CHAPTER I

INTRODUCTION

1.1 Background

At present, the tendency of energy demands is rapidly increasing. With high fuel prices and the possibility of diminishing supplies in the years ahead, the importance of developing systems to use energy more efficiently is apparent. One of the major components in a chemical processing system is the heat exchanger network, because it determines to a large extent the net energy consumption of the process. Tremendous efforts have been expended to establish a series of systematic approaches toward conserving energy and also minimizing losses in the process industries.

In the research, two approaches of energy conservation are selected for study, i.e., Pinch Technology Method, and Exergy-based Method. Pinch Technology Linnhoff, et.al. [1], divides the process objective in two specific performance targets : first it determines the minimum utility requirements, along with maximun energy recovery. Then it determines a heat exchanger network that results in the minimum number of heat exchangers subject to maximum energy recovery. The method utilizes the basic features of the pinch point and is called the pinch design method. With this method, one could readily predict the minimum utility requirements and the minimum heat exchanger units prior to actually developing the network. The method next provide simple criteria on how to synthesize a network that can meet these targets.

On the other hand, the exergy-based method, introduced by Ishida [2] is another systematic approach to the applying of the first and second laws of thermodynamics to system components and processes. This method is quite powerful and is applicable to the analysis of various kinds of processes, such as thermal, chemical, and mechanical ones, in a unified manner.

1.2 Objectives

1.2.1 To understand the basic principles of Pinch Technology and Exergy Analysis.

1.2.2 To determine the minimum utility requirements of a real plant and locate the pinch point.

1.2.3 To compare the predicted minimum utility requirements with the actual ones.

1.2.4 To suggest a practical alternative to reduce energy consumption and improve energy efficiency in the plant via suitable heat recovery and process improvement.

1.2.5 To carry out economical evaluation on the proposed process improvement.

1.3 Scopes of Work

1.3.1 Create a computer program to determine promptly the minimum utility requirements and to locate the pinch-point temperature.

1.3.2 Select a large-scale chemical or refinery plant to use as case study.

1.3.3 Find out actual utilities, heat exchanger network, energy and exergy losses existing in the plant.

1.3.4 Determine minimum utility requirements, and propose maximum-energy-recovery (MER) heat exchanger network of the selected plant.

1.3.5 Compare the results obtained in step (3) and (4) and then gain ideas on the magnitudes of energy losses and exergy losses (which means low energy efficicency).

1.3.6 Propose reasonable and practical process improvement and carry out economical evaluation on the proposed improvement.

1.4 Benefits Expected

1.4.1 To demonstrate how the pinch technology method and exergy-based method could be applied to improve energy efficiency of our actual process.

1.4.2 To point out the magnitudes of exergy losses and inefficiency in the process.

1.4.3 To come up with a practical energy improvement plan, including the required heat recovery network.

1.4.4 To compare the cost and benefits of the proposed improvement.