

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this study, the life cycle environmental impact assessment (LCIA) was performed for two types of bioplastics (PLA and PBS) and their model products which is garbage bag. In this study, we focused on global warming potential (GWP) which is represented by the GHG emission in term of kg CO₂ eq. per units of interest (kg resin or kg product). The study was divided into 2 parts: cradle-to-gate (only resin production) and cradle-to-grave (whole life cycle, including use and disposal). The cradle-to-gate results showed that GWP of PLA resin was lower than GWP of conventional plastic (PE) while the GWP of PBS was higher than GWP of conventional plastic resins. We have shown that the impacts could potentially be reduced by applying practical improvement options. For PLA resin, the overall GWP can be lowered by the utilization of wastewater from cassava plant to produce biogas for electricity generation. For the next generation, the overall GWP of PLA can be reduced by choosing gypsum free process to produce PLA resin. In case of PBS resin, the impact can be reduced by choosing to produce PBS resin purely from renewable resources and by reducing energy consumption in the process. When the whole life cycle environmental impact of bioplastic was considered (cradle-to-grave), the results obtained using Sa-med island as an experimental site show that the performance of bioplastic in term of GWP is better than conventional plastics and composting is an appropriate waste management to gain highest environmental benefits from bioplastics.

5.2 Recommendations

Although the life cycle environmental impact assessment was successfully conducted for two types of bioplastics (PLA and PBS), several recommendations could be offered as follows:

5.2.1 Suggestions for Improvement of Inventory Data

The data of sugar production from cassava starch were extracted from literature which it may be not good enough for real case. In order to get more accurate results, relevant data should be provided directly by the company.

As the inventory data from Wim J. Groot & Tobias Borén (2010) were used as the secondary data for the production of PLA resin of PURAC (Thailand), there were several assumptions and estimations were made in order for the research team to be able to have enough data to assess the environmental impact as planned. This could be improved if more complete and transparent data were achieved.

5.2.2 Suggestions for Improvement of Environmental Performance

5.2.2.1 *PLA Resin*

From the results, it can be seen that GWP impact mainly comes from the production of cassava-based PLA resin which covers the cassava plantation & harvesting, transportation, starch production, lactic acid and polylactic acid production. We have shown that utilization of biogas from wastewater of cassava plant to generate electricity help to reduce GWP significantly. However, increasing use of renewable energy in this energy intensive resin production process could help further reduce GWP value of cassava-based PLA resin. Developing biogas system from waste water is interesting choice to reduce GWP and can be more produced biogas from waste water. For the new generation, the process for PLA resin production should be gypsum free process which may help further decrease GWP of technology

5.2.2.2 *PBS Resin*

In case of PBS, it shows high GWP impact which is 5.3835 kg CO₂ eq./kg PBS resin. As PBS composes of 2 parts which are succinic acid and 1,4-butanediol (BDO), succinic acid from bio-based generates net GWP of 1.611 kg CO₂ eq./kg PBS resin while BDO from petroleum-based generates GWP of 2.618 kg CO₂ eq./kg PBS resin. For PBS resin, the impact can be reduced by choosing to produce PBS resin purely from renewable resources and by reducing energy consumption in the process.

5.2.2.3 *End of Life*

It is clearly shown in this study that the disposal technology and waste management system are very important to the overall environmental performance of the bioplastics. It is recommended that these two factors should be considered together with the development of bioplastics or even before so that the suitable disposal and waste management system could be set up to handle bioplastic wastes in order to minimize the environmental impacts of the bioplastics.

5.2.3 Suggestions for Use and Disposal of Bioplastic at Sa-med

The shops and people at Sa-med that joined with NIA project should be fully corporation in waste separation, in order to gain highest environmental benefits from bioplastics.

The environmental assessment of the end of life (disposal phase) was conducted as based on current waste management of Sa-med. Further study should be finding a new place to improve waste management by using benefits of bioplastic, it may be another tourist attraction.