DESIGN AND CONTROL OF DIVIDING-WALL COLUMN FOR TERT-BUTANOL DEHYDRATION SYSTEM VIA HETEROGENEOUS AZEOTROPIC DISTILLATION

ESCUELA SUPERIOR POLITÉCNICA DE CHIMBORAZO

RICHARD CARLOS ROJAS QUINTERO

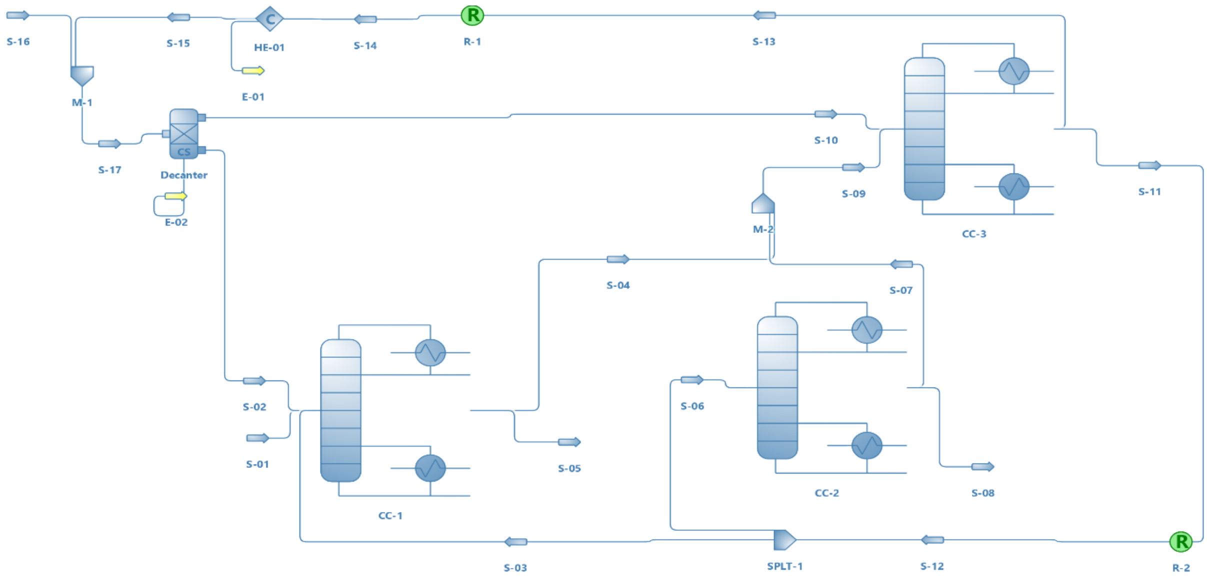
Email: richard_r9731@yahoo.com

Backgorund:

The production of tert-Butanol is used in great demand in chemical and pharmaceutical products, which is generally obtained by methods such as hydration or hydrolysis, being a product of great demand in the market in anhydrous tert-butanol, however the main The difficulty that arises is the formation of a homogeneous azeotrope between t-butanol and water at atmospheric pressure. Failing to separate into pure components through ordinary distillation, azeotropic distillation being an effective method, a popular method but with a lot of energy expenditure. The tert-Butanol dehydration process using a dividing wall column process, through heterogeneous azeotropic distillation is a new technology in the development of the simulation, trying to reduce excessive energy consumption using dividing wall columns (A-DWC) for heterogeneous azeotropes.

Description of the flowsheet

The process of obtaining tert-Butanol begins with an equimolar mixture of t-butanol and water at a temperature of 298.15 K with an atmospheric pressure of 101 325 Pa, it should be noted that the entire process was carried out in SI units, in the first column (CC-1) that functions as a pre-concentrator column, in addition to an azeotropic distillation column (CC-2), in which the flow diagram generates a control loop, in which it was necessary to implement the Recycle Loops tool, so that you can run the flow diagram, in column three (CC-3) that acts as a rectifier, the energy of the first two columns is used without having a reboiler duty, achieving the reduction of energy consumption, At the end of the cycle at the head of the (CC-3) a Condeser Duty must be implemented with which it is taken to a decanter for the separation of two liquid phases, in this case it is necessary to add the drag component that is the cyclohexane, which achieves the formation of a desirable ternary azeotrope, in the decanter it is intended for the separation of an aqueous phase that is fed to (CC-1) and an organic phase that is connected to (CC-3) for rectification, it should be noted that The organic phase is the one with the highest content of entrainment agent, for the condenser an energy of -4269.44kW was necessary, which will be removed to cool the head outlet of the column (V3), all the distillate outlets of the columns leave with a steam quality of 1, this being useful for the use of energy in the third column, reducing a reboiler in the column, an important part to consider is the output of the (CC-3), which specifies a liquid division ratio (βL) that corresponds to the relationship between the inflow to the (CC-2) and the output from the (CC-3) with a value of 0.90, which is of utmost importance in the control of the loops of the system, we worked with a thermodynamic model NRTL, for the non-ideality of the liquid-vapor equilibrium, as products in the process in the column (CC-1) a bottom product with 0.998 in water content is obtained and in the column



Results:

TABLE 1. STREAMS RESULTS FOR THE TERT-BUTANOL DEHYDRATION												
Object	**S-16**	**S-13**	**S-11**	**S-10**	**S-08**	**S-07**	**S-06**	**S-05**	**S-04**	**S-02**	**S-01**	
Temperature	298,15	356,216	353,527	312,233	360,394	353,659	353,492	371,694	353,307	312,233	298,15	**K**
Pressure	101325	101325	101325	101325	121995	101325	101325	104770	101325	101325	101325	**Pa**
Mass Flow	9,35104E-05	6,65585	5,89802	6,39562	1,02947	4,2695	5,29896	0,261534	1,88878	0,281864	1,27968	**kg/s**
Molar Flow	0,00111111	100,69	93,5436	88,3342	13,8889	70,5551	84,444	14,4275	35,3469	12,6139	27,7778	**mol/s**
Volumetric Flow	1,20923E-07	2,94303	0,00778534	0,00814682	0,00144594	2,04742	0,00698245	0,000272847	1,0247	0,000290469	0,00145587	**m3/s**
Mixture Specific Enthalpy	-388,875	84,4207	-499,151	-498,23	-386,739	85,2341	-502,47	-2221,6	86,0703	-1997,88	-930,336	**kJ/kg**
Mixture Specific Entropy	-1,10249	0,492371	-1,18128	-1,20018	-1,06287	0,47473	-1,18979	-5,8766	0,479764	-5,36501	-2,42101	**kJ/[kg.K]**
Mixture Molar Enthalpy	-32727,5	5580,39	-31472	-36073,1	-28665,7	5157,76	-31530,6	-40272,1	4599,22	-44643,7	-42859,1	**kJ/kmol**
Mixture Molar Entropy	-92,7849	32,5468	-74,4807	-86,896	-78,7815	28,7273	-74,6606	-106,528	25,6365	-119,884	-111,532	**kJ/[kmol.K]**
Vapor Phase Molar Weight	0	66,1021	61,3753	0	0	60,5129	61,1086	22,6822	53,4357	0	0	**kg/kmol**
Vapor Phase Specific Enthalpy	0	84,4207	85,2897	0	0	85,2341	85,2913	127,564	86,0703	0	0	**kJ/kg**
Vapor Phase Molar Fraction	0	1	1,51743E-05	0	0	1	1,40098E-05	4,40575E-10	1	0	0	

Table N.1: Streamwise Results for Tert-Butanol Dehydration Flowsheet