CHAPTER 3 METHODOLOGY

This chapter describes a methodology to achieve this work. The procedures to complete each step of the methodology are briefly outlined.

3.1 Methodology

This work provides the steps need to develop steady state and dynamic model of ROC's pilot distillation column. There are 6 steps to complete this work as shown in Figure 3.1.

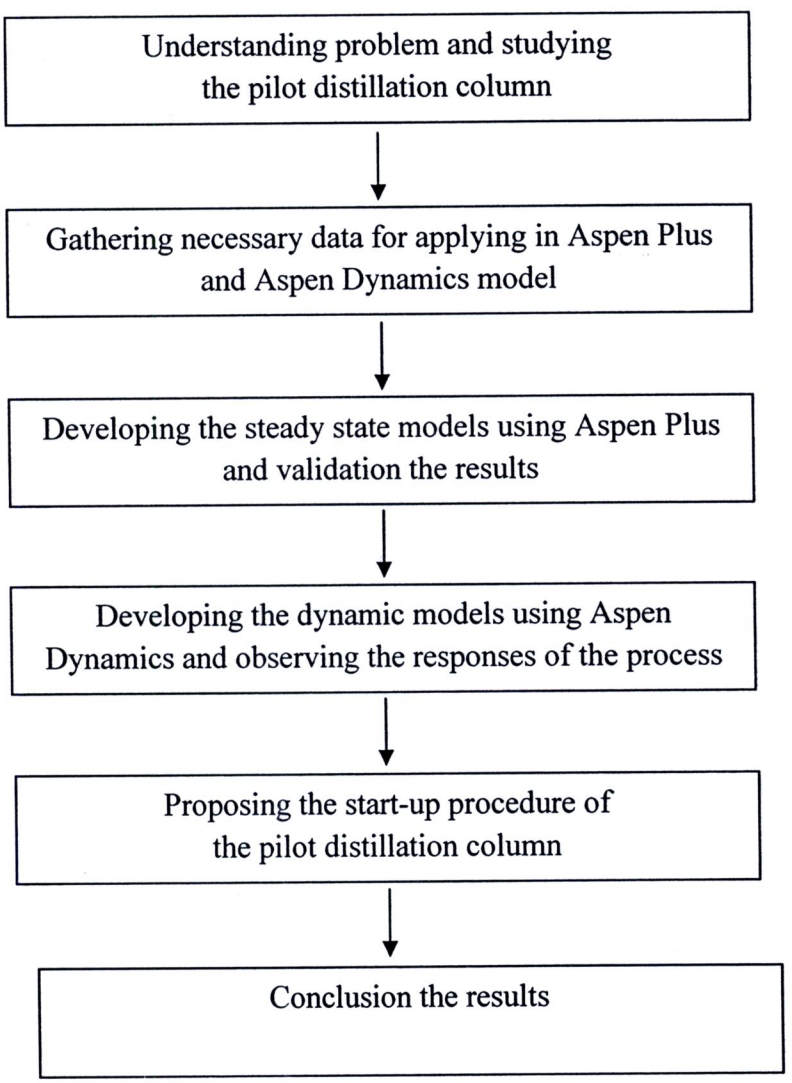

Figure 3.1 The methodology

3.1.1 Understanding problems and studying pilot distillation column

The first step is to understand the problem and study the pilot distillation column of R&D department in ROC plant. First of all, the problems which occur when the pilot distillation is operated and started-up are needed to understand. In this step, the objectives, scope of work and expected results are set to clarify the problems. Then, the process operation of ROC's pilot distillation column is necessary to understand. Moreover, the function of ROC's pilot distillation column equipments such as feed tanks, tower, reflux drum, heat exchanger and pump are also studied. In addition, this step includes literature that might be used in this work.

3.1.2 Gathering necessary data for applying in Aspen Plus and Aspen Dynamics model

The second step is to gather the necessary data which are important to develop the simulation model in Aspen Plus. In this step, the data which are feed flow rate, compositions, number of stages, reflux rate, distillate rate, temperature, pressure and pressure drop of the column must be specified in Aspen Plus model. The data which are need for Aspen Dynamics models are so complicated than Aspen Plus. The height and diameter of the column, the temperature of the utility, the initial liquid volume fraction, HETP and the section packed height are also added in the Aspen Dynamics model.

3.1.3 Developing the steady state model using Aspen Plus and validation the results

In this step, the steady state model which is used for determining the pack efficiency is constructed using Aspen Plus. The pilot distillation column is represented by RADFRAC model from Aspen Plus. This model is used to study the separation of Benzene-Toluene mixture. The heater which is submerged at the bottom of the column is instead by the reboiler that is the short cut model of RADFRAC model. Other auxiliary pieces of equipment, such as pump or throttling valve, are also modeled using standard Aspen Plus blocks. After the models are generated, the results from the simulation models such as the product specification and the temperature profile along the column are needed to validate with the test run data. Generally, the percentage difference of the mass fraction of Benzene in the overhead stream between the simulation results and test run data are less than 5 percent as an acceptable value, while the difference in term of the temperature profile of the column (A-E) are less than 2°C. Developed model from Aspen plus are used to describe the pack efficiency of ROC's pilot distillation column after this column is revamped.

3.1.4 Developing the dynamic model using Aspen Dynamics and observing the response of the process

After the steady state model is completely performed, this model is applied to the Aspen Dynamics simulation in order to generate the dynamic model. In the actual operation,

the process is manually controlled by the operator. Therefore, the dynamic model is also generated by except the control system. This developed model is used to study the process behavior of the pilot distillation column. The output parameters such as Benzene concentration in the overhead stream, the temperature profile of the column (A-E), sump and reflux drum level is observed when the operating conditions which are the feed location and the reflux rate are changed. In addition, the heat duty of the heater is also observed from this model.

3.1.5 Proposing the start-up procedure of the pilot distillation column

Nowadays, the start-up operation of ROC's pilot distillation column is not actual method. Therefore, the dynamic model is used to generate the start-up procedure of ROC's pilot distillation column is proposed. After the reflux rate is totally flowed to the column, three parameters which are distillate rate, reflux rate and bottom rate are concerned. There are three interested parameters in the start-up procedure so that there are divided into 6 scenarios. The best procedure will take the shortest time to reach a steady state and consume the fewest energy when compare with the other scenarios.

3.1.6 Conclusion the results

In the last step, the pack efficiency of ROC's pilot distillation column is obtained from the steady state model while the best start-up procedure which takes the shortest time to reach a steady state is proposed from the Aspen Dynamics model.