CHAPTER IV

RESEARCH METHODOLOGY

The research methodology for this study was pursued in order to investigate the environmental impacts and economic performance of production of wood plastic composites prepared from PVC/sawdust and PP/sawdust. This chapter includes selection of materials, equipments, variables and research methodology for evaluate the environmental impacts and economic performance of wood plastic composites production.

4.1 MATERIAL AND EQUIPMENT

1. A Desktop Computer
    Hardware Pentium(R) 4 CPU 3.00 GHz
    3.00 GHz, 1.00 GB of RAM
2. Window XP® software
3. SimaPro® 6.0 software
4. Microsoft Office XP® software

4.2 VARIABLES

This research study on environmental impacts and economic performance of production of Wood Plastic Composites (WPCs) associated with material acquisition, transportation, production and product disposal. The variable in this research are:

4.2.1 Independent Variable

- Resin used in Wood-Plastic Composites production
- Transportation model for materials and products
- Production process of Wood-Plastic Composites
- Disposal of Wood-Plastic Composites
- Cost

4.2. Dependent Variable is environmental impacts and economics performance of Wood-Plastic Composites.

4.3 RESEARCH METHODOLOGY

4.3.1Goal and Scope Definition

4.3.1.1 Objective and purpose of the research work

- This research collects data and create data base of two wood – plastic composites (WPCs) prepared from polypropylene and poly(vinyl chloride) composite with sawdust
- The environmental impacts of two wood plastic composites are evaluated via using SimaPro® 6.0 software with Eco-indicator 95 and Eco-indicator 99 method

4.3.1.2 Functional Unit

In this research, the chosen functional unit for evaluation is 1 kg of each WPCs

4.3.1.3 Scope and System boundary

This research studies on life cycle of WPCs based on PVC and PP associated with material acquisition, transportation, production and product disposal, and compare on environmental impacts between each step and economic to determine the process which has the highest performance for production of WPC.

4.3.1.4 Limitation and Assumption

1.The data acquirement is not derived from any processes in any companies. Data is derived from literature review such as thesis, paper from journals and database from SimaPro®6.0 software.

2.The inventory data of transportation for consideration in life cycle assessment is obtained from assumption of plant location decision which divided in 2 steps as follow:

2.1.Preliminary plant location decision: In this part, Consideration of plant location was study by comparison of environmental impacts from transportation of raw materials, products and transportation cost of 2 plant location: One is in Bangkok (plant near customers) and the other is in Rayong (plant near raw materials). Then, this part will show the appropriate plant location.

2.2.Detailed plat location decision: from preliminary decision, we know the suitable plant location that tell us the way for transportation of raw materials to plant and also the way for transportation of products from plant to customers. Which way and distance of transportation of both raw materials and products are included for consideration of LCA.

4.3.2 Life Cycle Inventory (LCI)

In this section, the principle of life cycle inventory analysis (LCI) will be applied to any activities that involve the direct and indirect use of energy or materials. The inventory analysis and the tasks to be fulfilled can be supported by a flow sheet for considered product

The inventory analysis includes collection and treatment of data to be used in preparation of material consumption, energy for all phases in the boundary of this study. The data acquirement is derived from 1. collecting from literatures and 2. using data base from SimaPro® 6.0 software

4.3.3 Life Cycle Impact Assessment (LCIA)

The impact assessment of this study uses SimaPro® 6.0 software using Eco-indicator 95 and Eco-indicator 99 method. Both methods can calculate numbers which express the environmental load of products or processes. Eco-indicator 99 is developed from Eco-indicator 95 and types of impact categories are relatively similar. The important differences between these 2 methods are

- Eco – indicator 99 can identify and show damage categories as graph and quantity which are derived from impact categories in characterization. Damage categories relate to human health, ecosystem quality and resource depletion.
- Characterization unit of Eco-indicator 95 is kg equivalent of each impact categories but Eco-indicator 99 is DALYs (for human health),

PDF x m^2 (for ecosystem quality) and MJ surplus (for resource depletion)

- Eco-indicator 99 is more concern in resource depletion effect than Eco-indicator 99.

4.3.3.1 Structure of method in SimaPro software®

SimaPro software® has many different methods for environmental impacts calculation such as CML method, EDIP method etc. However, the basic structure of impact assessment methods in SimaPro software® are:

- Characterization
- Damage Assessment
- Normalization
- Weighting

The last 3 steps of the impact assessment method mentioned above are optional according to ISO standards. Then, they are not allows available in all method (Pre' Consultants, 2004)

4.3.3.2 Factors used in Eco-indicator 95 and Eco-indicator 99

The structures of Eco-indicator 95 consist of characterization, normalization and weighting. Eco-indicator 95 is the successor of Eco-indicator 95. Te development of the Eco-indicator 99 started with design of the weighting procedure. All factors in these both methods obtained from data of SimaPro software 6.0 ® were shown in APPENDIX.