

Production of Dimethyl Ether

Background

A feasibility study on the production of 95.31 wt% dimethyl ether (DME) is to be performed. The plant is capable of producing 50,000 metric tons of DME per year via the catalytic dehydration of methanol over an acid zeolite catalyst. The goal is to design a grass-roots facility, which safely and efficiently produces DME.

DME is used primarily as a propellant. DME is miscible with most organic solvents and it has a high solubility in water [1]. Recently, the use of DME as a fuel additive for diesel engines has been investigated due to its high volatility (desired for cold starting) and high cetane number.

Process Description

The essential operations in the process are the preheating of the raw material (nearly pure methanol), reacting methanol to form DME, product separation, contaminant separation, and methanol separation and recycle.

Crude methanol, containing about 2 mol % impurities, is fed as a liquid in Stream 1, pumped up to 16.9 atm and combined with Stream 18, a methanol recycle stream. Stream 4 is then sent into heat exchanger where it is heated to a temperature of 243°C before it is sent to a packed bed reactor, to form DME. The reaction is slightly exothermic and the reaction products are heated to approximately 366°C before leaving the reactor. The reactor effluent is cooled in and then throttled to 10 atm before entering . Here, the dimethyl ether is separated from the other components

as distillate, Stream 9. The bottom product, Stream 10, stream 11 is throttled to 6.9 atm and sent to where the methanol and water are separated from the waste components. The waste components exit as distillate, Stream 12, and are sent to a waste treatment facility. The water and methanol exit as the bottoms stream, Stream 13. This stream is then throttled to 1 atm and then sent to where the water and methanol are separated. The water exits the bottom of the distillation column as Stream 15, and is sent to waste treatment. The methanol exits the column as distillate, Stream 16. Stream 16 is then pumped up to 15.1 atm and recycled back to mix with fresh methanol, Stream 3 in vessel .

Results

1. In stream 6 we get 81.079% conversion of methanol using plug flow reactor.
2. We get 95.31 wt% of dimethyle ether in stream 9.

References

1. "DuPont Talks About its DME Propellant," *Aerosol Age*, May and June, 1982.
2. Bondiera, J., and C. Naccache, "Kinetics of Methanol Dehydration in Dealuminated H-Mordenite: Model with Acid and Base Active Centres," *Applied Catalysis*, **69**, 139-148 (1991).