PRODUCTION OF DIMETHYL ETHER FROM METHANOL

Ayush Biyani

Sardar Vallabhbhai national institute of technology

ABSTRACT

Background

DME is a 'Second Generation Biofuel it has a slight ethereal odor. It liquefies under slight pressure, much like propane. It is relatively inert, noncorrosive, non-carcinogenic, almost non-toxic, and does not form peroxides by prolonged exposure to air. Its physical properties make it a suitable substitute (or blending agent) for liquefied petroleum gas (LPG, a mixture of propane and butane). The largest use of DME is currently as substitute for propane in LPG used as fuel in household and industry. DME has two other primary applications: as a propellant in aerosol canisters, and as a precursor to Dimethyl sulfate as an aerosol propellant, DME is useful as a somewhat polar solvent. It can also be used as a refrigerant.

The reaction of DME synthesis is mainly dehydration of methanol that is exothermic and reversible.

Methanol dehydration reaction :   **2 CH$_3$OH ↔ DME + H$_2$O**

Description of flowsheet

The methanol enters the process at a temperature of 25 °C and 100 kPa through which it goes into h pump to increase its pressure to 1550 kPa. Now the feed enters a mixer where it is mixed with the unreacted methanol from the previous cycle. From there the feed goes into a heater to increase its temperature to 250 °C. Now the feed goes into a conversion reactor where the dehydration reaction takes place where DME is formed. As 100% conversion is not there so along with DME, methanol will also be obtained in the product stream. From there the product stream goes into the distillation column where top product is DME and bottom product is a mixture of water and methanol. Bottom products from 1st distillation column go into the 2nd distillation column where after separation methanol is obtained as top product and water as bottom product. Now the methanol obtained can be used as again in the process

so for that we are using recycle and pump and cooler are used to match the conditions of methanol with initial feed conditions.

System of units

Temperature - °C, Pressure – kPa, Mass flow rate – kg/h, molar flow rate – kmole/h, other units – SI.

Flowsheet
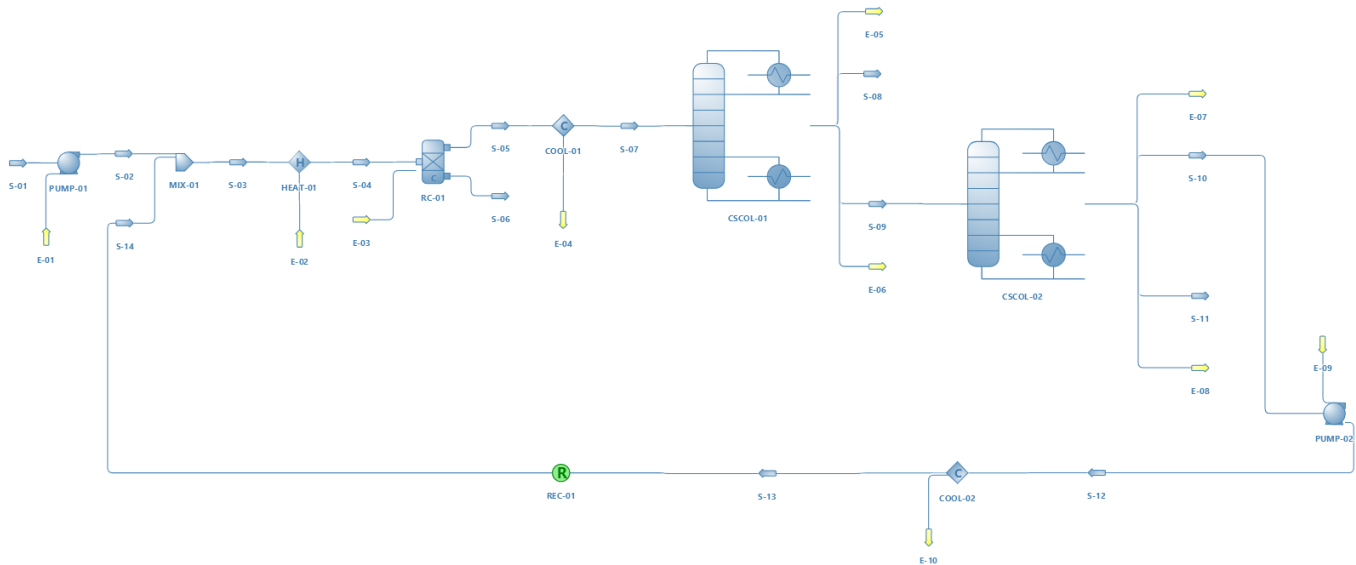
Result

Mole fractions of compounds in different streams after separation

Compounds	S-08	S-09	S-10	S-11
DME	0.999983	0.0189	0.0555	$3.608 * 10^{-9}$
Methanol	$1.673 * 10^{-5}$	0.3151	0.9034	0.0099
Water	$1.406 * 10^{-7}$	0.666	0.04107	0.99

Reference

https://www.jocpr.com/articles/design-and-simulation-of-a-plant-producing-dimethyl-ether-dme-from-methanol-by-using-simulation-software-aspen-plus.pdf