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New sustainable treatment based on chitosan and halloysite nanotubes for the conservation of waterlogged archaeological wood

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Abstract

Chitosan (CHI) is among the most used biopolymers in conservation science due to its antibacterial and antioxidant properties [1,2]. On the other hand, the nanotubes of halloysites (HNT) are used as fillers due to their excellent thermal and mechanical properties besides the possibility of being used as nano-reservoir for sustained release of active agents [3]. In this work, Chitosan/Halloysite Nanotubes dispersion has been designed as a novel green protocol for the conservation of waterlogged archaeological wood. Firstly, CHI/HNT dispersion was prepared at a fixed concentration of chitosan, of 2%, and HNT was added at a concentration from 0 to 3%. The immersion protocol of waterlogged archaeological wood was monitored for 72h and subsequently, it was dried for 24h at room temperature. The percentage of consolidant adsorbed from wood was measured gravimetrically. Colorimetric analysis and optical microscopy revealed the characteristic surface of untreated and treated archaeological wood. Chemical imaging was also applied to determine the spatial distribution of CHI/HNT dispersion on waterlogged archaeological woods. Thanks to this last analytical approach it was possible to assess that a more homogeneous distribution was possible when the concentration of nanotube was increased. However, at the same time, an increase in the aggregations of chitosan were also visible at the maximum concentration of HNT. Meanwhile, a physico-chemical characterization was carried out on wooden samples to investigate the mechanical and thermal properties before and after treatment. A higher thermal and mechanical resistance has been shown in the samples treated with CHI/HNT dispersion compared to the untreated archaeological wood sample. Since wood is a hygroscopic material, it was important to consider water vapor absorption/desorption after CHI/HNT treatment, thus an immersion test and a water uptake measurement were performed. Finally, the aging test of archaeological wood samples led to the examination of the efficacy of CHI/HNT composites as a protective formulation for archaeological wood: lignin index of archaeological wood samples was calculated before and after they were exposed to nitric acid for 72h. In conclusion, the proposed CHI/HNT dispersion presents a promising strategy for conserving waterlogged archaeological wood. This is attributed to the ability of chitosan to form a film with antioxidant and antibacterial properties, serving as a green and sustainable reinforcing coating and the capacity of halloysite nanotubes to enhance the thermal and mechanical resistance of wood samples.

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Archaeological woolen textiles in a fragile state: the potential of polysaccharide based consolidants

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Abstract

For the preservation of archaeological textiles, there is no one procedure that fits all. Freeze drying of fresh waterlogged finds is a possible choice; however, in cases of very high fragility, it may be insufficient. Moreover, the method is problematic for objects that are dry already or need to be retreated. Similarly, severely degraded textiles in a dry state may benefit from greater cohesion to allow movement for exhibition and research though protection against further physical degradation. As always, risks must be weighed against benefits of a given consolidation measure. The fact that many applications of current consolidation materials show varying drawbacks, has stimulated rich research on alternative conservation treatments. The tremendous progress in the use of bio-inspired materials in many fields of material science and medicinal research, is encouraging for the potential of bio-polymers and their derivatives for the preservation of archaeological textiles. In the current study, investigating a range of polysaccharide/glycan-based compounds for conservation of severely degraded archaeological