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Title: Partial Replacement Effect of Montmorillonite with Cellulose Nanowhiskers on Polylactic Acid Nanocomposites

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1 **Partial Replacement Effect of Montmorillonite with Cellulose Nanowhiskers on Polyactic**  
2 **Acid Nanocomposites**

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14 **Abstract**

16 In this study, hybrid montmorillonite/cellulose nanowhiskers (MMT/CNW) reinforced polyactic  
17 acid (PLA) nanocomposites were produced through solution casting. The CNW filler was first  
18 isolated from microcrystalline cellulose by chemical swelling technique. The partial replacement  
19 of MMT with CNW in order to produce PLA/MMT/CNW hybrid nanocomposites was performed  
20 at 5 parts per hundred parts of polymer (phr) fillers content, based on highest tensile strength  
21 values as reported in our previous study. MMT were partially replaced with various amounts of  
22 CNW (1, 2, 3, 4 and 5 phr). The tensile, thermal, morphological and biodegradability properties  
23 of PLA hybrid nanocomposites were investigated. The highest tensile strength of hybrid  
24 nanocomposites was obtained with the combination of 4 phr MMT and 1 phr CNW. Interestingly,  
25 the ductility of hybrid nanocomposites increased significantly by 79 % at this formulation. The  
26 Young's modulus increased linearly with increasing CNW content. Thermogravimetric analysis  
27 illustrated that the partial replacement of MMT with CNW filler enhanced the thermal stability of  
28 the PLA. This is due to the relatively good dispersion of fillers in the hybrid nanocomposites  
29 samples as revealed by transmission electron microscopy. Interestingly, partial replacements of

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