Morphological changes of wood after short term natural weathering evaluated with SEM

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Wood as a building material has been traditionally used for different types of load-bearing structures, decking, façades cladding, doors and windows. Recently the global trends of wood re-application as construction and façades materials are observed. It is due to nature-based inspiration, aesthetic, artistic and design requirements, as well as due to the trends of natural resources use in sustainable development. Wooden elements often suffer due to mechanical, environmental or biological alterations during their service life. The most susceptible parts are unprotected surfaces since they are mostly exposed to ageing, weathering or decay.

The goal of this work was to investigate the microstructure degradation of thin wooden samples exposed for short term weathering. Tests were performed in whole month of July, which according to previous research is considered as a most severe for weathering of wood micro-sections (Raczkowski, 1980).

Experimental samples were prepared from one piece of Norway spruce wood (*Picea abies* L. Karst.) on the slicing planner (Marunaka). The thickness of samples was ~100µm and the efficient surface exposed to weathering was 30 x 35mm (width x length respectively). Sets of samples were placed for natural exposure at 45º to the horizon, facing the four directions: North, West, East and South in San Michele, Italy. Samples were collected before exposition and after 1, 2, 4, 7, 9, 11, 14, 17, 21, 24 and 28 days of natural weathering. Scanning electron microscopy was used for evaluation of structural integrity of wood surface (Hitachi TM 3030 SEM).

Microscopic methods provided detailed information about surface morphology. The first sign of deterioration visible on the SEM images was the openings of bordered pits membranes in radial walls of early wood tracheids (Figure 1a). In the successive step the membrane covering the piths was broken, and presence of small diagonally oriented micro-checks was observed. With the progress of degradation enlargement of the pith crack was noticed being the result of the contraction of the cell wall caused by moisture variation. The advancement of weathering (UV degradation, leaching effect of water and mechanical damages caused by wind blow) leads to complete destruction of the pit membrane and crack propagation. The pit openings are then enlarged and in consequence the whole pit erodes away (Fig. 1b).

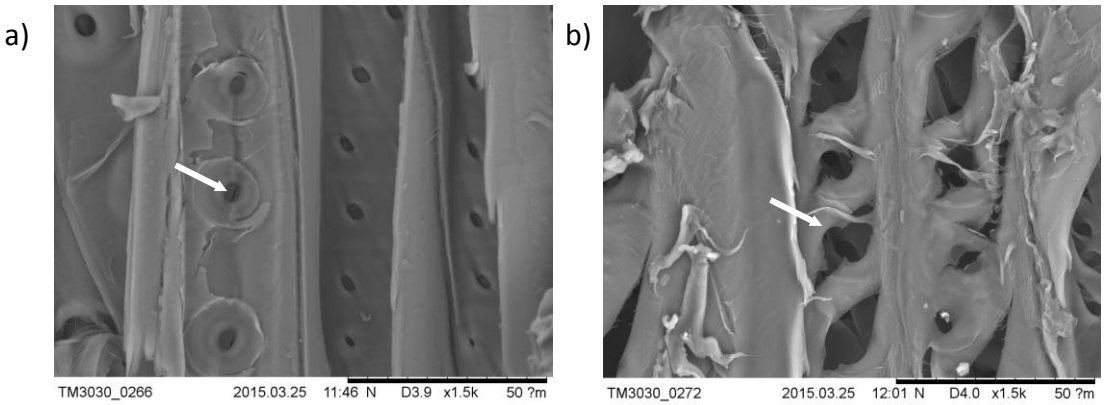

Figure 1: SEM images of early wood exposed to south for 2 days (a) and 21 days (b).

Scanning electron microscopy (SEM) was used here for examination of the morphological characteristics of naturally weathered thin wooden samples. It was confirmed that early wood was more susceptible to damage than late wood, which was explained by the fact that cells in early wood have thinner and weaker walls and in consequence has lower density. It was also observed that western and northern exposure sites are slightly less affected by weathering process. First signs of fungal infestation, not visible by naked eye were observed after 17 days of natural weathering.

References

Raczkowski J. 1980. Seasonal Effects on the Atmospheric Corrosion of Spruce Micro-Sections. Holz als Roh- und Werkstoff 38, 231-234.

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