Separation of Pentane and Hexane from a $C5^+$ stream through two different distillation sequence

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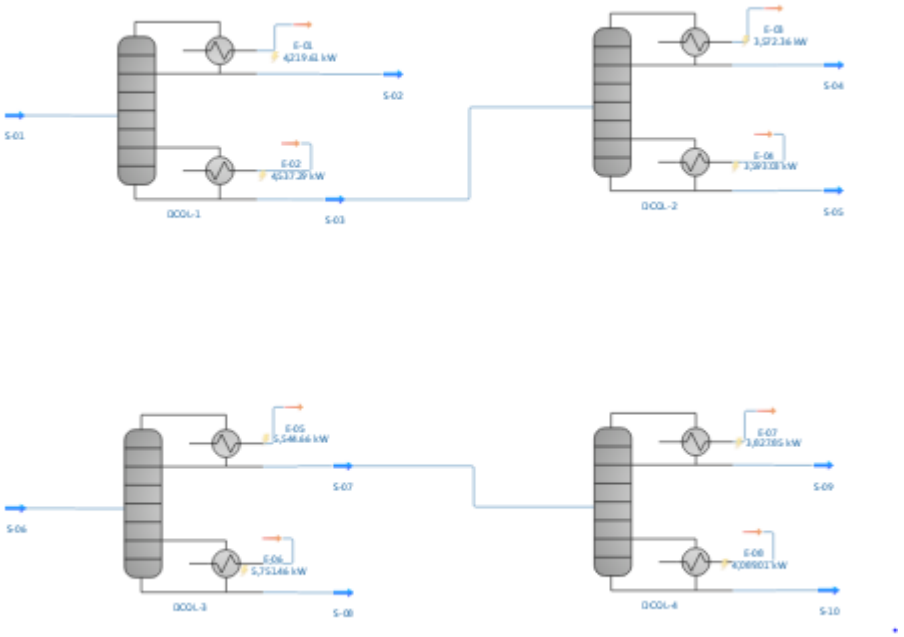
Background:
The bottom product from a debutanizer of an LPG unit is termed as $C5^+$ stream. To separate out the valuable pentane, isopentane and hexane from a $C5^+$ stream and the various aspects of this process is of our particular interest. Together these three components constitute approximately 75-80 % of a typical $C5^+$ stream. These components have a wide spectrum of applications which further necessitates the need for a commercial technique for their separation. In this flowsheet two such possibilities of sequential distillation are being explored namely direct and indirect sequence of distillation.

Flowsheet Description:
As suggested above there are two schemes involved here, the first of which is direct sequence of distillation (shown in top diagram) in which pentane and isopentane are separated as distillate (S-02) of first column and the bottoms (S-03) of first column is sent to the second column from which hexane is separated as distillate (S-04) and a $C7^+$ stream exits as bottom (S-05). Meanwhile in indirect sequence of distillation (shown in bottom diagram) pentane, isopentane and hexane are separated as a distillate (S-07) and sent to the second column from which pentane and isopentane are separated as distillate (S-09) and hexane as bottom (S-10). A $C7^+$ stream is taken as bottom (S-08) of first column.



In the above given flowsheet two identical feed stream (S-01 & S-06) are used for both the sequence. The feed consists of eight components, the composition of which is shown below. The feed is a liquid stream at 2.8 bar pressure. Here the Peng-Robinson thermodynamic package is employed since all the components involved are hydrocarbons.

Component	n-C_4	i-C_5	n-C_5	n-C_6	n-C_7	n-C_8	n-C_9	n-C_{10}
mol %	0.01	29.17	24.32	26.92	12.48	5.7	1.14	0.26

Results:

Recovery of various components		
	Direct (%)	**Indirect (%)**
Pentane	96.94	96.88
Isopentane	99.26	99.38
Hexane	96.08	94.02

Heat duties		
	Direct (kW)	**Indirect (kW)**
Column 1		
Condenser	4219.61	5544.66
Reboiler	4537.29	5751.46
Column 2		
Condenser	3572.26	3827.85
Reboiler	3593.03	4089.01

Conclusions:

From the above given set of data, it is easy to make a comparison between both the sequence of distillation. But the economic viability of such an operation not only depends upon the recovery rate, indeed they are strongly influenced by the heat duties of reboiler and condenser, reflux ratios and pressure gradient across the column. The choice of the sequence on an industrial scale is chosen only after taking into account all of these factors. Furthermore, this flowsheet in DWSIM can be utilized in order to vary these mentioned parameters and study about their effect on the process and hence obtain an optimal model.