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# EVALUATION OF ANOXIC TREATMENT FOR THE CONSERVATION OF WOOD ARTEFACTS

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Anoxic treatment is a long-established and widely diffused methodology for the conservation of wood artefacts of the cultural heritage against biological agents (i.e. insects). Despite its common employment and its recognised efficacy, the evaluation of the harmfulness of the method with respect to different wood species and to different superficial finishings has been scarcely investigated so far. Wood permeability to gases is another key aspect influencing the treatment which requires further investigations. This last actually represents a crucial point to be considered in order to achieve an effective and low time-consuming result.

In the present study, the evaluation of nitrogen-based anoxic treatment for the conservation of wood is reported with a particular view to the above reported aspects. Three wood species have been selected (spruce, walnut and poplar) and fully characterized, because of their extensive use in the production of objects of the cultural heritage (furniture, design objects, painting supports, etc.). The selected species typically show rather different mechanical and microstructural features. Eleven different superficial treatments have been applied in order to simulate the most common finishing conditions. The anisotropicity of wood when tested along axis in the three principal linear directions (longitudinal, radial, and tangential) has been considered as well, since it strongly affects its behaviour. A specific methodology for the evaluation of wood permeability has been defined.

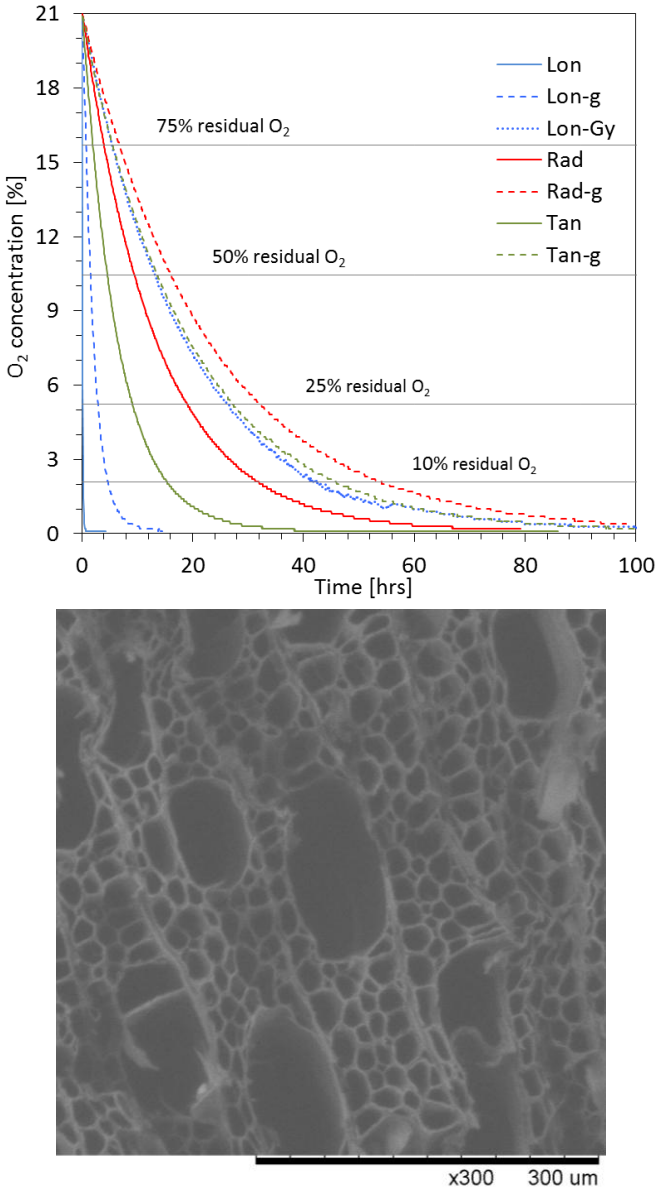


Fig. 1. (left) Gas permeability of poplar under different conditions expressed as percentage of oxygen loss versus time (Lon = longitudinal direction; Rad = radial direction; Tan = tangential direction; -g = glue finishing; -Gy = gypsum preparation layer); (right) SEM image of poplar microstructure observed along the longitudinal direction.

The results show that wood permeability to nitrogen is highly influenced by four main aspects: wood species, sample thickness, finishing treatment, and principal linear direction considered. A selection of the permeability results of poplar and the documentation of the microstructural features along the longitudinal linear direction are reported in Fig. 1.

The harmfulness of the treatment, carried out in anhydrous conditions, has been confirmed under the aesthetic, chemical and mechanical point of view, by means of a multi-analytical approach. All samples before and after the treatment have been constantly kept in controlled RH conditions (RH = 50%). One of the main concerns to the use of anoxic treatment is related to the possible variation in the moisture content of the material. Therefore, particular attention has been paid to monitor this parameter through the evaluation of mass variation and by means of Near Infrared (NIR) spectroscopy. NIR spectroscopy is quite informative for what

concerning the water content of the wood since the combination and overtone modes of the fundamental $H_2O$ vibrational modes fall in the 1000-2400 nm region. Moreover, NIR spectroscopy coupled with multivariate analytical statistical techniques can be used to predict chemical or mechanical properties of wood.

NIR spectra acquired on the different wood species (untreated materials and samples with different kinds of finishing analysed before, immediately after the anoxic treatment, and 38 days after the anoxic treatment) have been submitted to factor analysis (FA) and principal components analysis (PCA) in order to highlight differences due to the humidity content.

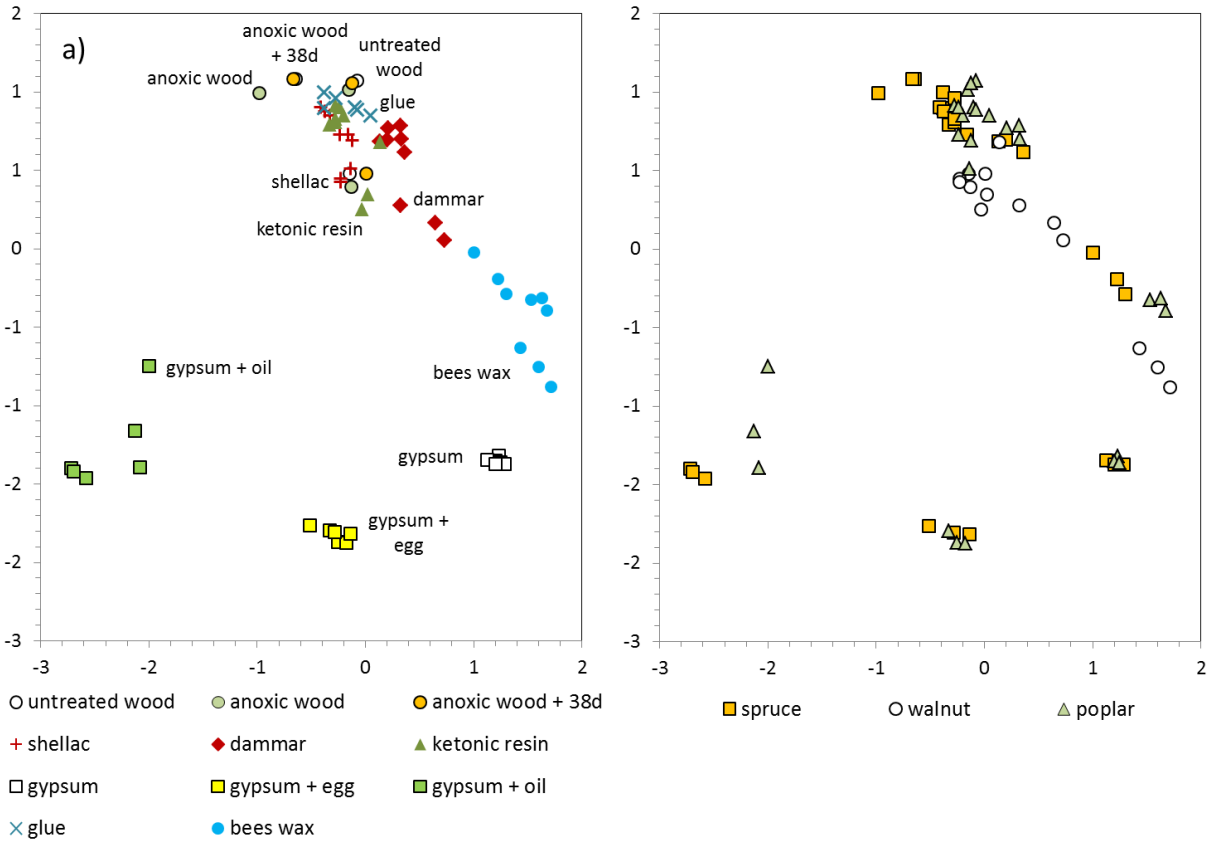


Fig. 2. (a) Scatter plots obtained from factor analysis starting from NIR spectra for all the wood samples: untreated, treated with the different finishings (glue, shellac, dammar, ketonic resin bees wax, gypsum, gypsum + egg, gypsum + oil and after the anoxic treatment (at the end of the treatment or after 38 days); (b) the same scatter plot where the woods essences have been evidenced (the variance corresponding to the first two factors is 95%)

The results obtained have evidenced that the main differences among the samples are due to the kind of treatment applied. Furthermore, within each group of samples having the same finishings, differences depending on the wood essence can be identified, as reported highlighted in Fig. 2a and Fig. 2b.

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