

NEW CONTROL STRUCTURE FOR DIVIDED-WALL COLUMNS AS DESCRIBED BY LUYBEN

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Here, simulation is carried out for Divided-Wall column in which three component are separated. Divided-Wall column are arranged in a such way that middle section of a single column splits using vertical wall in the vessel at an appropriate position. In these types of columns feed is introduced into the prefractionator side of the wall and sidestreams removed from the other side. Mostly sidestream contains intermediate boiling component of the ternary mixture.

In Divided-Wall column in bottom vapor is split between the two sides in proportion to cross-sectional area of each side, which is fixed by the physical location of the wall. At top section of column, the liquid coming down from the rectifying section also split between two sides of the wall using a total liquid trap-out tray from which part of total liquid went to prefractionator and rest to the sidestream.

About Flowsheet:

Herein simulation carried out for the separation of benzene, toluene and o-xylene. Feed contains 30 mole% benzene, 30 mole% toluene and 40 mole% o-xylene which feded in column at a rate of 3600 kmol/h [feed temperature 84.85°C]. Column has total 70 number of stages with feed stage of 21 and sidestream at stage 44. Here column designed as that the wall runs from stage 10 down to stage 34. For graphical understading immagine also attached as below.

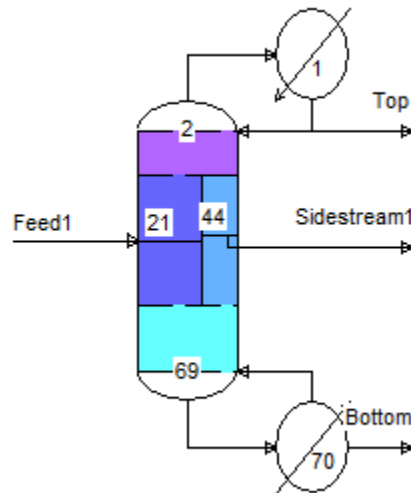


Figure 1: Divided-Wall column Graphical presentation

Source: chemsep userinterface

Here, liquid split ratio and vapor split ratio taken as 0.35 and 0.65 respectively. This ratios are inserted in chemsep column to designed Divided-Wall column as shown as belwo immagine.

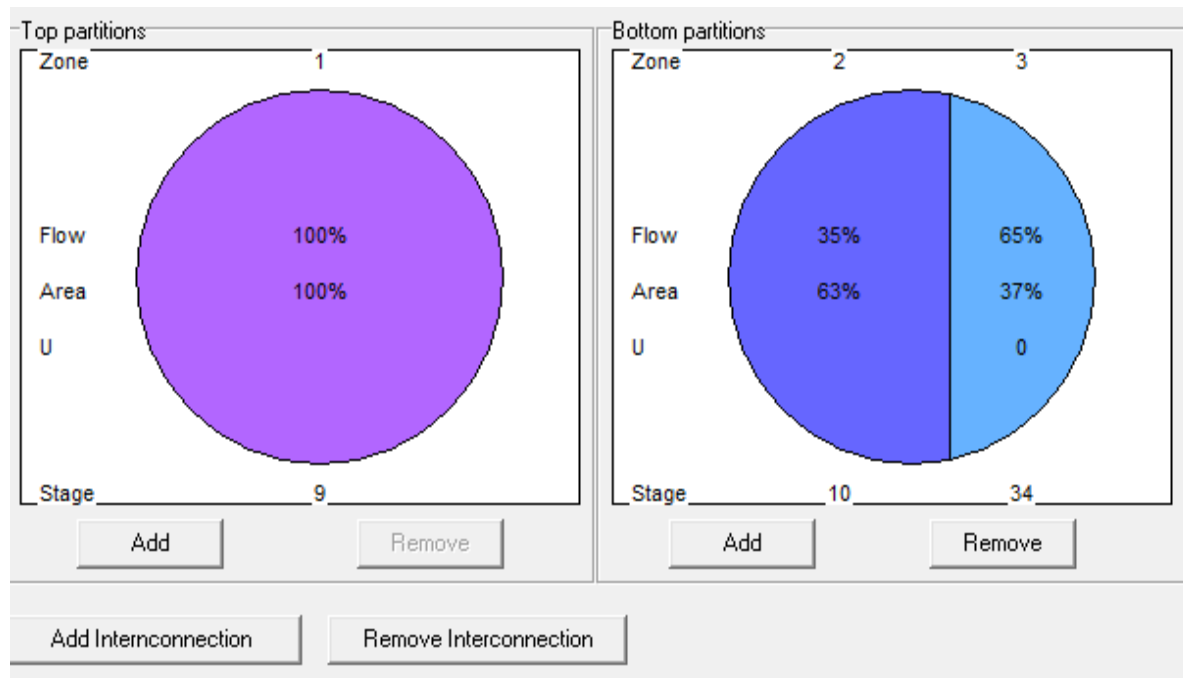


Figure 2: Interconnection set-up in chemsep

Source: chemsep userinterface

For solving this column Chao-Seader thermodynamic model used to get accurate results. From the simulation as a top product 98.97% pure toluene obtained at a rate of 1065 kmol/h and sidestream contains 99% pure benzene and as a bottom product o-xylene obtained at a rate of 1452 kmol/h. From the simulation below results obtained.

Stream Data					
Object	Toluene	O-xylene	Benzene	BTX	
Temperature	90.6892	129.53	50.1056	84.85	C
Pressure	0.555295	0.67	0.37	1	atm
Molar Flow	1065.6	1452.57	1081.83	3600	kmol/h
Molar Fraction (Mixture) / Benzene	0.00843527	1.80987E-08	0.99	0.3	
Molar Fraction (Mixture) / Toluene	0.98973	0.00999998	0.01	0.3	
Molar Fraction (Mixture) / O-xylene	0.00183497	0.99	3.58213E-11	0.4	

Figure 3: Simulation Data

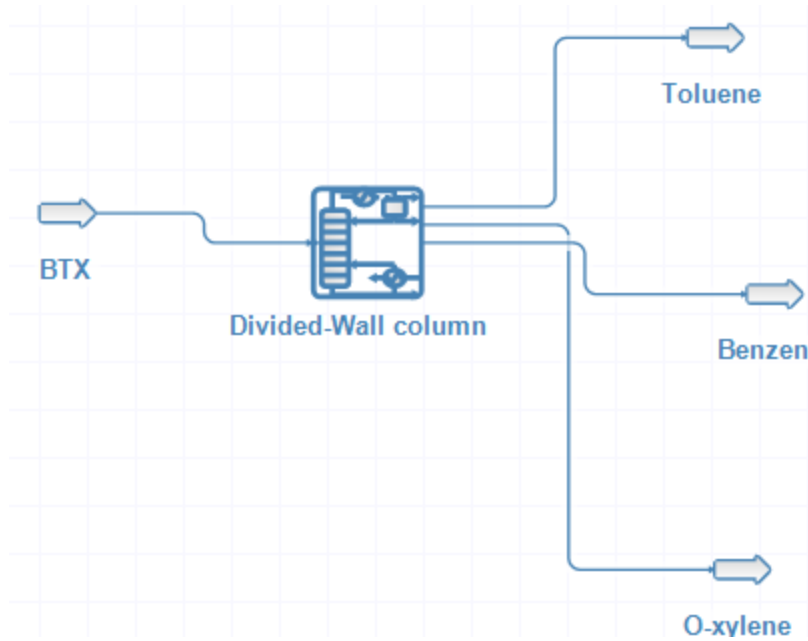


Figure 4: Simulated Flowsheet

Observation:

During simulation its observed that sidestream composition vary with selection of appropriate liquid split or sidestream flow rate and also by vapor boilup. Also toluene purity may increased if we withdraw side stream as vapor but a vapor sidestream can not considered as effective in Divided-Wall column beacause the vapor cannot be manipulated during operation.

References:

[1] Ling, H., & Luyben, W. L. (2009). New control structure for divided-wall columns. *Industrial & Engineering Chemistry Research*, 48(13), 6034-6049.