Energy-Saving Design of a Methyl Methacrylate Separation Process

Abstract:

In this new technique of separating mixture of Methyl Methacrylate, Methanol and Water Top product is designed as Stable node whereas Bottom is designed as unstable node. In earlier designs bottoms are kept at saddle point. So there is significant saving in the steam cost. Another advantage is that the loss of methyl methacrylate product is reduced as compared to previous designs. This in turn reduces the operating cost.

Introduction:

Wu et al [1] devised a two-column design with a bottom decanter. The reproduced flowsheet is shown in Figure 1. The bottom composition of the distillation column was designed to be near MMA/H2O azeotrope so that a decanter can be designed to obtain aqueous and organic streams. The system is shown which contains two column and one recycle stream. The drawback of this design is that the bottom composition of the distillation column needs to be placed near a saddle point (MMA/H2O azeotrope) of this ternary system. Another disadvantage of this system is that large reboiler duty is required.
To overcome these drawbacks new energy saving design is proposed which is discussed in next section

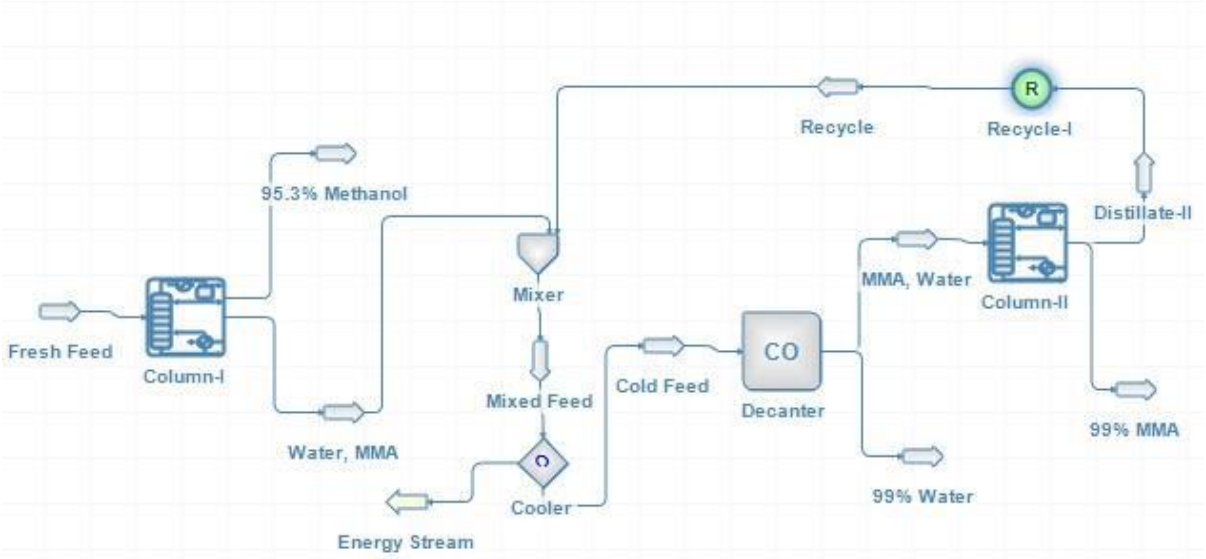

Figure-I

Energy-Saving Design

The proposed conceptual design flowsheet using the same process units by avoiding the saddle point is shown in Figure 2. The fresh feed, containing 69.79 mol % MeOH, 12.5 mol % water, and 17.71 mol % MMA, After cooling to 50 °C Feed is sent to decanter for liquid-liquid separation containing aqueous and organic stream respectively which are further separated in distillation column. As this new design contains two columns and two recycle streams. The systems with two columns and two recycle streams are difficult to converge in steady state

operation. For such system to converge dynamic simulation is used. Therefore in present steady state operation recycle loops are not closed so that simulation can be converged in steady state operation.

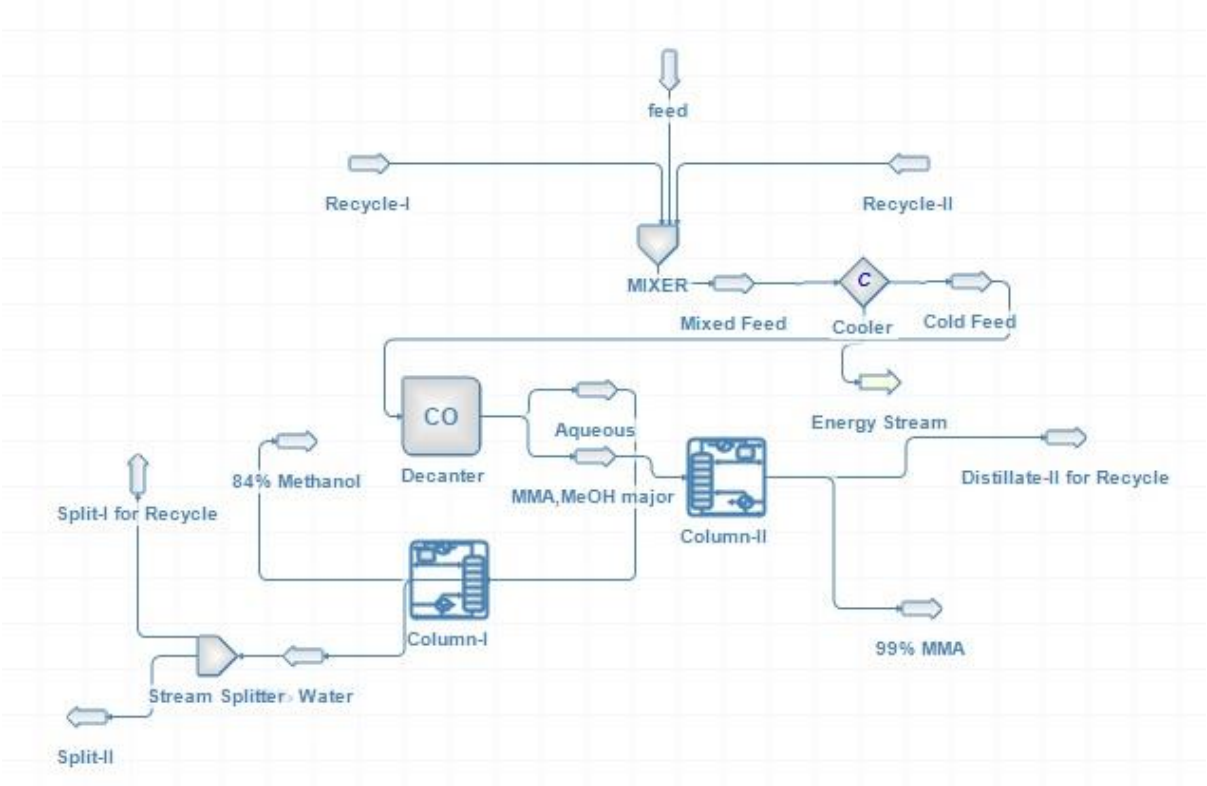

Figure-2

Results:

Stream Properties:									
Object	feed	Split-II	Split-I	Mixed Feed	MMA,MeOH major	Distillate-II	Cold Feed	Aqueous	
Temperature	298.15	372.448	372.448	366.265	323.15	351.109	323.15	323.15	K
Pressure	1.2	1	1	1	1	1	1	1	atm
Molar Flow	100	11.1433	264.653	394.539	22.5511	15.9905	394.539	371.988	kmol/h
Molar Fraction (Mixture) / Water	0.125	0.99	0.99	0.722564	0.262034	0.365721	0.722564	0.750483	
Molar Fraction (Mixture) / Methanol	0.6979	0.01	0.01	0.21803	0.194496	0.274011	0.21803	0.219457	
Molar Fraction (Mixture) / Methyl methacrylate	0.1771	9.76594E-11	9.76594E-11	0.0594055	0.54347	0.360268	0.0594055	0.03006	

Reference:

[1] Energy-Saving Design and Control of a Methyl Methacrylate Separation Process
Wei-Lun Chang and I-Lung Chien*
https://pubs.acs.org/doi/abs/10.1021/acs.iecr.6b00391