CHAPTER I

INTRODUCTION

1.1 Importance and Reason of Research

Etherification is one of the most important chemical processes in organic chemical industry and is a typically reversible process in which conversion is limited by equilibrium conditions. An integration of pervaporation into the conventional etherification processes, therefore, offers an opportunity to shift the chemical equilibrium by removing water from the reaction mixture directly. Due to an effect of operating temperature, which influences the reactor performance through its influences on reaction rate and membrane permeability, it is necessary to control the process to operate in the most favorable conditions to achieve a desired objective.

In this work, a continuous stirred tank reactor integrated with pervaporation developed by Suttichai (2003) is considered. The study is aimed at reversible etherification reaction. A jacket is utilized to control the operating temperature at its desired values.

It is known that the pervaporation membrane reactors exhibit inherently complex and nonlinear dynamic behaviors. The presence of complexity and nonlinearity in such processes post a challenging control problem that is difficult to handle with model-based control techniques; model-based controllers are based on the mathematical model of the processes which can not be actually achieved.

In recent years, neural networks have been proposed as the promising tools for identifying chemical process models from processes data. Neural networks are very useful because of their abilities to model the complex nonlinear processes, even when processes understanding are limited. With their excellent nonlinear representational capabilities, neural networks have shown widespread applicability in a variety of fields, ranging from molecular modeling to stock market predictions. They have found exponentially increasing usage in a broad spectrum of science and

engineering applications. In process control, neural networks provide an attractive alternative in nonlinear systems modeling and have activated their use in various control-related applications.

1.2 Objectives of Research

The objectives of this research are:

1. To develop an appropriate neural network model for a pervaporative membrane reactor in CSTR mode.

2. To design a control configuration for a pervaporative membrane reactor to track the obtained optimal operating temperature.

1.3 Scopes of Research

The scopes of this research are:

1. To develop an appropriate neural network model for a pervaporative membrane reactor in CSTR mode.

2. To design a control configuration for a pervaporative membrane reactor to track the obtained optimal operating temperature.

1.4 Contributions of Research

1. This research provides a neural network model of hybrid etherification process.

2. This research provides a neural network control strategy of hybrid etherification process.

3. This research provides a guideline for future control strategy of other highly non-linear and complex systems without knowing the relation between inputs and outputs.

4. Make the world better, by improving the production of ETBE which is the less toxic additive for the gasoline compared with the currently using MTBE (The Republic South Africa, Department of Environmental Affairs and Tourism, and Department of Minerals and Energy, 2001).

5. To be an inspiration for the new generation process control engineers for realizing the whole concept of work, back to the mandatory basic concepts, start from the main control objectives, find the way through and reach the goal.

1.5 Research Procedures

1. Study and collect data in which related to the pervaporative membrane reactor for etherification process.

2. Study and collect data, related research with neural networks. Study the use of MATLAB program.

3. Derive a process dynamic model using analytical method.

4. Create the training and testing data sets from the derived model.

5. Train the neural networks using the created training data sets.

6. Test the neural networks model using the created testing data sets.

7. Select the appropriate structures of neural network model and controller.

8. Simulate the neural network control of the pervaporative membrane reactor for etherification process.

9. Result analysis and summary.

1.6 Structure of Thesis

This thesis is organized as follows. First, the literature reviews of both the pervaporative reactor and the neural network in the chapter 2. Second, the theories of the pervaporative reactor and the neural network are explained in the chapter 3. Next, the applications of a neural network modeling and control for hybrid etherification process are in the chapter 4. In the chapter 5, there are the discussion, the conclusion and the recommendation for future works.