CHAPTER 1

INTRODUCTION

A total chemical process system typically consists of the chemical plant, the heat exchanger network and the utility plant.

The utility plant has to meet the demands for electricity, high-pressure steam as driving power and process steam at various pressure levels, etc.

When electricity and steam are needed simulteneously, a turbogenerator usually presents and interesting option, in which case we have to decide what amount of electricity and extract steam to produce and to buy, the so-called "cogeneration problem."

The chemical process plant, especially the petrochemical industry, has seen extensive use of optimization technique as tools in the areas of process design and synthesis. For example, by simple application of the transportation problem in linear programming, one may match suitable hot and cold stream of a heat exchanger network to obtain minimum heating or cooling duties.

To the author's best knowledge, the published literature shows very few cases in which a nonlinear optimization technique has been applied to the cogeneration problem.

Today's rapid technological advances are producing such a huge number of competing designs and alternative operating conditions. And when the continuous changes in production costs and market prices are taken into consideration, it is clear that it pays to make adequate estimation of optimality.

The aim of a mathematical model is to provide a formal description of the corresponding physical process. The model helps bridge the gap between the physical process and the understanding of that process.

Modeling the cogeneration problem is rewarding because it strengthens one's insights and provides a logical methodology to probe the unknown. The development of a reliable model also offers the possibility of optimization.

The present study attempts to show how a nonlinear optimization method may be applied to the cogeneration model to obtain the optimal operating conditions of the utility plant and the parametric sensitivity of the optimality.

1.1 Objectives of the Present Study

The main objectives are :

1. Apply the Generalized Reduced Gradient (GRG) method to the optimization of a couple of processes which had been solved by some other optimization methods, so as to reveal the advantages and disadvantages of the GRG method.

2. Formulate and model the cogeneration problem based on a real plant in Thailand.

3. Apply the above GRG method to the cogeneration problem in Thailand and see whether increased benefits may be obtained compared to the existing operating conditions.

1.2 Scope of the Present Study

The scope of work encompasses the following :

1. Set up a computer program for carrying out the GRG optimization method on the University's IBM 3043. For simplicity, the program will be called GREG.

2. Use GREG to solve

   a. An alkylation process.

   b. The cogeneration problem of a pulp and paper plant.

3. Formulate and develop a computer model for the cogeneration problem of an existing fibre synthetic plant in Thailand.

4. Use GREG to find the optimal operating conditions for the utility plant of the above fibre synthetic plant.

5. Study the effects of process parameters, especially fuel cost, purchase cost of electricity and process utility demands on the optimum solution of the above problem.