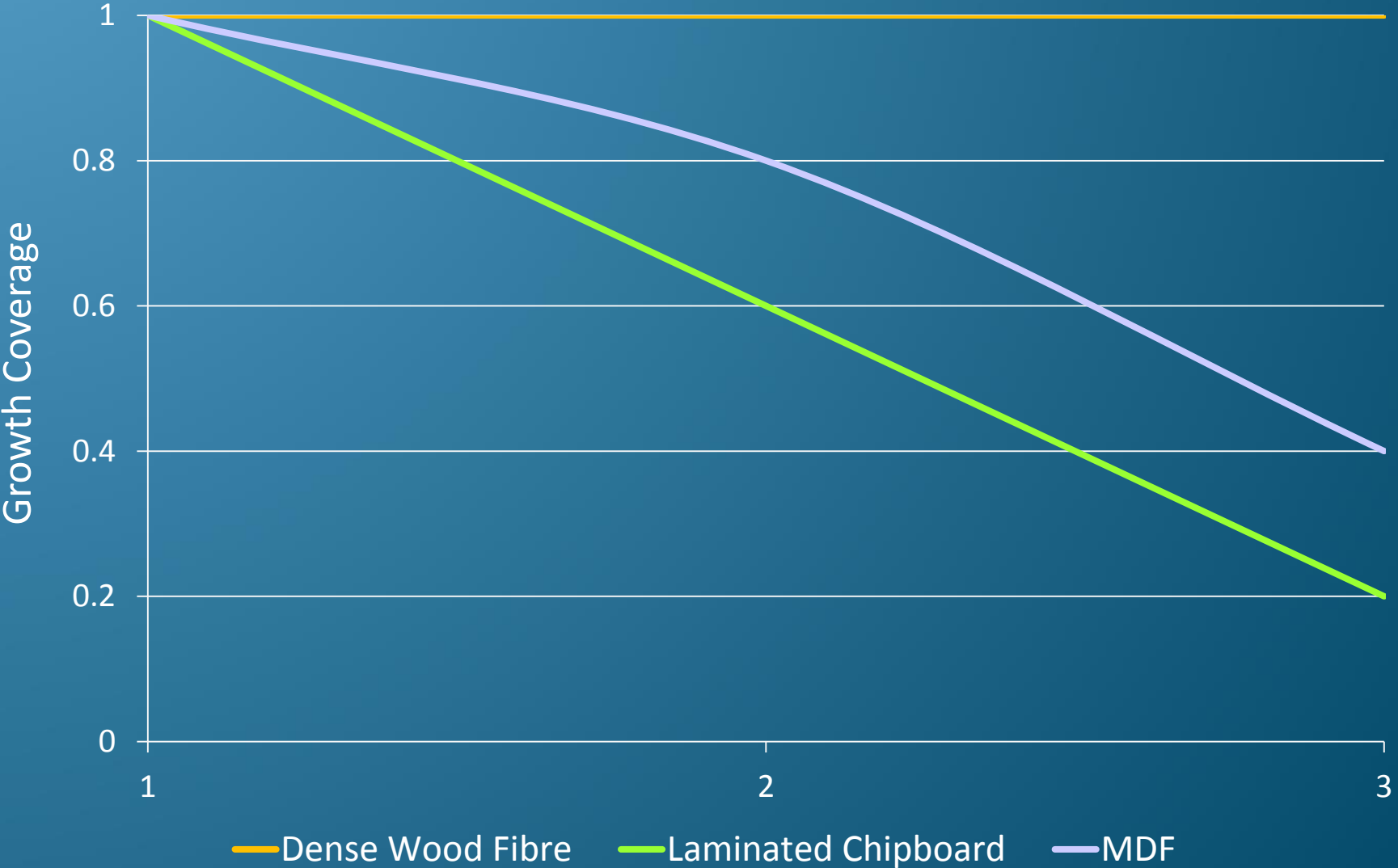
- Visual assessment based on BS-EN 846
 - Scale of 0 to 5
 - 0 is no growth
 - 5 is 100% coverage
- **Primary, secondary and tertiary** colonisers were identified and recorded





Suggests that through vapour sorption alone, materials MC was high enough to support growth

Primary, secondary and tertiary colonisers





What does the work show?

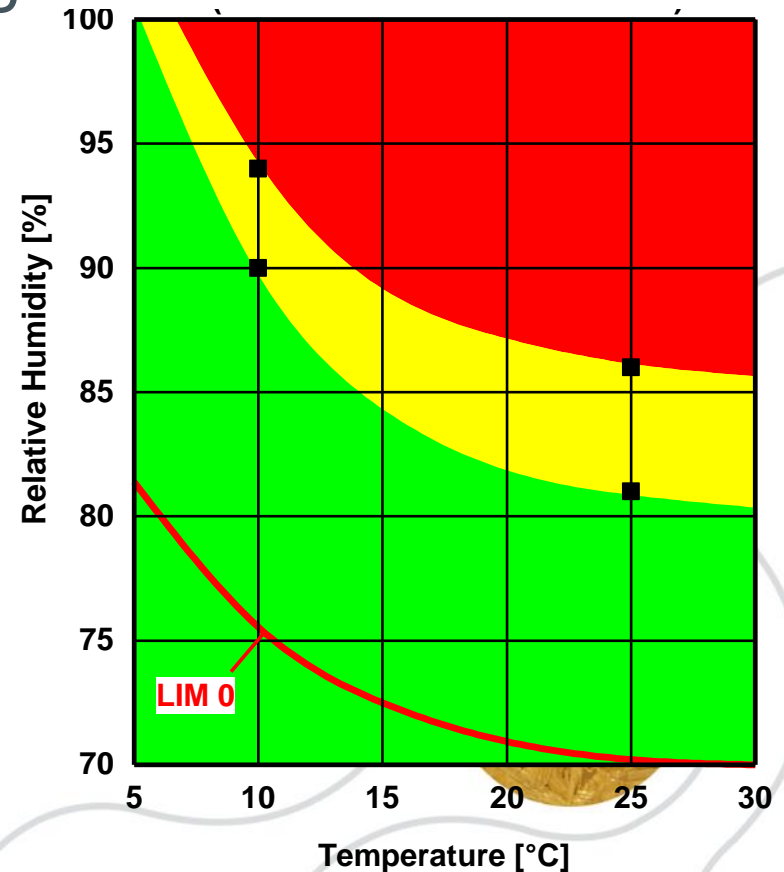
- Growth
- Variation in growth dependant on material
- Different moisture environments highlighted difference in growth
- Succession of growth
- Tests the whole product





Other methods available...

- Fraunhofer Isopleth testing
 - Takes 100 days





Any other issues with material testing?

- The methods test A material
- Doesn't take into account material interactions
 - Modular construction
 - Bio-based building materials





Use of bio-based building materials

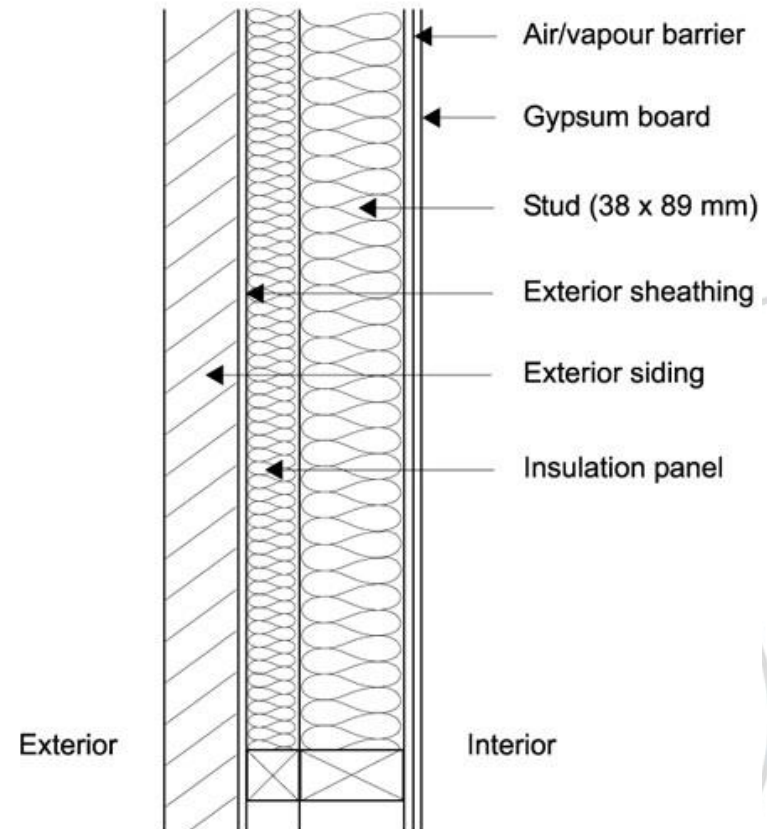
- The use of alternative bio-based materials in building is on the increase.
- For example – insulating material
 - Up to 20% bio-based in Germany
 - 10% in France
 - 1% in UK





Bio-based construction materials

- Bio-based materials often used as components in multilayer products
 - Sheathing – e.g. wood/brick/blockwork
 - Structural elements
 - Vapour barrier
 - Cavity insulation
 - Ideally breathable but water resistant





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.





In case of failure in service...?

- 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?





Need for new test methods?

- Improve and adapt existing methods
- Design a method to test effects of material interactions on material susceptibility to fungi
- Develop a lab exposure test that could test modular components?

