CHAPTER III
EXPERIMENTAL

3.1 Materials and Equipment

3.1.1 Equipment

Laptop Acer (Aspire 4920 Intel(R) Core 2 Duo processor T5550 1.83 GHz RAM 2 GB, Microsoft Office 2007)

3.1.2 Software

Gabi 5

3.2 Methodology

3.2.1 Literature Survey

a. Study and review the background of the cow manure management in U.S.

b. Study the new process design that the groups of senior students of Chemical & Environmental Engineering at The University of Toledo, Ohio, USA, created in part from lab experiments and CHEMCAD simulation program.

c. Study LCA software program and its simulation method to analyze environmental impacts of the newly proposed cow manure treatment process and other existing systems.

d. LCA considered only for the treatment operations. Emissions from material acquisition, construction, and disposal were not included in LCA.

3.2.2 Life cycle assessment (LCA)

3.2.2.1 Goal and Scope

The goal of this study was to investigate and compare the environmental impacts of the proposed manure conversion process to existing management methods practiced in the United States of America. A LCA software

program, Gabi 5 was used. Five LCA scenarios including the proposed biosolids fuel production process have been created based on a dairy farm in Northwest Ohio:

- Scenario 1A : Untreated holding pond with land application (slurry).
- Scenario 1B : Untreated holding pond with land application (scraped).
- Scenario 2 : Anaerobic digestion with co-generation of methane for energy production.
- Scenario 3A : Proposed biosolids process with fly ash mixture for energy production (slurry).
- Scenario 3B : Proposed biosolids process with fly ash mixture for energy production (scraped).

The scope of this research will cover the following: Investigate the flows of energy and carbon in the proposed process design and existing management systems. Perform life cycle analysis (LCA) simulation and compared the greenhouse gases emissions in the proposed process design and existing management methods such as land application and anaerobic digestion.

The functional unit has been identified as the environmental impact of manure management systems. We have also determined to limit the analysis only to the processes and components directly involved in the operation and construction of the manure management. For all input and output flows are expressed per functional unit. In order to make a functional unit has been defined to management of cow manure waste of 347 cattle for one year.

3.2.2.2 Inventory Analysis

We have to collect data that related to manure waste and environmental impact for all relevant factors and set up the system boundaries of all unit processes. Then, we have to set the material and energy balance for all of process and quantify how much energy used, how much solid, liquid and gaseous wastes were generated and emitted to environment, at each stage of the product's life.

3.2.2.3 Life Cycle Impact Assessment (LCIA)

Started to calculate the impact potentials based on the LCA results by using IPCC (2006) method and software program, Gabi 5. The impacts of the management plans were analyzed and compared on greenhouse gas emissions, and acidification of the each scenario.

3.2.2.4 Interpretation

The potential of the each scenario to reduce energy, and environmental impacts at each stage of the process was investigated using the life-cycle assessment results. The improvement on environmental impacts was analyzed, and the best method to manage cow manure waste in U.S was recomended.