Abstract

Key words: biopolymers, polylactic acid, PLA, Mater-bi, renewable packaging, sustainable packaging.

This study investigates the possibility of making Tetra Pak non-aseptic packaging more sustainable by replacing the currently used fossil-based low-density polyethylene (LDPE) laminate, with a renewable starch-based polymer laminate. Two starch-based materials are studied: polylactic acid (PLA) and the brand named biopolymer Mater-bi. The study is divided into two sections for separate analysis; the cradle-to-factory-gate section, concerning the production of the polymer granules from the extraction of raw materials to the sale of the granules, and the end-of-life section, concerning the laminated packaging after final disposal. A final analysis will draw from both sections from which one discussion will follow.

Literature review research methods are employed to investigate the cradle-to-factory-gate environmental aspects, including energy use, water use, and equivalent CO_2 emissions. Information is taken primarily from published life cycle analysis reports. The end-of-life section includes investigations into the following aspects: paper fiber recovery and quality during re-pulping, energy recovery through incineration, equivalent CO_2 emissions for incineration and land-filling, polymer material recycling possibilities, performance in automated sorting technology, and reactions in the presence of re-pulping chemicals. Firsthand empirical data is collected through experiments for most aspects and some literature review used for supporting data. Literature review is used to investigate other related issues, such as the use of food crops for industrial purposes and the use of genetically modified organisms.

Results from this analysis show that replacing LDPE with the starch-based biopolymers investigated will not improve the sustainability of the packaging at this point in time. On closer examination of the cradle-to-factory-gate aspects, the three materials rate nearly equal, with some slight differences. Some significant results show that the production of LDPE requires more fossil energy but the included feedstock energy can be recovered through incineration, thus acting as an energy credit. PLA and Mater-bi require less cradle-to-factory-gate fossil energy, but disregarding feedstock energy, they use more fossil energy in the actual production process, which is not recoverable. Some significant outcomes for the end-of-life section show that there are some problems with re-pulping PLA laminated materials. One sample type resulted in very low fiber recovery and another resulted in polymer contamination of the recovered paper fiber stock. Mater-bi laminated materials performed well in re-pulping but the quality of the recovered fiber was slightly decreased through the increase of “stickies”, small adhesive contaminates. Polymer material recycling after use and storage is possible for Mater-bi, but not for PLA due to the absorption of water during storage.