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CH18B020

ASSIGNMENT-2 PROCESS ENGINEERING

Flowsheet

1. Concentration of butanol in the Distillate stream

The concentration of butanol (in terms of mole fraction) is **0.024814**

Distillate concentrations:

Component	distillate
Butanol	**0.024814**
Isobutanol	0.975186

2. Butanol Concentration < 0.2 lbmol/hr in distillate

Parameters to change: Operating pressure, Distillate to feed ratio, Reflux ratio, Trays, Feed tray location. Changing pressure and reflux ratio did not have much effect on the flow rate.

Conditions-1: Reducing distillate to feed ratio (obviously) reduced butanol flow in distillate. Flow rate of <0.2 was achieved for **Distillate to Flow rate ratio** of **0.18** (other parameters as given in question). The flow rates were found to be:

Component	units	feed	bottoms	distillate
Butanol	lbmol/hr	50	49.8052	0.194801
Isobutanol	lbmol/hr	50	32.1948	17.8052

Conditions-2: At **number of stages to 40** with **feed entering at the top of the 25th tray** helped reduce butanol flow to less than 0.2 lbmol/hr (other parameters as given in question). Note that I have changed the feed tray also because it has considerable effect on flow rates.

Flow rates

Component	units	feed	bottoms	distillate
Butanol	lbmol/hr	50	49.80355	0.196451
Isobutanol	lbmol/hr	50	0.196451	49.80355

Mole fractions

Component	feed	bottoms	distillate
Butanol	0.5	0.996071	0.003929
Isobutanol	0.5	0.003929	0.996071

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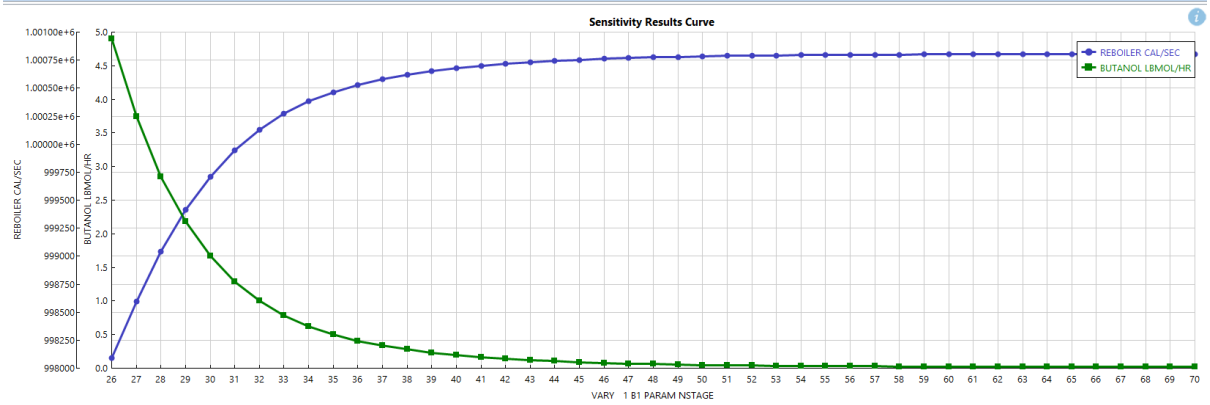
3. Number of trays vs Reboiler Duty tradeoff



Trays varied from 26-70. Feed enters on top of 25th tray.

x-axis: number of stages. y-axis: reboiler duty (in cal/s)

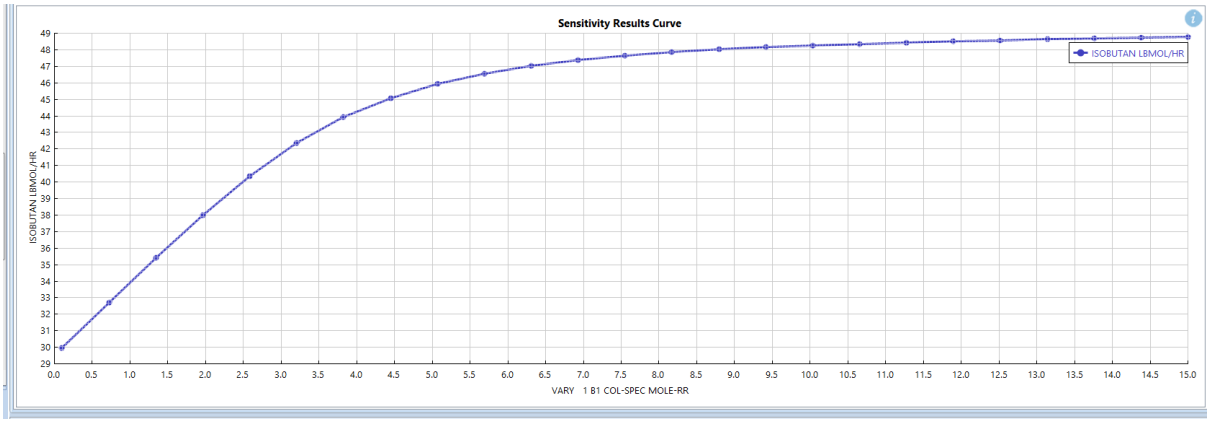
4. Recovery of 90.2% of Isobutanol

Total flow rate of isobutanol in feed = 0.5*100 = 50 lbmol/hr

=> Required Isobutanol flow rate in distillate = 0.902*50 = 45.1 lbmol/hr

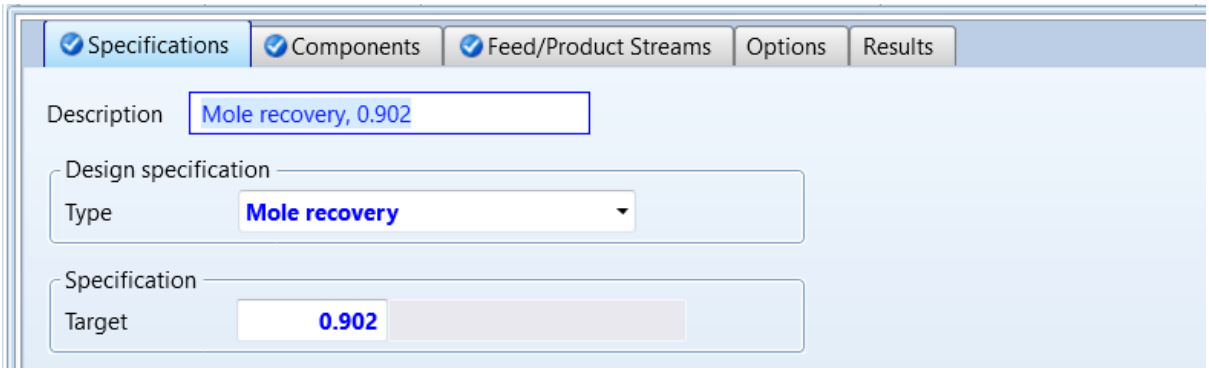
From the graph obtained using sensitivity analysis, we find the resulting reflux ratio (corresponding to 45.087 lbmol/hr isobutanol flow) = 4.45

Reflux ratio = Reflux rate/Distillate rate => Reflux rate = 4.45*50 = **222.5 lbmol/hr**



5. Using "Design Specification" and "Vary" feature in the Radfrac block

<u>Design specification</u>



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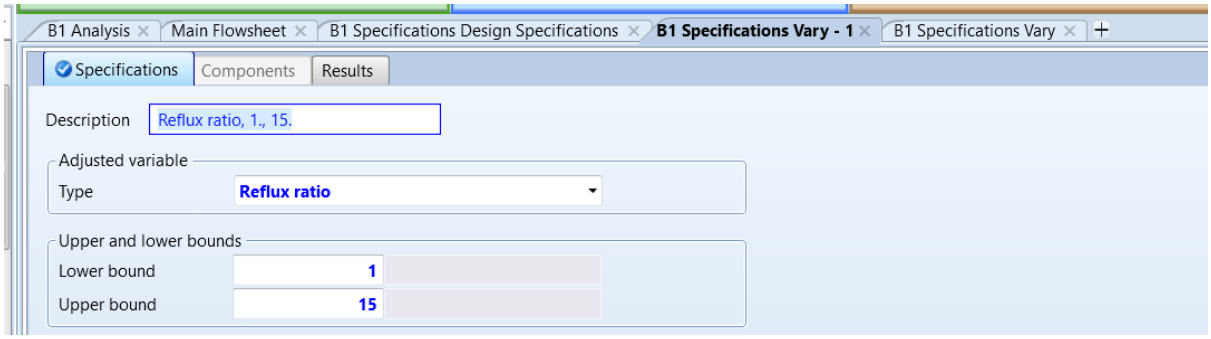
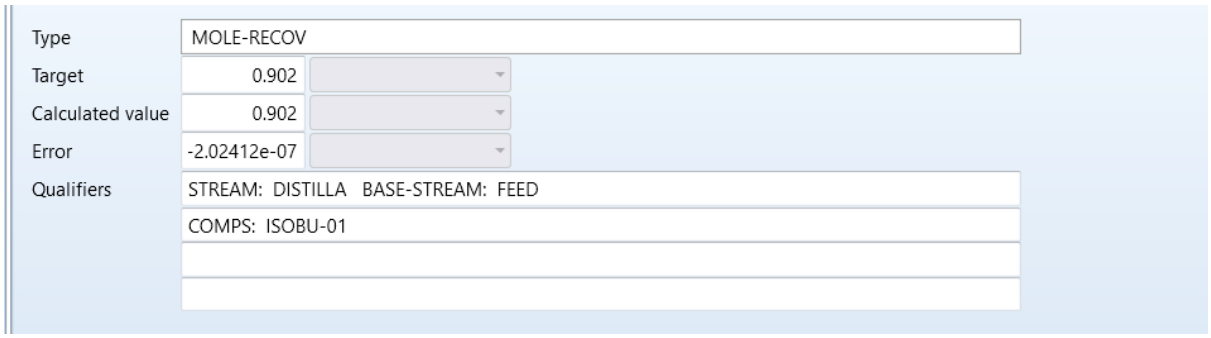
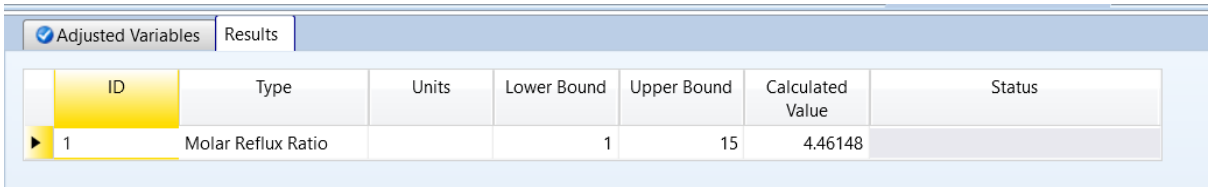
Vary



Results





ID	Type	Units	Lower Bound	Upper Bound	Calculated Value	Status
1	Molar Reflux Ratio		1	15	4.46148	

Reflux Ratio = 4.4615

Reflux ratio = Reflux rate/Distillate rate => Reflux rate = 4.4615*50 = **223.075 lbmol/hr**

(matches closely with previous answer)