CHAPTER I
INTRODUCTION

The demand of water and energy unavoidably increases especially in petrochemical plants. Water is a mostly used raw material in many units for example, stripping, scrubbing, extraction and many washing operations. After freshwater is used, it generates wastewater containing many contaminant levels. And it is considered to be reused or treated before discharging it to rivers. Similarly, heating and cooling utilities are also required for many plants for increasing productivity in both quality and quantity.

The main objective of this project is to reduce high consumption of both water and heating/cooling utilities in the industrial processes. To solve this project, water and heat exchanger networks are developed in order to reduce water and energy usages.

Reuse/recycle water network technique is applied to solve the high-water-demand problem where concept is to reduce fresh water usage to meet safety limitation of contaminant concentration in waste water. The strategies were developed in two main methods. First is graphical targeting coupled with heuristics which is easy to analyze the minimum amount of fresh water required but it is difficult to get the optimal water/waste water network. Second is mathematical programming using linear programing (LP) to target the minimum freshwater usage and generate the optimal network. In addition, water network with treating unit is required in order to extremely reduce amount of freshwater together with waste water discharged contaminant concentration. Nonlinear programming (NLP) and mixed-integer nonlinear programming (MINLP) mathematical model are developed to generate the most economical water network with treating unit where the main objective is network cost. However, MINLP is hard to calculate because of non-convexity of problem, therefore four-step calculation procedure is introduced to solve the optimal network.

To optimize the freshwater and utility usage simultaneously, it can be done by solving mass balance together with heat balance. Direct and/or indirect heat exchange methods are introduced to calculate the optimal water and heat exchanger network. MINLP mathematical programming is developed to solve this problem where objective is to minimize freshwater and utility cost.

This work aims to study and generate mathematical model to design the optimal reuse/recycle water network with treating-unit using case study data from published research. And the model to solve combined water network with heat exchanger network will be developed. All scenarios are run by GAMS that consists of MILP, NLP and MINLP.

OBJECTIVES OF RESEARCH WORK

1. To study the water reuse/recycle network with regeneration of single contaminant and design by mathematical programming.
2. To generate optimal water reuse/recycle network with regeneration.
3. To study combined water and heat exchanger network model with various scenarios.
4. To propose the mathematical model of water and heat exchanger network using GAMS.

SCOPES OF RESEARCH WORK

1. Focus on single-contaminant problems data.
2. Generate a mathematical model to design optimal water reuse/recycle network with regeneration units by GAMS.
3. Generate a mathematical model to simultaneously design optimal mass and heat exchanger network to minimize freshwater and utility using GAMS.