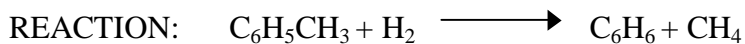


## MATERIAL BALANCE



FEED: Toluene & hydrogen

MIXED FEED: Toluene, hydrogen, benzene & methane

PRODUCTS: Benzene, toluene, methane & hydrogen

Benzene production = 250 tons per day  
= 133.36 kmols/hr

Feed stream: Assuming a 70% conversion per pass, toluene is supplied.

Toluene = 139.6253 kmols/hr

Hydrogen make-up: Taking hydrogen to toluene ratio in the mixed feed as 5:1, H<sub>2</sub> input, which is 95% pure hydrogen, is

Hydrogen = 308.7208 kmols/hr

Methane = 16.2484 kmols/hr

Recycle liquid stream: The bottoms of the distillation column is recycled.

Toluene = 51.8979 kmols/hr

Benzene = 1.0591 kmols/hr

Recycle gas stream: 7% of gas separated in the separator is used as fuel gas & 93% is recycled.

Hydrogen = 1324.5399 kmols/hr

Methane = 1139.9266 kmols/hr

Mixed feed stream:

Toluene = 191.5207 kmols/hr

Benzene= 1.0591 kmols/hr

Hydrogen = 1633.2607 kmols/hr

Methane = 1156.1750 kmols/hr

### **Reactor**

The mixed feed stream enters the reactor & a 70% conversion of toluene is assumed.

Reactor product stream:

Toluene = 57.4562 kmols/hr

Benzene= 135.1314 kmols/hr

Hydrogen = 1499.1962 kmols/hr

Methane = 1290.2397 kmols/hr

### **Separator**

The feed to the separator is the product stream from the reactor. Ninety five percent of hydrogen is assumed to go with the gas stream.

Gas stream leaving the separator:

Hydrogen = 1424.2364 kmols/hr

Methane = 1225.7277 kmols/hr

Liquid stream leaving the separator:

Toluene = 57.4562 kmols/hr

Benzene= 135.1314 kmols/hr

Hydrogen = 74.9598 kmols/hr

Methane = 64.5120 kmols/hr

### **Stabiliser**

In this, the whole H<sub>2</sub> & CH<sub>4</sub> are removed. Around 0.5 % of benzene also goes with the off-gas.

Liquid stream leaving the stabiliser:

Toluene = 57.4562 kmols/hr

Benzene= 134.4591 kmols/hr

### **Distillation column**

The feed to the distillation column is the bottoms from the stabiliser. The residue stream from distillation column is recycled.

Distillate stream:

Toluene = 5.5583 kmols/hr

Benzene= 133.4 kmols/hr

Residue stream:

Toluene = 51.8979 kmols/hr

Benzene= 1.0591 kmols/hr