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BAWORNKIT NEKHAMANURAK : EFFECT OF SURFACE - MODIFIED CALCIUM CARBONATE NANO-PARTICLES ON PROPERTIES OF BIOCOMPOSITES. THESIS ADVISORS : ASST. PROF. DR. PAJAERA PATANATHABUTR, Ph.D., ASST. PROF. DR. NATTAKARN HONGSRIPHAN, D.Eng. 192 PP.

There is an increasing demand on the use of biodegradable plastic, which can be renewable. A five-year Roadmap (2008-2012) for bioplastic development in Thiailand was approved. Currently, biodegradable poly(lactic acid) (PLA) is offering a potential alternative to petrochemical plastics in food packaging applications. However, it is comparatively brittle and stiff at room temperature, so modification is needed for PLA in order to apply with flexible-desired applications with breathability and gas barrier properties. This research aims to investigate the effect of $CaCO_3$ nano-particles and plasticizers on mechanical, physical, thermal properties and rheology of PLA nanocomposite, and to improve its breathability and gas barrier properties by adding $SiO_2$-$CaCO_3$ nano-particles at different mole ratio of Si:Ca. This research found that adding of nano-sized $CaCO_3$ into PLA could improve processability of this commercialized biopolymer by lowering $T_{cc}$ to around 105 $^oC$, resulting in maintaining melt strength of the nanocomposites throughout the casting rolls. Polyethylene glycols (PEGs) and tributyl citrate (TbC) plasticizers could improve flexibility of $CaCO_3$-PLA nanocomposites as well as caused good dispersion of nano-sized $CaCO_3$ in plasticized PLA matrix. The research found the synergism of fatty acid coating on $CaCO_3$ and transesterification of PEG/TbC plasticizers on thermal degradation of PLA, caused the dramatically decrease in mechanical properties of PLA. However, TbC plasticizer could improve flexibility as well as maintain processability of $CaCO_3$-PLA nanocomposites, especially handling in casting rolls. The successful preparation of high porosity and hydrophilic modified $SiO_2$-$CaCO_3$ nano-particles by sol-gel process using TEOS as precursor was performed in this research. Adding of $SiO_2$-$CaCO_3$ nano-particles had positive effect on mechanical properties, thermal properties and thermal stability of PLA. TbC plasticized [$SiO_2$-$CaCO_3$]-PLA nanocomposites sheet showed ability to be innovated as active food packaging materials because it gave higher $O_2$ and $CO_2$ permeability but slight increase of water vapor permeability, compared to neat PLA. These properties were desirable for keeping fresh fruit and vegetable and extending the shelf life of the products.

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