

# Production of ETBE using C4-stream and Ethanol

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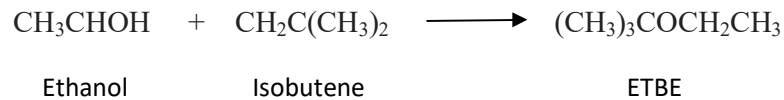
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## BACKGROUND

Due to restriction of leaded gasoline, MTBE (Methyl Tert Butyl Ether) used to increase octane number of gasoline. Presence of MTBE in ground-water has proved its adverse effect on ecology and environment. In these conditions ETBE (Ethyl Tert Butyl Ether) is much better alternative as gasoline additive.

## FLOWSHEET DISCRPTION

In this process Ethanol(95%) and C4 stream is used to produce ETBE. After making reactant mixture according to reaction condition, mixture is fed to plug flow reactor to have liquid phase Reaction. Conversion if PFR is 82 % with respect to Isobutene.



Product mixture is separated by Distillation with high pressure. As product we are getting 96.5 % pure ETBE form bottom of distillate. In unreacted components, C4s can be separated by gas-liquid separator to have C4s in vapor phase and other unreacted as in liquid phase.

## RESULTS

Result of flowsheet is as follows.

Object	Ethanol + Water	C4	2	4	Reactant Mixture	Product PFR -019	Distillation Column Feed	ETBE (Bottom Product)	DC Top Product	Unreacted C4	Unreacteds	
Temperature (K)	298.15	298.15	350	344	337.733	337.733	393	465.849	369.713	377.013	377.013	
Pressure (Pa)	101325	202650	1.00E+06	1.01E+06	1.00E+06	788131	788131	1.62E+06	1.40E+06	1.40E+06	1.40E+06	
Mass Flow (kg/s)	2.44768	7.82484	2.44768	7.82484	10.2725	10.2725	10.2725	3.91014	6.36211	5.08504	1.27706	
Molar Flow (mol/s)	54.8	139	54.8	139	193.8	152.723	152.723	39	113.723	91.2361	22.4869	
Volumetric Flow (m3/s)	0.00330928	1.60991	0.00352776	0.0145088	0.016946	0.0159671	0.549431	0.0074967	0.0122475	0.15818	0.00236969	
Mixture Density (kg/m3)	739.643	4.86041	693.835	539.318	606.192	643.357	18.6966	5.22E+02	519.463	32.1473	538.916	
Mixture Molar Weight (kg/kmol)	44.6658	56.2938	44.6658	56.2938	53.0058	67.2625	67.2625	100.26	55.9439	55.735	56.7914	
Vapor Phase Molar Fraction	0	1	0	0	0	0	1	0.000632368	0	1	0	
Molar Fraction (Mixture)	Isobutene	0	0.36	0	0.36	0.258204	0.0586877	0.0586877	2.72E-05	0.078809	0.0826721	0.0631351
	Ethanol	0.95	0	0.95	0	0.268627	0.0719142	0.0719142	0.0337194	0.0850156	0.0628442	0.174972
	Tert-butyl ethyl ether	0	0	0	0	0.268964	0.268964	0.965805	0.0299391	0.0198369	0.0709264	

## REFERENCE

Introduction to Process Engineering and Design by S B Thakore and B I Bhatt, Tata McGraw Hill, 2nd Edition, 2007.

Carles Fite; Montserrat Iborra; Javier Tejero; Jose F. Izquierdo and Fidel Cunill, "Kinetics of the Liquid-Phase Synthesis of Ethyl Tert-Butyl Ether (Etbe)," *Industrial & Engineering Chemistry Research*, vol.33, 1994, pp. 581-591.

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