CHAPTER V
CONCLUSIONS AND RECCOMMENDATION

Life cycle assessment (LCA) was used to evaluate the environmental impact associated with the manufacturing of 3 types of plastic which are polyurethane foam (PU), general purpose polystyrene (GPPS), and high impact polystyrene (HIPS) by using SimaPro 5.1 software. Life cycle inventories (LCI) are successfully generated for all three plastics.

Life cycle impact assessment (LCIA) of the three plastics has been performed by using Eco-indicator 95 and Eco-indicator 99 provided in SimaPro 5.1. The results obtained from the LCA study on the polyurethane foam manufacturing show that the major environmental impacts are in heavy metal and acidification. Damage assessment shows that the damages are mainly on resource depletion and human health which result from impact categories such as depletion of fossil fuels category (resource depletion), respiration of inorganic substances and carcinogenic effect which have direct effect on human health. By conducting LCA throughout 5 phases of PU foam production, the results indicate that manufacturing and use phases contribute mainly to the environmental impacts. For manufacturing phase, the environmental impacts mainly come from production of polyether-polyol which is used as the main raw material in the production of formulated polyol. The environmental impact in use phase (injection process) is mostly from isocyanate and its production which is the important chemical used in the injection of polyurethane foam.

For GPPS manufacturing, the environmental impacts are high in the following categories: acidification, summer smog formation, and carcinogenic effect, respectively. The damage assessment occurs mostly from resource depletion and human health. Among 5 phases in GPPS production, manufacturing phase and use phase are the main contributors to the environmental impact. In contrast to PU foam, the disposal phase is advantageous for the environment because recycling process can reduce the use of materials in the manufacturing phase. In the manufacturing phase, the environmental impacts come mainly from the production of styrene monomer and water in Thailand. For use phase, the impact on the environment is mostly from electricity production in Thailand.

Similar results to the LCA of GPPS are obtained for HIPS manufacturing but the impact is slightly higher due to the use of polybutadiene rubber in the production of HIPS. Considering all 5 phases in HIPS production, the environmental loads mainly come from manufacturing and use phases. The production of styrene monomer, polybutadiene rubber, and water are the main environmental impact in the manufacturing phase. In the use phase, the impact comes from the utilization of electricity.

Several suggestions can be made for improving the environmental impact from the production of these petrochemical products. From the results, emphasis should be on the raw materials used in the manufacturing process. Replacement of diphenylmethane diisocyanate (MDI) by toluene diisocyanate (TDI) in PU foam manufacturing can reduce environmental impact considerably. MDI is used as chemical in use phase for injection together with formulated-polyol to produce the polyurethane foam. Furthermore, the environmental impact of GPPS manufacturing can be reduced by reducing the electricity consumption in the use phase. There are 2 injection machines, 450-ton and 350-ton, of which 450-ton is normally used to produce clear shelf for refrigerator. By switching to use 350-ton, energy consumption can significantly be reduced which leads to approximately 20% reduction in the overall environmental impact.

In addition, since the major environmental impact of all three plastics studied is mainly from the energy consumption. This problem may be improved by applying cleaner technology or other appropriate energy conservation technologies to the manufacturing process of these petrochemical products.