CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

As the pressures on the chemical process industries to improve their environmental performance and the demand for a simple LCA tool that can be integrated with other process design tools. LCA tool, LCSoft has been presented been presented together with the bioethanol production from cassava rhizome as a case study. A new database has been created and new predictive models for estimation of the environmental impacts have been developed. LCSoft based on the framework allows a fast, reliable, and systematic calculation of inventories and emissions, and the integration with other important tools for economic and sustainability analysis allows a robust, flexible, and systematic calculation in order to perform multi-criteria evaluation.

In fact, the process development continuously improved in order to arrive the best design. LCSoft and tool integration need to be improved according to this reason. Regarding to LCSoft and tool integration framwork; Tool 1, life cycle inventory (LCI) knowledge management; Tool 2, estimation of environmental factors using the group contribution^{+} method (GC^{+}) in order to calculate environmental impacts for a wide range of chemicals; Tool 3, LCA calculation models should be improved. Tool 1; LCI database can be extended for application in the wider ranges, the interface can be further simplified for easy data entering, and modules in this tool can be expanded in order to account more LCI data. Tool 2; characterization factors of environmental impact can be increased in order to calculate more important environmental impacts and cover for process evaluation, this tool can be expanded in order to estimate more environmental related-properties, the predictive models should be performed uncertainty analysis, and more molecular information can be added in order to predict more characterization factor of the complex chemicals. Tool 3; this tool can be expanded in order to calculate more LCA related-terms, and the interpretation of results from this tool can be adjusted for a better conclusive results representation. Tool 4; This tool can be further simplified for easy data entering and faster process evaluation, and the interface can be expanded with other external process design tools.

Finally, future work are focused on extension of LCI database in LCSoft, methodology improvement for supporting on calculation of more process indicators, integration with other important external tools, and quantification of the effect of uncertainties of estimated properties on the design of sustainable processes.