DECORATED MULTI-WALLED CARBON NANOTUBES DISPERSED IN PHBHV FOR WOOD PRESERVATION

Mădălina Elena DAVID[1,2,*], Rodica-Mariana ION[1,2], Lorena IANCU[1,2], Ramona Marina GRIGORESCU[1],

[1] National Institute for Research and Development in Chemistry and Petrochemistry – ICECHIM, 202 Spl. Independentei, 6th district, 060021, Bucharest, Romania;
[2]Valahia University, Doctoral School of Materials Engineering Department, 13th Aleea Sinaia, Targoviste, Romania
**e-mail: david.madalina@icechim.ro*

INTRODUCTION:

Wooden artifacts are subjected to several degradation factors which affect more or less their structural integrity and mechanical strength. Thus, the consolidation of wood artifacts has become a global problem and new systems are investigated in order to find a capable consolidate that ensures better durability over time [1].

In this study, nanocomposites based on multi-walled carbon nanotubes (MWCNTs) decorated with hydroxyapatite (HAp), zinc oxide (ZnO), or silver (Ag) nanoparticles synthetized by our team [2, 3] were dispersed in a poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBHV) solution in order to study their ability as consolidate for wood.

METHODS:

Each type of nanocomposites (at different concentrations 0.1, 0.2 and 0.4%) was dispersed in a solution of 2% PHBHV in chloroform, with the purpose to obtain an uniform dispersion of the nanomaterials in the polymeric matrix (Figure 1). After the wood samples were treated by brushing, the samples were conditioned for a month at H=55±5 % and T= 22 ± 5° C and then artificial aging test by exposure to temperature variations (cold-check test, according to ASTM D1211-97 [4]) was carried out in order to investigate the degradation of the wooden materials (color changes according to ASTM 2244 [5]), contact angle and mechanical behavior.

RESULTS:

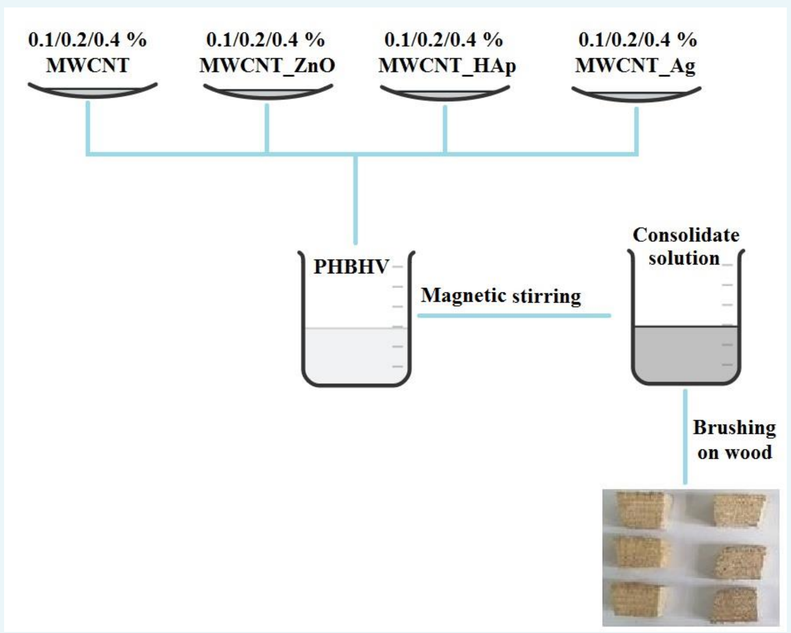

Figure 1. Consolidate solutions obtaining

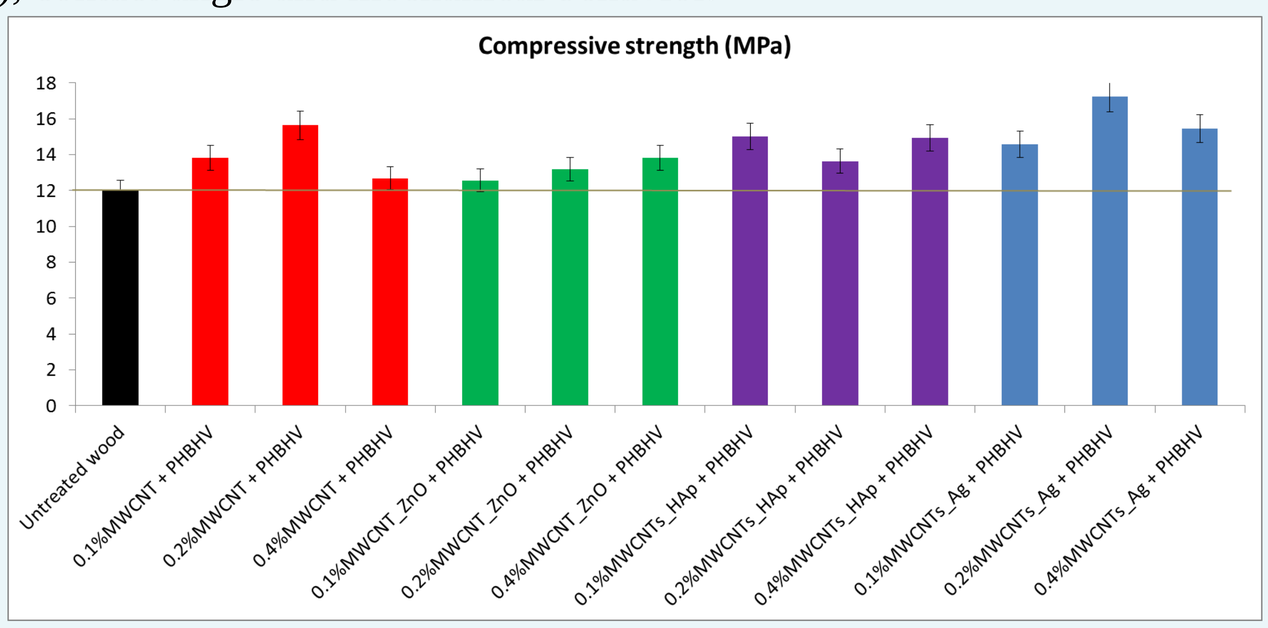

Figure 2. Mechanical resistance of untreated and treated wood samples

Table 1. Variation of the chromatic parameters and total color difference calculated (ΔEx) after cold-check test reported to the initial chromatic parameters of the samples

Treatment	ΔL_x	Δb_x	Δa_x	ΔE_x
Untreated wood	1.54	0.19	2.89	3.28
0.1% MWCNT+ PHBHV	0.40	1.58	2.29	2.81
0.2% MWCNT+ PHBHV	0.92	0.56	1.96	2.24
0.4% MWCNT+ PHBHV	0.23	0.68	2.16	2.28
0.1% MWCNT_ZnO+ PHBHV	0.35	0.48	2.46	2.53
0.2% MWCNT_ZnO+ PHBHV	0.16	0.43	2.26	2.31
0.4% MWCNT_ZnO+ PHBHV	0.80	0.73	2.75	2.96
0.1% MWCNT_HAp+ PHBHV	0.75	0.01	2.25	2.37
0.2% MWCNT_HAp + PHBHV	0.36	0.54	2.27	2.36
0.4% MWCNT_HAp + PHBHV	0.82	0.58	2.15	2.38
0.1% MWCNT_Ag+ PHBHV	0.49	0.42	2.25	2.34
0.2% MWCNT_Ag + PHBHV	0.10	0.31	2.35	2.38
0.4% MWCNT_Ag + PHBHV	0.20	0.15	2.33	2.34

where: ΔL is the difference in lightness, calculated with the formula: $\Delta L = L_{treated\ sample} - L_{untreated\ sample}$; Δa is the chromatic deviation of the coordinates of a* coordinates, calculated with the formula: $\Delta a = a_{treated\ sample} - a_{untreated\ sample}$; and Δb is the chromatic deviation of the b * coordinates, calculated with the formula: $\Delta b = b_{treated\ sample} - b_{untreated\ sample}$.

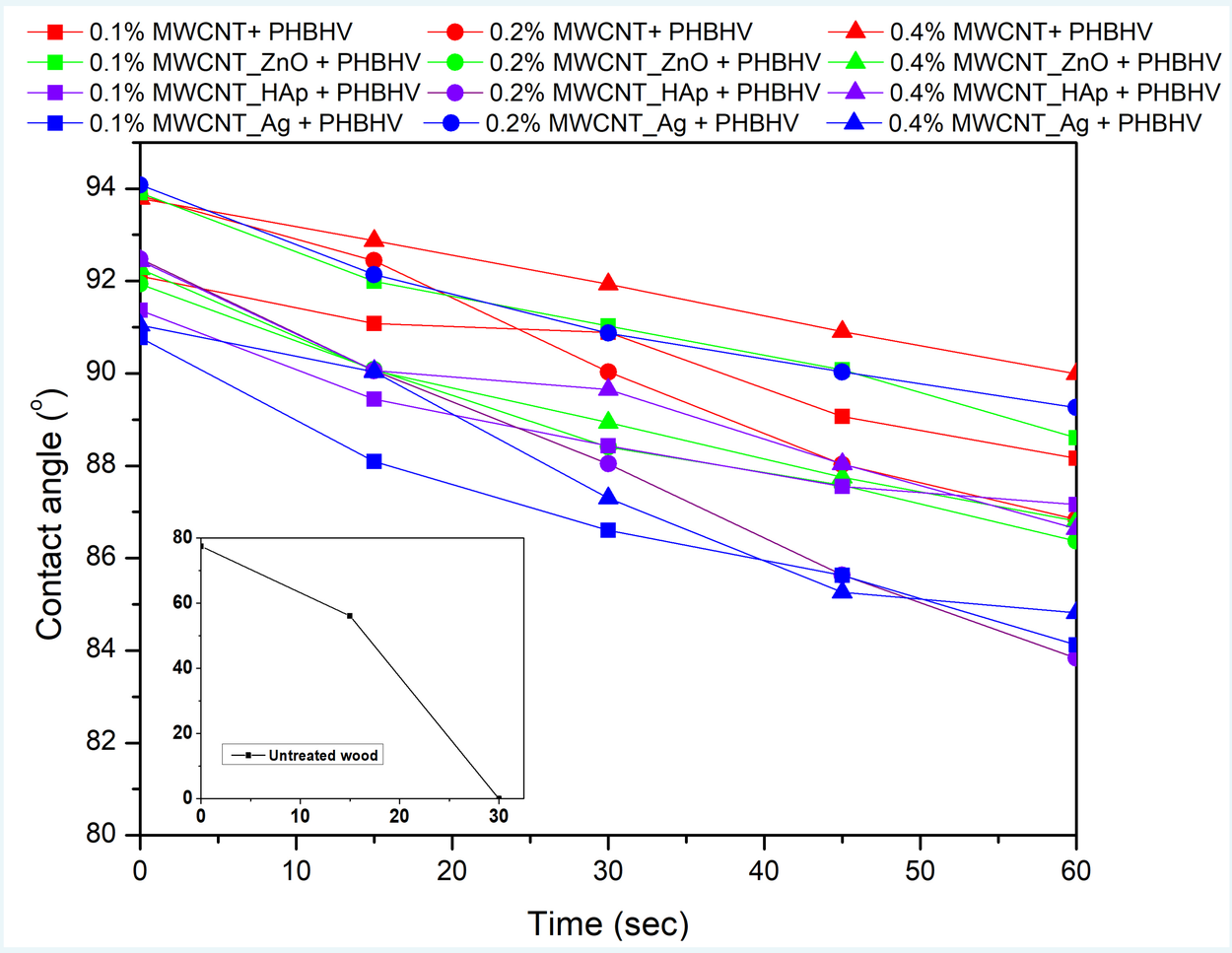

Figure 3. Contact angle of untreated and treated wood samples

CONCLUSION:

The obtained treatments have the ability to protect the wooden material, even after it was exposed to extreme conditions, maintaining its mechanical properties and a hydrophobic character for a long time.

References:

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