

Synthesis of Isobutane form n-butane

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Introduction

Generally, butane is used to produce the isooctane which has very high octane number and used in gasoline blending. Crude oil usually contains both n-butane and isobutane, but isobutane is in insufficient amount to meet the alkylation requirements. So isomerization of n-butane is done to increase the amount of isobutane in crude mixture.

Development of Flowsheet in DWSIM

All the specifications of the unit operations and thermodynamics are elaborated in the literature. So we have used all the specifications as they are. Here, we have used Chao-Seader model as the thermodynamic property package (same is used in literature).

For more details about the unit operation specifications and the stream properties, please refer to the flowsheet and literature.

Purpose of Study

Isobutane is a very important petrochemical as it is used to make isooctane using alkylation with C_4 olefins. Now the so formed isooctane helps improve the quality of fuel by increasing its octane number. Generally, isobutane is in less concentration in crude oil and as a result we require to increase the isobutane concentration in the stream. Therefore, this flowsheet provides a method to improve the isobutane concentration in the stream.

Description of Flowsheet

A fresh feed of 100 lb mol/h is fed to a 62 staged packed column mainly containing the mixture of n-butane and isobutane, propane and isopentane being small in amount. The heavy isopentane is removed from bottoms as 95 mol% pure. The distillate contains almost 90 mol% pure isobutane and propane and n-butane remaining as impurity. The column condenser operates at 90 psi so that cooling water as utility can be used. We want all the n-butane to be converted to the isobutene. This is done by one side reactor which is fed by vapor sidestream withdrawn from the stripping section of the column. The vapor is condensed, pumped upto 125 psi, vaporized and fed into gas phase tubular reactor. The sidestream flow rate is 220 lb mol/h. the reactor inlet is at 165 °F, which is the dewpoint of

the sidestream at 125 psi. The reaction occurs and the reactor yields 38 mol% of isobutene. This stream is again sent to the column in the enriching section at 92 psi.

Result

Object	Feed	D1	B1	R3	Reactor Output 1	Unit
Flow Rate	12.5998	11.9351	0.664691	27.7	27.7	mol/s
Propane	0.01	0.0105	0	0	0	mol/mol
Isobutane	0.2	0.90943	0	0.0899	0.38873	mol/mol
n-Butane	0.74	0.0555	0.05	0.9054	0.6066	mol/mol
Isopentane	0.05	0	0.95	0	0	mol/mol

References

[1] William L. Luyben, Control of an Isomerization Column/Reactor Process, (2011).

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