CHAPTER III

LITERATURE REVIEW

The following literatures in this chapter concentrate on the theory and application of LCA in many process or product and, also, concentrate on the production of WPC.

3.1 LIFE CYCLE ASSESSMENT

Angelo Riva (2006) presents results of the application of LCA method in order to evaluate the environmental advantages of natural gas over other fossil fuels and to have advanced techniques for analysing the environmental aspects of the gas industry. The evaluation of published studies and the application of the method to electricity production with fossil fuels, by using data from published databases and data collected by the gas industry, demonstrate the importance and difficulties of having reliable and updated data required for a significant LCA. Results show that the environmental advantages of natural gas over the other fossil fuels in the final use stage increase still further if the whole life cycle of the fuels, from production to final consumption, is taken into account.

Krisakorn Jiamjamrusilp (2004) assessed the environmental impacts of powder coating paint using life cycle assessment technique. Impact categories was studied such as ozone layer depletion, acidification etc. The system boundary of this study cover production process, transportation, use and disposal of powder coating paint. After using SimaPro 5.1 software with Eco-Indicator 95, it indicated the environmental impacts as following: coating powder paint step(86.1%), transportation step (6.4%), and production of powder coating paint step (6.3%)

Krystyna Czaplicka (2003) present a methodology of eco-designing of multi-layer composites using a design of conveyor belts as an example.In the present article, the methodology of designing of multilayer conveyor belts has been shown, experimental results of strength of designed belts have been presented, the eco-indicator 99 according to the SimaPro 5 methodology has been calculated and the methodology of optimisation of strength properties regarding various belts and their impact on the environment during the entire product life cycle has been presented.Changing physical and mechanical properties of layers constitute belt results in changing of rigidity and flexibility of the belt, which determine required exploitation properties of the belt.Using life cycle assessment (LCA) methodology, the pressure on the environment might be evaluated with respect to the category of human health, resources and quality of ecosystem.Defining objective function (selection criteria) allows to optimise the mechanical strength of the composite being taken into account and also its impact on environment using the life cycle assessment.

Oranuch Pruitichaiwiboon (2004) focused on life cycle assessment for 18000 Btu/h of rotary compressor. SimaPro 5.1 software with Eco-Indicator 95 is used to assess the environmental impact of rotary compressor. The environmental impacts in the stage of manufacturing, transportation, use and disposal are 0.0015, 0.000189, 9.45, -0.00125 kPt respectively. The results show that the use stage has the great environmental impacts, resulting from electricity consumption. The LCA results can specify weak the points which should be improve to be more efficient.

3.2 LIFE CYCLE ASSESSMENT FOR COMPARISION

Corbie`re-Nicollier, T. (2001) determined the environmental performance of China reed fibre used as a substitute for glass fibre as reinforcement in plastics and to identify key environmental parameters. A life cycle assessment (LCA) is performed on these two materials for an application. Considering the whole life cycle, the polypropylene production process and the transport cause the strongest environmental impacts during the use phase of the life cycle. Since thermoplastic composites are hardly biodegradable, incineration has to be preferred to discharge on landfills at the end of its useful life cycle.

Jantanapa Sahunin (2005) estimated the environmental impacts of production of SiO_2 nano-particle, chemical product of major industry importance, and identified the suitable production method conducted life cycle assessment (LCA) for estimation. The types of SiO_2 nano-particle production including sol-gel process, flame aerosol process and spray pyrolysis was investigated. Based on the results of the study, flame aerosol process has impacts to the human health, ecosystem quality and resources less than sol-gel process and spray pyrolysis, respectively.

Jirunya Paoluglum (2005) conducted life cycle assessment (LCA) to assess environmental impacts of the production of polystylene (PS) and polyurethane foam (PU foam) using SimaPro ® 5.1 with Eco-indicator 99 and Eco-indicator 95 method for estimation the environmental impact. The system boundary of PS and PU foam production was set to include manufacturing, distribution, transportation, use and disposal. It was found out that the environmental impacts of two products come mainly from the manufacturing and use phases. It also observed that the production of PS creates the environmental impacts approximately 1.5 times higher than PU foam.

Norgate, T.E. (2007) Evaluated both new and existing processes for primary metal production to assess their environmental impacts is often difficult due to the many inputs and outputs involved using Life Cycle Assessment (LCA) method. The metals considered included copper, nickel, aluminium, lead, zinc, steel, stainless steel and titanium, by both pyrometallurgical and hydrometallurgical routes in some instances. The environmental profile included greenhouse and acid rain gas emissions, solid waste emissions and gross energy consumption. New process technologies for primary metal production can be expected to reduce the environmental impacts of metal production, and estimates of likely reductions for technologies involving stainless steel, titanium and aluminium are also presented.

Reginald B.H.(2005) investigates the environmental impacts of the production of EPS and CPB from 'cradle-to-gate', comparing two inserts—both the original and proposed new designs. In the second part, LCA is applied to investigate various end-of-life cases for the same materials. The study will evaluate the environmental impacts of the present waste management practices in Singapore. Several 'what-if' cases are also discussed, including various percentages of landfilling and incineration. The SimaPro LCA Version 5.0 software's Eco-indicator 99 method is used to investigate the following five environmental impact categories: climate change, acidification/eutrophication, ecotoxicity, fossil fuels and respiratory inorganics.

Warunee Musichat (2005) investigated the environmental impacts in order to select a suitable process of production of multiwalled-carbon nanotube (MWNTs) by chemical vapor deposition process using life cycle assessment (LCA) technique for quantified the environmental impacts. Three different CVD process was considered: using ethane and iron on alumina, acetylene and iron-cobalt on calcium carbonate, and acetylene and cobalt-molybdenum on magnesium as catalyst. The results show that production of MWNTs by ethane as carbon source and iron on alumina as catalyst has minimum effect on human health, ecosystem quality and depletion of resource. Thus, the most suitable process is production of MWNTs using ethane and iron on alumina as catalyst in environmental impacts view points.

3.3 WOOD-PLASTIC COMPOSITES (WPC)

A.K. Bledzki (2005) studied structure–properties relationship of wood fibre (WF)– PP composites related to WF types and compounding techniques, namely two-roll mill, high-speed mixer and twin-screw extruder. It was shown that twin-screw extruder compounded composites had higher mechanical properties than those compounded in a two-roll mill or a high-speed mixer. The use of compatibilisers (MAPP) in the compounding step improved the mechanical properties of the composites in dry conditions regardless of the compounding process, however, in wet conditions a decrease in tensile and flexural strength was observed for all composites. It was shown that the use of compatibilisers significantly improved the hydrophobicity of WF surface. However, the bulk of WF remains unmodified and accessible to water.

Y.S. Kim (2004) presents the processing/structure/property relationships for artificial wood made from stretched PP/wood-fiber (WF) composites that have required strength and density. The results show that artificial wood adopted a texture similar to that of natural wood. The tensile strength and the elongation at break of the stretched PP/WF 30 wt% composites were significantly increased 5 times, but the tensile modulus (stiffness) was lowered by 25%. The tensile properties of the stretched PP/WF 30 wt% composites were not a sensitive function of the preheating time nor the oven temperature.

Chanida Yotinwattanakamtorn (2004) studied on the production and mechanical properties of wood-plastic composites (WPC) using sawdust, waste, and polypropylene as fiber and matrices, respectively. The quantity of sawdust in polypropylene was investigated on affecting to the mechanical properties. From the results, it indicated that increasing of sawdust in polypropylene makes tensile modulus increase but tensile strength and %elongation at break decrease. It also show that optimum amount of sawdust for production of WPC based on PP is 30%wt.

Jakarin Pomjirasuk (2003) introduced Methyl methacrylate and butylacrylate (MMA-*co*-BA) copolymeric processing aids into poly(vinyl chloride) wood–sawdust composites. It was found that the mixing torque, wall shear stress, and extrudate swell ratio increased with increasing processing aid content. Moreover, it was found out that tensile modulus, %elongation, tensile strength, impact strength are decreased when increasing of sawdust. At 16.7-41.2%wt, the mechanical properties did not change too much but the optimum amount of sawdust for production of WPC based on PVC is 33%wt.