Neat Operation for Separating Methanol-Water

**Flowsheet Description:**

Neat operation means the condenser duty required in the one column is exactly equal to the reboiler duty in the next column. Here the system used is Methanol-Water. Methnol is more volatile so it is obtained as Distillate in both the units with purity around 99% . The water is obtained from the bottoms in each column which is around 99% pure.
The feed composition is 60 mol % Methanol and 40mol % Water flowing at a rate of 1 kmol/s. The feed is split in the ratio of 0.5086 and 0.4914 kmol/s so that the column operates "neat". The low pressure column-I operates at 0.6 atm and column-II operates at 5 atm. Reflux ratio in column-II is 2 so that heat duty of condenser-I and reboiler-II are same.
The flowsheet is as shown:
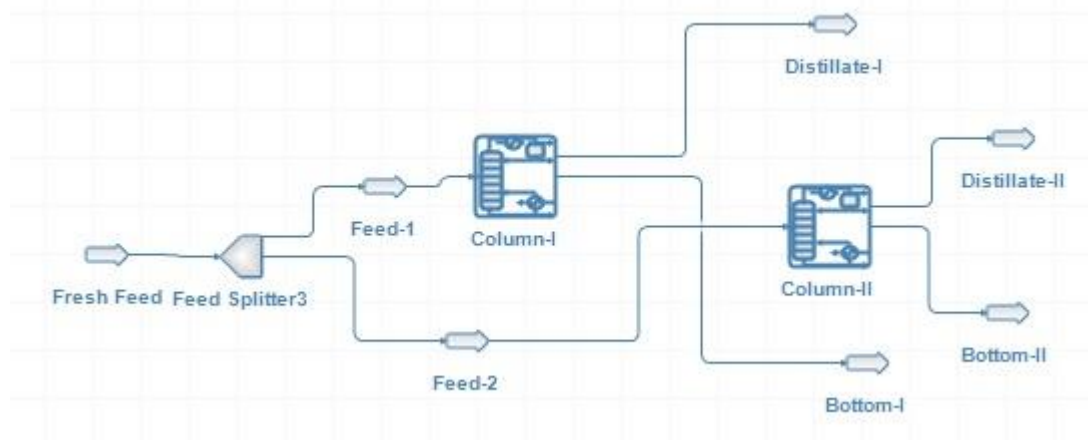
Results:

Master Property Table								
Object	Fresh Feed	Feed-2	Feed-1	Distillate-II	Distillate-I	Bottom-II	Bottom-I	
Temperature	298.15	298.15	298.15	385.734	325.553	425.544	359.408	K
Pressure	1	1	1	5	0.6	5	0.6	atm
Molar Flow	3600	1769.04	1830.96	1075.26	1105.9	693.776	725.06	kmol/h
Molar Fraction (Mixture) / Methanol	0.6	0.6	0.6	0.987129	0.993377	5.14799E-11	4.87801E-10	
Molar Fraction (Mixture) / Water	0.4	0.4	0.4	0.0128709	0.00662252	1	1	

The component purity of each stream is around 99 %.As condenser duty in Column-I is same as Reboiler Duty in Column-II that is 33188 kW. By this operation total capital investment and energy consumption is reduced.

Reference:

Distillation Design and Control using Aspen Simulation, second edition. William L. Lubeyn.