

Nantharat Phruksaphithak 2012: Direct Melt Polycondensation of Lactic Acid and PLA Modification by Blending. Doctor of Philosophy (Chemistry), Major Field: Chemistry, Department of Chemistry. Thesis Advisor: Associate Professor Cholticha Noomhorm, Ph.D. 179 pages.

Synthesis of polylactic acid (PLA) by direct melt polycondensation (DMPC) using two cationic exchange resin catalysts (A and B) with 100 g, 1 kg and 10 kg of commercial lactic acid (LA) were studied. DMPC was carried out by varying the mole ratio, temperature and alternating between N₂ and reduced pressure for different time periods. It was found that PLA obtained from B has a higher \overline{M}_w than A with 100 g of LA. The highest \overline{M}_w of PLA obtained was from B = 113,000 with mole ratio of LA:B = 500:1 at 170°C for 12 h. Thus catalyst B was chosen for carrying the PLA synthesis in 1 kg and 100 kg. $\overline{M}_w \sim 146,000$ of PLA was obtained with mole ratio of LA:B = 500:1 at 180°C for 24 h for 1 kg system when carrying the DMPC surrounding with dry ice atmosphere. Contrarily, only 13.0% of PLA with $\overline{M}_w = 87,000$ was obtained with mole ratio of LA:B = 500:1 at 170°C for 48 h for 10 kg system when carrying the DMPC surrounding with dry ice atmosphere.

Modification of PLA properties was carried out. It was found that % elongation was higher than pure PLA when blending PLA with polyethylene glycol (PEG) and polydioxolane (PDXL), thus PEG and PDXL can be used as plasticizers to toughen PLA. Using PEG and PDXL as compatibilizers in PLA/DF (duck feather fiber) blends shown although tensile strength (T.S.) and elongation at break (EB) of PLA/PEG/DF and PLA/PDXL/DF blends were higher than PLA/DF, they were still lower than pure PLA. Finally, the T.S. and EB of PLA blends with five impact modifiers; gloves latex (LT1), natural rubber latex (LT2), poly(*cis*-1,4-isoprene) (IR), poly(acrylonitrile-*co*-butadiene) (NBR) and poly (ethylene-*co*-vinyl acetate) (PEVA); confirmed that all impact modifiers had the capability to toughen PLA.

Student's signature

Thesis Advisor's signature