

Nanocellulose as bio-inspired consolidant for degraded wood

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INTRODUCTION:

Nanocellulose, in particular cellulose nanocrystals (CNCs), are very important for recovery and conservation of Cultural Heritage; they give better results respect synthetic products and they do not alter the visual aspect of artistic surfaces. In this research work CNCs were used as bio-inspired consolidant for degraded wood and compared with two of the most used traditional resins: Paraloid B-72 and Regalrez 1126. This innovative bio-consolidant was characterized by Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR) and Ultraviolet-visible Spectroscopy (UV/Vis). The wood samples were treated with the three different consolidants and then they too were characterized by Optical Microscopy and SEM to analyse the appearance and morphology of each consolidant. Moreover, colorimetric analysis and mechanical tests were carried out to evaluate the alterations of the visual aspect and the mechanical behaviour of the treated samples.

Characterization of cellulose nanocrystals (CNCs)^[1]

Scanning Electron Microscopy (SEM)

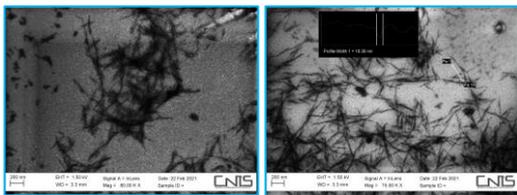


Fig.1. Scanning electron microscopy (SEM) micrographs of cellulose nanocrystals (CNCs).

- Tiny rod-shaped particles;
- 15-30 nm in width.

FT-Infrared Spectroscopy (FTIR)

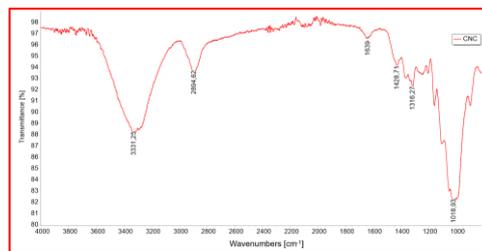


Fig.2. FTIR spectrum of cellulose nanocrystals (CNCs).

Only characteristic peaks → absence of surface modification.

UV/Vis Spectroscopy

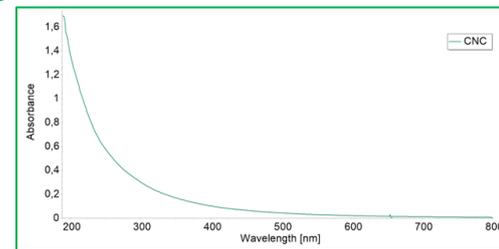


Fig.3. UV/Vis spectrum of cellulose nanocrystals (CNCs).

No obvious peaks.

Characterization of treated degraded wood samples^[2]



Nanocellulose (Samples A)

Fig.4. Samples treated with nanocellulose.



Paraloid B-72 (Samples B)

Fig.5. Samples treated with Paraloid B-72.



Regalrez 1126 (Samples C)

Fig.6. Samples treated with Regalrez.

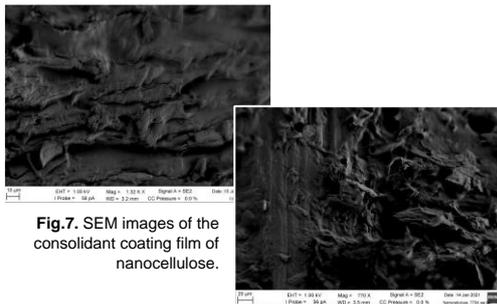


Fig.7. SEM images of the consolidant coating film of nanocellulose.

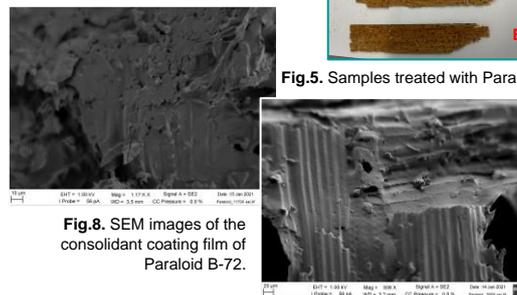


Fig.8. SEM images of the consolidant coating film of Paraloid B-72.

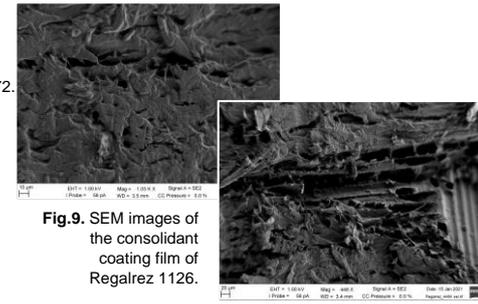


Fig.9. SEM images of the consolidant coating film of Regalrez 1126.

Colorimetry

Samples treated with nanocellulose do not alter their color unlike those treated with Paraloid B-72 and Regalrez 1126.

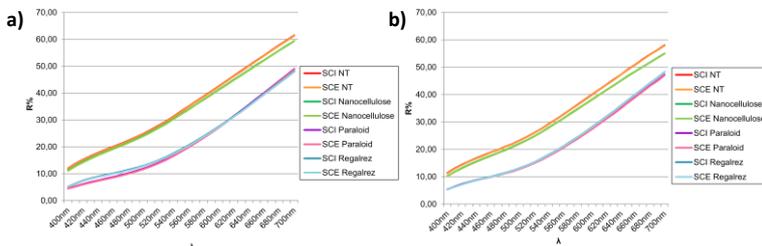


Fig.10. Reflectance spectra of untreated (NT) and consolidated samples (Nanocellulose, Paraloid, Regalrez), acquired in SCI and SCE mode, few days (a) and one month (b) after the consolidation treatment.

Bibliography:

- ^[1]Kumar, R. et al. A comprehensive review on production, surface modification and characterization of nanocellulose derived from biomass and its commercial applications. *Express Polym. Lett.* (2021), 15, 104-120.
^[2]Basile, R. et al. Bio-inspired consolidants derived from crystalline nanocellulose for decayed wood. *Carbohydr. Polym.*, (2018), 202, 164-171.

Mechanical Tests

Both nanocellulose and Regalrez treated samples showed a more elastic behaviour than those treated with Paraloid, more rigid as the untreated sample.

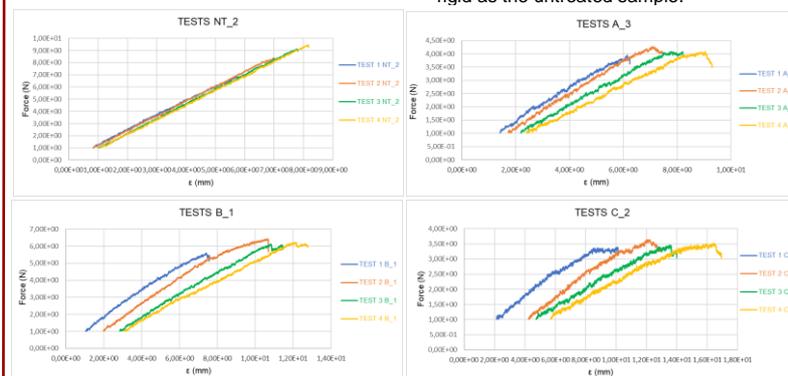


Fig.11. Force-deformation curves of untreated (NT₂) and treated sample with nanocellulose (A₃), Paraloid (B₁) and Regalrez (C₂).