Maytinee Sanmaneechai 2013: A Study of Life Cycle Impact of Polylactic Acid/Starch, Polyethylene Terephthalate and Polyvinylchloride Boxes. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Thumrongrut Mungcharoen, Ph.D. 96 pages.

The first objective of this study is to collect inventory data and assess the life cycle impact of bio-based boxes that made from Polylactic acid and cassava starch blend (PLA/starch) at the ratio of 70/30, 50/50 and 30/70 compared to petroleum-based boxes that made from Polyethylene terephthalate (PET) and Polyvinylchloride (PVC) using the Life Cycle Assessment technique. The functional unit is specified as 10,000 boxes of 8 x 10 x 2.8 centimeters size from PLA/starch 70/30, 50/50, 30/70, PET and PVC boxes which weigh 549.65, 397.20, 804.00, 582.77 and 462.51 kilograms, respectively. The SimaPro 7.2 software with the CML 2 Baseline 2000 version 2.03 method is used in this study.

The study is divided into 2 parts. The first part is the production including the raw material production, transportation and boxes production. It is found that PLA/starch 50/50 box has the lowest total environmental impact. The result indicates that the 50/50 is the appropriate ratio for binding of cassava starch and PLA to produce the box with the lowest weight. For bio-based boxes, the highest environmental impact is from the use of electricity for PLA pellet production step. For petroleum-based boxes, PVC box has lower total environmental impact than PET box. The highest environmental impact is from the raw material extraction to the resin pellet production step. In the second part, the whole life cycle of box including the waste management of box after the end of life is studied. The results show that composting is the best waste management method for bio-based boxes and can reduce the environmental impact by 61-75%. For petroleum-based boxes, incineration with heat recovery is suitable and can reduce the environmental impact by 14-40%.

The second objective of this study is to evaluate the carbon footprint (CFP) throughout the life cycle of bio-based and petroleum-based boxes. It is found that the lowest carbon footprints of bio-based boxes from PLA/starch 70/30, 50/50 and 30/70 with composting are 0.109, 0.057 and 0.046 kg CO_2 equivalent, respectively. For petroleum-based boxes from PET and PVC with incineration with heat recovery, the carbon footprints are 0.140 and 0.117 kg CO_2 equivalent, respectively.

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