Unchalee Suwanmanee 2010: Modeling and Life Cycle Environmental Assessment of Conventional and Degradable Plastic Packages. Doctor of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Thumrongrut Mungcharoen, Ph.D. 205 pages.

The first objective of this study is to assess environmental impact associated with two types of packages using the Life Cycle Assessment technique. The materials of trays package are Polylactic acid (PLA) and Polystyrene (PS) while the materials of garbage bags package are PE/starch blend (PE/starch), PE/Total degradable plastic additive blend (PE/TDPA) and conventional Polyethylene (PE). The functional unit is specified as 420 liters of 20 x 14 x 1.5 cm. of PLA and PS trays which weights 15.10 and 4.03 kilograms, respectively. For garbage bags, the function unit is 500,000 liter of 58.4 x 95.25 cm. for PE/starch, PE/TDPA and PE bags which weight 416.83, 93.17 and 60.83 kilograms, respectively. The system boundary is from raw material extraction to waste management. The Life Cycle Impact Assessment was done by using Microsoft Excel and the SimaPro 7.02 program together with the CML 2 Baseline 2000 version 2.03 method. It is found that trays' production and transportation to consumers, the energy consumption and environmental impact of PLA trays is 1.88 times and 2.57 times more than the PS trays, respectively. As mentioned above, the highest portion comes from electricity and natural gas used in PLA production for PLA trays and raw material extraction for PS trays. The main environmental impacts are marine aquatic ecotoxicity, human toxicity and global warming. For waste management, the results show that incineration and heat recovery is suitable for both PLA and PS trays while composting or landfill with energy recovery from methane collection is also appropriate for PLA trays. For garbage bags, it is found that during the garbage bags' production and transportation to consumers, the energy consumption and environmental impact of PE/starch garbage bags is the highest of all materials studied due to high consumption of virgin PE pellets. The highest energy consumption and environmental impact come from raw material extraction for all garbage bags. For waste management, the results show that incineration and heat recovery is the most suitable for garbage bags, while landfill with energy recovery from methane collection is appropriate as well.

The second objective of this study is to propose and evaluate the kinetics of C-$CO_2$ evolution during biodegradation of plastic materials including PE, microcrystalline cellulose (MCE), PE/starch, and PLA. The aerobic biodegradation under controlled composting conditions was monitorated according to ISO 14855-99. It is found that the first order reaction in series with a flat lag phase model is desirable for MCE, PE/starch and PLA.

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