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TiO_2 NANOPARTICLES INCORPORATED CMC-MMT NANOCOMPOSITE FOR FOOD PACKAGING APPLICATIONS

A.W.N.D. Perera[1*], S.N. Wijesooriya[3] and N.M. Adassooriya[1,2]

[1]Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka
[2]Department of Chemical and Processing Engineering, University of Peradeniya, Peradeniya, Sri Lanka
[3]Department of Food Science and Technology, Wayamba University of Sri Lanka, Gonawila, Sri Lanka
[*]nawodaperera1995@gmail.com

The demand for sustainable food packaging material has increased compared to nonbiodegradable packaging because plastic waste is a serious environmental problem. In this study, different composites of citric acid (CA) crosslinked montmorillonite (MMT) reinforced carboxymethyl cellulose (CMC) films with TiO_2 nanoparticles (NPs) (average size < 20 nm) incorporated to act as antimicrobial agents were investigated for applications in food packaging. Films were fabricated using the solvent casting method with 25% (w/w) CA as the crosslinking agent, and 1%, 3%, and 5% TiO_2 NPs were added to the CMC-MMT nanocomposite with glycerol as a plasticizer. The films were characterized by FTIR, TGA, and PXRD and evaluated for water solubility, moisture content, and moisture uptake ability. The addition of CA and TiO_2 NPs lowered the moisture uptake (MU), water solubility (WS), and moisture content (MC) by reducing polymer network interactions. FTIR analysis confirmed the formation of ester crosslinks between CMC and CA. It was found that MC decreased from 34.3% to 33.3% when the concentration of CA increased and reduced to 29.3% with the addition of 5.0% TiO_2 NPs. The WS was reduced from 67.9% to 66.9% when the amount of CA increased from 15.0% to 25.0% and reduced from 66.7% to 65.2% when the amount of TiO_2 NPs increased from 1.0% to 5.0%. Incorporation of 3% TiO_2 NPs into CMC/MMT/CA25% film remarkably reduced the MU by 21.9% at 97.0% RH and 16.1% at 40.0% RH. According to the thermal analysis, the addition of TiO_2 NPs enhanced the thermal stability of CMC films. The PXRD revealed that TiO_2 NPs and MMT modified the original structure of the CMC by increasing the crystallinity of the films. From the overall results, CA crosslinked TiO_2 NPs incorporated CMC-MMT films were found to exhibit the lowest WS, MU, and MC.

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Keywords: Moisture Uptake, Moisture Content, Nanocomposite, Water Solubility