Production of Butyl Acetate from Methyl Acetate and Methanol

Eduardo Pacheco e Silva
Federal University of Rio Grande do Sul

Background & Description:

Butyl acetate can be produced by the reaction of methyl acetate with butanol in a reversible, liquid-phase, mildly exothermic reaction. Methanol is the second product. The chemical equilibrium constant is less than unity, so the reactor effluent contains significant amounts of the reactants, which must be recovered for recycle back to the reactor. The volatilities are such that there are three distillation columns and two recycles.

The first column C1 takes the two light components overhead (methyl acetate and methanol) and the two heavy components out of the bottom (butanol and butyl acetate). In order to achieve the expected bottom and distillate specifications C1 column is set to a reflux ratio (RR) of 0.317 and a bottom mole fraction of methanol of 0.001. The C1 distillate is fed to a second column, which produces product methanol out of the bottom and a recycle stream of the methyl acetate/methanol azeotrope in the distillate. The C1 bottom is fed to a third column, which produces product butyl acetate out of the bottom and a recycle stream of butanol in the distillate. C2 and C3 specifications are as follows, RR = 1 and bottom mole fraction of methyl acetate = 0.01 , RR = 1.92 and bottom mole fraction of butanol = 0.01, respectively.

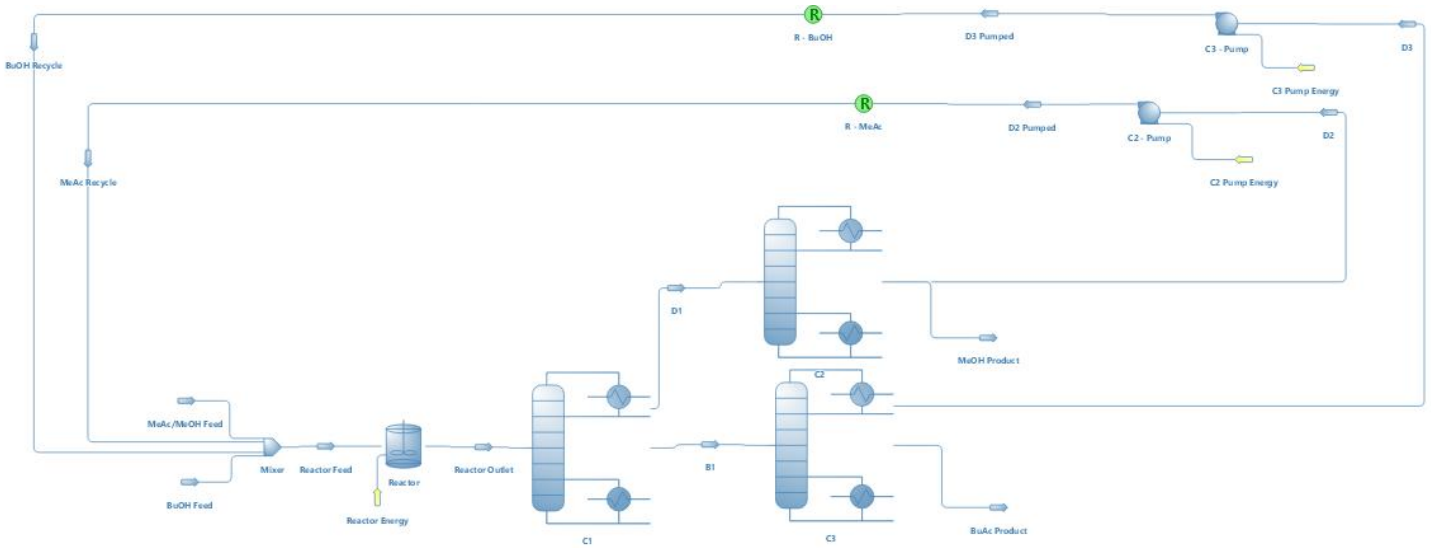

Figure 1. N - Butyl Acetate Production Flowsheet.

Results:

Table 1. Streamwise Results for the Butyl Acetate Production Flowsheet.

Object	MeAc/MeOH Feed	MeAc Recycle	MeOH Product	Units
Temperature	305,0	340,1	339,7	K
Pressure	15,0	15,0	1,1	atm
Mass Flow	5726,39	9000,03	3258,56	kg/h
Molar Flow	100,00	152,38	99,61	kmol/h
Molar Fraction (mixture) / 1-butanol	0,0	0,0	0,0	%
Molar Fraction (mixture) / N-butyl acetate	0,0	0,0	0,3	%
Molar Fraction (mixture) / Methyl acetate	60,0	64,2	1,0	%
Molar Fraction (mixture) / Methanol	40,0	35,8	98,7	%
Object	BuOH Feed	BuOH Recycle	BuAc Product	Units
Temperature	305,0	438,4	452,4	K
Pressure	15,0	15,0	4,0	atm
Mass Flow	4402,82	17564	6966,68	kg/h
Molar Flow	59,40	212,37	60,20	kmol/h
Molar Fraction (mixture) / 1-butanol	100,0	79,4	1,0	%
Molar Fraction (mixture) / N-butyl acetate	0,0	20,6	99,0	%
Molar Fraction (mixture) / Methyl acetate	0,0	0,0	0,0	%
Molar Fraction (mixture) / Methanol	0,0	0,0	0,0	%

Table 2. CSTR Specifications.

Object	Reactor	Units
Pressure Drop	10	atm
Residence Time	0,085	h
Volume	4	m^3
Temperature Delta	-30,1	K
Heat Load	-906,4	kW
Outlet Temperature	350	K
Methyl Acetate: Conversion	37,1	%

Table 3. Columns Specifications.

Object	C1	C2	C3	Units
Top Specification	0,32	1,00	1,92	RR[1]
Bottom Specification	MeOH = 0,1%	MeAc = 1%	BuOH = 1%	CC[2]

[1] - Reflux Ratio ; [2] - Component Composition.

References:

(1) Luyben, William. Design and Control of the Butyl Acetate Process. *Ind. Eng. Chem. Res.* **2011**, 50, 3, 1247-1263