CHAPTER III
EXPERIMENTAL

3.1 Materials and Equipment

3.1.1 Equipment

Computer laptop model: Intel(R) Core(TM) i3 at CPU 2.13GHz, RAM: 3 GB and 64-bit Operating system.

3.1.2 Software

a. PROII version 9.1
b. Microsoft office excel 2010
c. GAMS version 21.2

3.2 Research Procedures

There are many options to reduce power consumption which the conceptual of design improvement is illustrated on Pinch-Exergy graphical method.

3.2.1 Shaft Work Targeting Technique

Linnhoff and Dhole (1992) proposed the methodology that combined pinch-exergy graphical by replacing temperature in CCs to Carnot factor, $\eta_c = 1 - (\frac{T_0}{T})$, and rename to ECCs. This method can help to design or manipulate pressure to reduce area between hot and cold in ECCs that is proportional exergy loss due to heat transfer. The steps are following.

a. Create a stream table that consists of temperature, pressure and enthalpy of each stream.
b. Transform temperature to Carnot factor for construct ECCs where T_0 is the temperature of environment and T is temperature of the object to be cooled.

c. After construct ECCs, configuration of pressure to improve process where the area between hot and cold in ECCs directly relate to work equivalent lost due to heat transfer by assume process does not change.

d. Another improvement by changing process to reduced utility consumption and followed by manipulate pressure to reduce shade area result in reduced shaft work.

3.2.2 The Extended Pinch Analysis and Design Method with Novel Exergy Diagram

This method is proposed by Aspelund (2007) which manipulated pressure to minimize irreversibility in heat transfer processes and develop by expanding pressurized streams result in producing cold duty. This method use parallel with the novel exergy diagram (Marmolejo-Correa and Gundersen, 2012) to estimate exergy target (minimizing exergy destruction). The novel exergy diagram is a linear relation between exergetic temperature and the corresponding exergy components. The steps are following.

a. Determine the total exergy in hot and cold stream in order to find the exergy efficiency

b. Construct the traditional CCs in order to find the minimum utilities and the room for improvement. In addition, construct exergy diagram to estimate exergy destruction by transforming temperature in CCs to exergetic temperature by using the square bracket factor in equation (2.75) and calculate the exergy component for supply and target conditions when ambient condition is $T_0 = 25$ °C and $P_0 = 1$ atm.

c. Develop process by selecting heuristic rules (Aspelund, 2007) to manipulate pressure of streams.

d. Determine the new exergy efficient and exergy diagram to see the improvement.

3.2.3 Mathematical Programming

Mathematical Programming is proposed by Yee and Grossman (1990) which can provide simultaneously optimize process flowsheet with heat integration.

a. Design model with isothermal mixing assumption base on base case study.
b. Run the model by GAMS.
c. Interpret the result from GAMS and generate heat exchanger network.
d. Validate heat exchanger network by PROII.