CHEMICAL ENGINEERING PROGRAMME HK03
KC40003 Final Year Project 1
Complex Engineering Problems Documentation

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Project Title : Energy-Efficient Distillation Columns Design for Existing Distillation Columns Sequence
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Abstract:
In this study, the driving force approach will be used to identify energy-efficient distillation columns design of an individual distillation column in the existing distillation columns sequence. The driving force curves of all binary splits of a multicomponent will be constructed, where each curve is representing an individual column. Then several points located at those curves will be selected representing the column design candidates. Three different points (points A, B, C) will be selected, where point A is located at the maximum of the curve and points B and C are located slightly below the maximum point. Then, the existing individual distillation column will be redesigned based on these points. Different values of reflux ratio and feed location will be calculated based on each selected points and then to be used to simulate distillation column using rigorous simulation approach. Once simulation for all design points have been conducted, then all energy requirements of reboilers and condensers for all distillation columns will be obtained and analysed. The energy requirements from all sequence designs will be compared with the existing sequence. It will be expected that the used of driving force approach in redesigning individual distillation columns will help in synthesizing energy-efficient distillation columns sequence in an easy, efficient and systematic manner.

Problem Statement:
Through years of technological advancement, distillation technique has become more refined to better accommodate nowadays industrial demand for efficient separation of intended products. This process however is still very energy intensive, especially when it is used in a large-scale industry. According to Lucia (2010), 40,000 distillation columns are approximated to be running in US alone, which consume 1.2 MM barrels oil on daily basis. That is about 6 % of total energy expended daily. With the rising need for various industrial plants to keep on using distillation technology, more energy will eventually be exploited for this end and therefore depriving more of the energy resources that is already finite to begin with. Therefore, optimizing the distillation column sequences can go a long way in saving our planet energy resources as well as reducing the overall operating cost. With all that said, the study will be carried out strictly in accordance with the driving force approach for synthesizing the distillation column sequences.

Research Objective:
a. To optimize an existing direct sequence distillation column by using the fundamental driving force method in multicomponent product separation.
b. To compare and assess the energy consumption of an existing direct sequence with the improved sequence as simulated in Aspen HYSYS.

Research Methodology:
The major focus of the study is on modelling distillation column sequences. The projects begin by reviewing the previous research and articles related to distillation column sequence optimization under supervisor supervision in order to have a better understanding of the theory and methodology used. After that, the next step would be to generate a list of feasible sequencing options depending on the plotted multicomponent driving force curves. Then, by using Aspen HYSYS, simulate the outlined distillation column sequences and calculate the amount of energy usage by each sequences generated. Lastly, compare all the sequences energy usage and draw a conclusion on which sequence save the most energy among all of the other sequences.

Complex/Broadly/Well-Defined Engineering Problems

√	**WP1**	**Depth of Knowledge Required** Engineering Problem Solving & Engineering, Chemical Process Principles, Thermodynamics, Process Design, Mass Transfer & Separation Processes, Process Simulation & Integration
√	**WP2**	**Range of Conflicting Requirements** Minimum energy requirement
√	**WP3**	**Depth of Analysis Required** Driving force graphical analysis, distillation columns sequence analysis, distillation column design
√	**WP4**	**Familiarity of Issues** Unfamiliar issue only applicable to the project
√	**WP5**	**Extent of Applicable Codes** Aspen HYSYS process simulation, driving force graph
	WP6	**Extent of Stakeholder and Level of Conflicting Requirement**
	WP7	**Interdependence**