Industrial production of Acetone by dehydrogenation of Isopropanol

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BACKGROUND:

Acetone is one of the most important industrial solvent being used in industries from a long back. A lot of interest is being shifted to acetone derived chemicals .It is widely used as a volatile compound in paints and varnishes .the global requirement of acetone in India is estimated to be 55000 tons annually It was initially prepared by dry distillation of metal acetates but recently a number of methods have been devolved including biosynthesis, Cumene process etc .One of the most economical process is by the dehydrogenation of Isopropanol followed by fractionation.

PROCESS DESCRIPTION:

The process starts with a pure stream of Isopropanol being introduced in an equilibrium reactor, where a temperature of 530 K and a pressure drop of 10 bars is maintained .On an account endothermic reaction takes place and heat is absorbed during the process.

$$CH_3CH(OH)CH_3 \leftrightarrow CH_3COCH_3 + H_2 \qquad \Delta Hr = +57000 KJ/Kmol$$

.The top product of the reactor is given to a flash separator, where a pressure drop of 2000 pa is maintained and hydrogen is separated as a lighter product at the top and mixture of Isopropanol and acetone is taken as a bottom product .This product is then mixed with the stream from the end process and fed to a 12 stage distillation tower, where a pressure of 1 atm and a reflux ratio of 1.5 is maintained. The top product contains pure Acetone having purity of 99 percent and the side stream and bottom product contains mixture of Isopropanol and traces of acetone which again given to a distillation column where same conditions are maintained, the bottoms and the side stream of this column contains Isopropanol which is recycled back and mixed with the feed of distillation column. In this process 99 percent of acetone is produced with most of the unreacted Isopropanol being recycled and energy is recycled wherever feasible.

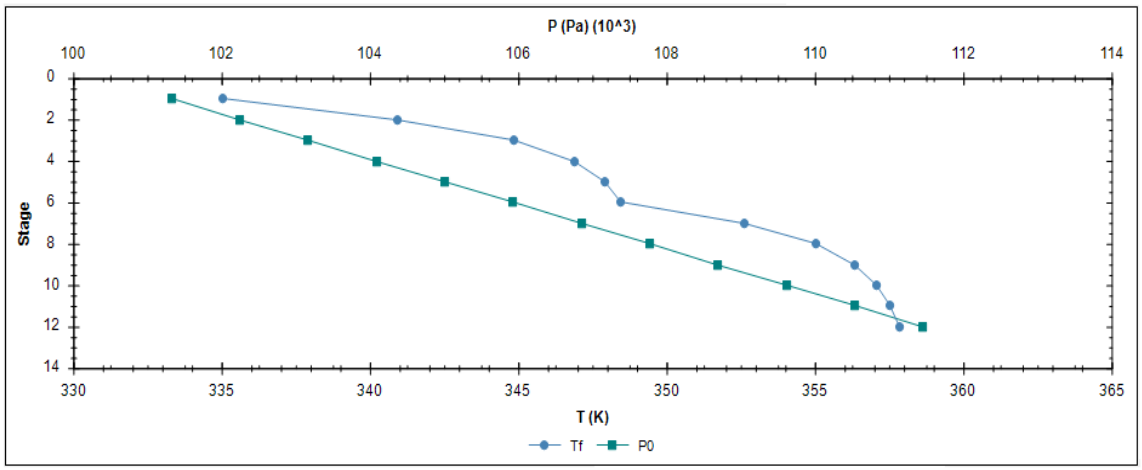

Fig 1.Temperature and pressure profile of distillation Column.

RESULTS: The stream wise results are:

OBJECT	ACETONE	HYDROGEN	ISOPROPANOL	mixA+iso	Mix 2	Mix 3
Temperature K	61.34	325	399.99	331.6459	530	325
Pressure Pa	101315	1,374,958	463,636.63	101325	1376958	1374958.3
Mass Flow kg/s	73.38	12.72	144.2306	139.94	144.23	131.51
Molar fraction/Isopropanol	0.001	0	1	0.27	0.06	0.12
Molar fraction/Acetone	0.999	0	0	0.73	0.47	0.88
Molar fraction/Hydrogen	0	1	0	0	0.47	0.01

REFERANCE:

Dryden’s Outlines of Chemical Technology vol.3