

Diabatic Distillation

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INTRODUCTION

My Project is on Diabatic distillation, also called Heat Integrated Distillation. Distillation processes worldwide consume around 3% of the total energy consumed, due to the large number of distillation processes. Therefore it is an area, where a lot of energy can be saved. The conventional distillation process has a very low efficiency and therefore there is room for improvement. By using Diabatic distillation, the efficiency of the process can be increased and thereby large amounts of energy can potentially be saved. In this project, a new and simple design method based on the conventional McCabe-Thiele method will be developed

THEORY

For a Heat Integrated Distillation Column(HIDiC), the rectifying section are operating at a higher pressure than the stripping section. Thereby there is a temperature difference between the section, which can be used to transfer heat internally in the column between the sections.

For setting up the model for the system, simple mass and energy balances are used.

METHODS

For making the design, the McCabe-Thiele method is used. First it is applied on a conventional distillation column. This results in a number of stages with corresponding compositions used to determine the heat transfer. This is used to calculate liquid and vapour flows from the mass and energy balances and thereby, new operation lines can be drawn for the McCabe-Thiele diagram. This iterates until the same number of stages is repeated and this is then the number of stages needed in the HIDiC, with the specified pressure difference. All operation conditions also needs to be specified

RESULTS

The design and simulation calculations are carried out in MatLab. All have a feed flow of 100 kmole/hour with a feed composition of benzene of 0.5 and feed thermal conditions $q = 0.5$.

Cases	P_r	Design x_w	Design x_D	N	Sim x_w	Sim x_D	X_s
1	1.95	0.05	0.95	24	0.949	0.051	58.2%
2	2.02	0.025	0.975	30	0.974	0.026	59.4%
3	1.70	0.1	0.9	24	0.902	0.098	56.9%

Table 1 Design vs. simulation results for the benzene-toluene system

CONCLUSION

This method is very simple method based on the well-known design method McCabe Thiele. Providing the desired operation conditions and purities of the compound, together with the thermodynamical data, the design template can give the number of equilibrium stages needed. Afterwards the simulation can be carried out and the energy savings can be calculated. This results in energy savings of 57-59% for the cases evaluated. This is a huge potential for saving large amounts of energy in the industry. Further study, especially experimental studies are vital for improving this distillation method.