

Ethylene Oxide Production from Styrene

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Abstract:

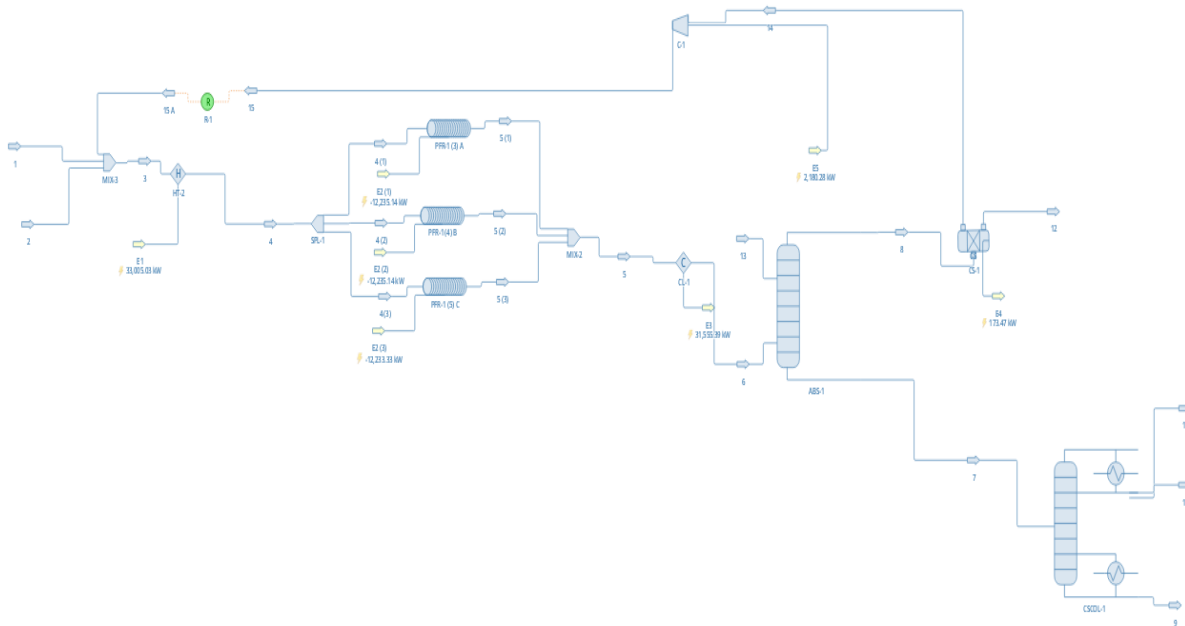
Ethylene oxide is a chemical used to make ethylene glycol (the primary ingredient in antifreeze). It is also used to make polyethylene oxide, and both the low-molecular-weight and high-molecular-weight polymers have many applications including as detergent additives. It is rarely shipped outside the manufacturing facility but instead is often pumped directly to a nearby consumer. The first two streams are Ethylene and oxygen they connected to a mixer which also have recycle stream came from CO₂ removal, then stream 1,2 and 3 with heater connected becomes stream 4 goes to steam splitter and then to the reactor is (Plug Flow Reactor-PFR), we use three reactors for this process then one more mixer settler connects stream 5 should have to cool down, hence we add one cooler to cool down the fluid then we get stream no 6 which move forward to absorption tower where Ethylene oxide absorbed into water. The overhead vapor from the absorber (containing typically <100 ppm of EO) is sent to the carbon dioxide removal unit comprising of a two-column absorber/stripper unit where a portion of the carbon dioxide is removed using hot potassium carbonate solution and purged from the system. This stream is sent to a stripping column where the majority of EO is sent overhead and condensed. The dissolved gases are vented from the overhead reflux

drum and a 99.5% EO stream is produced as overhead product. The bottom stream from the stripping column contains water and trace amounts of EO. This stream is cooled and may be recycled back to the absorber. From this process simulation we try to show how the ethylene oxide production plant works in real life application.

Thermodynamic Package:

- Roults Law

Flow Sheet :



Result:

Object	1	2	3	4	4 (1)	4 (2)	4 (3)	5	5 (1)	Units
Temperature	50	50	59.4834	224.6	224.6	224.6	224.6	224.6	224.6	C
Pressure	22	22	22	22	22	22	22	21.2185	21.2185	bar
Molar Flow	334.676	365.285	16290.2	16290.2	5430.33	5430.33	5429.51	16164	5388.26	kmol/h
Molar Flow (Mixture) / Oxygen	0	365.285	1195.4	1195.4	398.487	398.487	398.427	830.224	276.755	kmol/h
Molar Flow (Mixture) / Methane	1.0131	0	9727.4	9727.4	3242.63	3242.63	3242.14	9727.4	3242.63	kmol/h
Molar Flow (Mixture) / Carbon dioxide	0	0	834.5	834.5	278.18	278.18	278.139	993.819	331.29	kmol/h
Molar Flow (Mixture) / Ethylene	333.663	0	4464.46	4464.46	1488.23	1488.23	1488	4132.41	1377.54	kmol/h
Molar Flow (Mixture) / Ethylene oxide	0	0	0.112197	0.1122	0.0374	0.0374	0.0374	252.505	84.1726	kmol/h
Molar Flow (Mixture) / Water	0	0	68.2999	68.2999	22.7678	22.7678	22.7644	227.62	75.877	kmol/h

Object	5 (2)	5 (3)	6	7	8	9	10	11	Units
Temperature	224.6	224.6	68.5	70.4618	46.9559	154.85	50.2582	50.2582	C
Pressure	21.2185	21.2185	21.2185	21	20	5.5	4.9	4.9	bar
Molar Flow	5388.26	5387.45	16164	7400.87	15763.1	7048.87	342	10.008	kmol/h
Molar Flow (Mixture) / Oxygen	276.755	276.713	830.224	0.096776	830.131	2.13E-21	0.000256	0.096518	kmol/h
Molar Flow (Mixture) / Methane	3242.63	3242.14	9727.4	1.02251	9726.39	0	0.002627	1.01986	kmol/h
Molar Flow (Mixture) / Carbon dioxide	331.29	331.24	993.819	1.97231	991.844	2.70E-20	0.099726	1.87257	kmol/h
Molar Flow (Mixture) / Ethylene	1377.54	1377.33	4132.41	1.60242	4130.8	7.55E-21	0.015918	1.58647	kmol/h
Molar Flow (Mixture) / Ethylene oxide	84.1726	84.1602	252.505	252.162	0.34361	20.3336	226.482	5.34624	kmol/h
Molar Flow (Mixture) / Water	75.877	75.8657	227.62	7144.02	83.5993	7028.53	115.4	0.086347	kmol/h

Object	12	13	14	15	15 A	Units
Temperature	46.9559	25	46.9559	59.8882	59.8882	C
Pressure	20	21	20	23	23	bar
Molar Flow	172.89	7000	15590.2	15590.2	15590.2	kmol/h
Molar Flow (Mixture) / Oxygen	0.0153609	0	830.116	830.116	830.116	kmol/h
Molar Flow (Mixture) / Methane	9.73E-07	0	9726.39	9726.39	9726.39	kmol/h
Molar Flow (Mixture) / Carbon dioxide	157.344	0	834.5	834.5	834.5	kmol/h
Molar Flow (Mixture) / Ethylene	4.13E-07	0	4130.8	4130.8	4130.8	kmol/h
Molar Flow (Mixture) / Ethylene oxide	0.231417	0	0.112197	0.112197	0.1122	kmol/h
Molar Flow (Mixture) / Water	15.2994	7000	68.2999	68.2999	68.2999	kmol/h

References

1. Dever, J. P., K. F. George, W. C. Hoffman, and H. Soo, "Ethylene Oxide," Kirk-Othmer Encyclopedia of Chemical Technology, online version (New York: John Wiley & Sons, 2004).
2. Stoukides, M., and S. Pavlou, "Ethylene Oxidation on Silver Catalysts: Effect of Ethylene Oxide and of External Transfer Limitations," Chem. Eng. Common. 44 (1986): 53-74.