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Ageing phenomena of oak wood-animal glue bonded assemblies for preservation of cultural heritage

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Keywords: Ageing phenomena, Animal glue, Oak wood, Preservation, Cultural heritage

1. Background

The **structural preservation** of panel paintings and decorated furniture as significant parts of Dutch cultural heritage, requires comprehensive knowledge on the **long term behaviour** of their constituent materials namely wood and **animal glues**.

A decorated cabinet crafted by Jan van Mekerem (1684-1744) is chosen as the case study



Fig 1. Cabinet of Jan van Mekerem on display at the Rijksmuseum, Amsterdam.

2. Problem statement

The environment-induced ageing of wooden artefacts is often due to failure of the glue joints between the wooden parts. This behaviour is largely not understood.

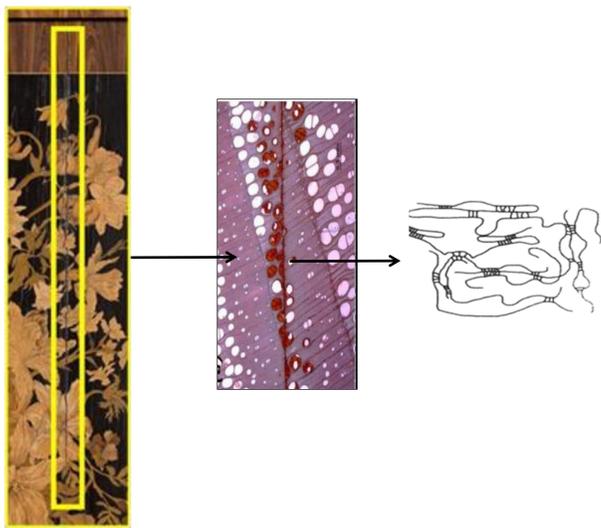


Fig 2. The development of a vertical crack along the glue joint of the panels.

3. Materials

Animal glues are protein based adhesives made of skin and/or bones of mammals and fish species. *Features:*

- Bio based/non-toxic
- Water soluble
- Solidifying by cooling and water evaporation
- Highly reversible joints with wood
- Sensitive to temperature and humidity fluctuations

Oak Wood

- Highly hierarchical structure
- Anisotropic mechanical and physical properties
- Sensitive to moisture and temperature fluctuations

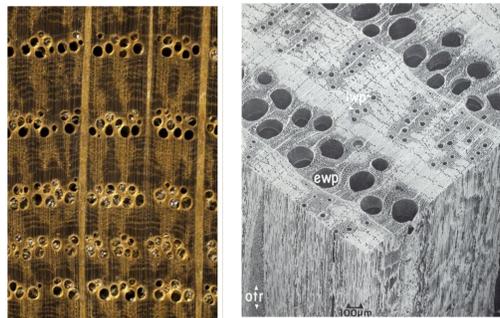


Fig 3. (Left) cross-section micrograph of white oak (Richter, H.G., and Dallwitz, M.J. 2000), (Right) Red oak cross section (Core, H.A. et al. 1979)

Bonded assembly of oak wood/animal glue

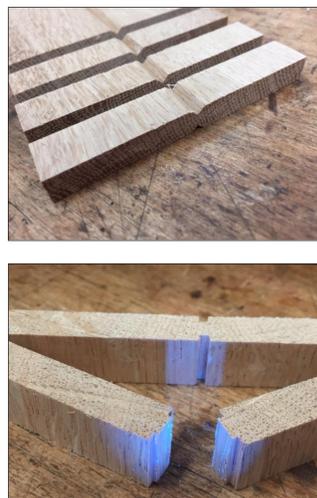


Fig 4. Test specimens for tensile strength testing of wood/glue interface

4. Research approach

✓ Analysis of historical glue:

Old glue is extracted from the cabinet and its origin and chemical composition will be analysed.



Fig 5. Extraction of old glue from the historical cabinet in Rijksmuseum, Amsterdam.

✓ Development of accelerated ageing protocol

- Temperature fluctuation
- Relative humidity fluctuation

✓ Experimental monitoring of ageing

Monitoring changes in physical/chemical and mechanical properties of animal glues and their bonded assemblies after ageing protocol

- Chemical degradation
- Physical degradation
- Mechanical degradation

5. Expected outcome/objectives

* Understanding long term behaviour of animal glues and their bonded assemblies with oak wood

* Giving the conservators/art restorers a time window of durability of the glues under environmental conditions of musea

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