CHAPTER VI

CONCLUSIONS

A dynamic distillation calculation using the reduced-order technique as a multicomponent compartmental approach has been reported to be highly successful. The present study has demonstrated without doubt the effectiveness and usefulness of such concepts when it is applied to an actual distillation column, Debutanizer of Bangchak Petroleum Industry.

The design method adopted here may be categorized into 3 stages, i.e., generation of thermodynamic calculation, dynamic distillation and dynamics compartmental model analysis, and comparison between each model.

As the starting point of the generation of thermodynamic calculation stage, the S-R-K equation of state is selected for calculation of all thermodynamic properties, i.e., enthalpy, Vapour-Liquid Equilibrium, and density of liquid and vapour mixture. The physical constants and coefficients of equations are collected from Equilibrium-Stage Separation Operations in Chemical Engineering (1981) as shown in Appendix C.

In the second stage the dynamic distillation and dynamics compartmental models are developed. The Debutanizer of Bangchack Petroleum Industry has been selected as our case study. The data are first checked for credibility and consistency by comparing with the steady-state distillation which calculated by the existing program, PRO II. Once the data are accepted as reliable, the step changes in feed flow rate, $\pm 15\%$ are applied to study the dynamic behaviour.

For different input forcing, typical responses of the full-order, 5-compartment, and 4-compartment models are considered. For ±15% changes in feed flow rate, the compartmental model responses, both of four- and five- compartments, show a reasonably close representation of the dynamics against the full-order model and the steady state calculation, PRO II, in bottom and top of distillation column. Furthermore, the compositions in all sensitive trays of a compartmental model also give an acceptable representation of the dynamics and yields against the full-order model and the steady state calculation as well.

With these results, it can be concluded that the compartmental approach can be applied to a Debutanizer column of Bangchack Petroleum Industry. The advantages of this approach are as follows:

- This feature guarantees steady state agreement between the compartmental and full-order model because the formulations of the compartment separation functions use shortcut relationships yields of a steady state for non-sensitive stages.

- For a conventional distillation column design, it can use only a few compartments to obtain a reasonable accuracy instead of all stages of the column.

However, the selection of sensitive stages in each compartment will affect slightly with accuracy depending on the compartment selection. This can be shown from the results that the calculation that contains higher number of compartment will give better representation of the dynamics than the calculation that contain lower number of compartment. Table 6.1 summarized the results obtained in the present study. It compares the deviation between full-order and compartmental models among the various cases.

Table 6.1 Summary of the results.

Stage	Composition n-Butane		% Deviation from PRO II	Composition n-Butane		% Deviation from full-order model	
	Steady state PRO II	Full-order Model		Five (5) Compartment	Four (4) Compartment	Five (5) Compartment	Four (4) Compartment
BTM	0.004760	0.004555	4.31%	0.003911	0.003792	14.14%	16.75%
2	0.017270	0.016734	3.10%	-	0.013962	-	16.57%
6	0.083960	0.079520	5.29%	-	0.072268	-	9.12%
9	0.167200	0.145213	13.15%	-	0.156817	-	7.99%
22	0.677840	0.667594	1.51%	-	0.728692	-	9.15%
TOP	0.480140	0.480800	0.14%	0.485808	0.485812	1.04%	1.04%