MANUFACTURING PROCESSES

In the mid 20^{th} century, commercially Toluene was produced from

1. **From Coal Gas and Light Oil**

   Toluene or Toluol is obtained from light oil by fractional distillation. The light oil obtained by coal carbonization is recovered by cooling and scrubbing the by- product coke oven gas. The light oil which condenses with the tars (about 55 of the tar0, is recovered by rectification.

   The light oils (containing 12 to 20% toluene), scrubbed from coke oven gas and distilled from tar, are combined and fractionally distilled in continuous or semi continuous units. Between 0.1 to 0.2 gal of toluene is obtained per gal of combined light oil distilled.

2. **From Petroleum by Hydroforming**

   Reaction:

   $$C_6H_{11}CH_3 \longrightarrow C_6H_5CH_3 + 3H_2$$

   Process:

   Toluene is produced from specially selected fractions of petroleum, rich in naphthenes, by catalytic reforming (also known as hydroforming). This involves catalytic dehydrogenation in the presence of hydrogen (which reduces coke formation) to yield a mixture of aromatic hydrocarbons, chiefly toluene.

   The feed stock (a selected naphtha fraction) is preheated in heat exchangers and is then totally vaporized in a furnace. Here it is joined with a hydrogen rich recycle gas and a mixture is passed through a reactor with a constant time. The reactor contains a dehydrogenated catalyst consisting of 10% molybdenum dioxide on alumina. The reaction gas passed through heat exchangers (preheating the feed stock) to a gad – liquid condenser and separator. Here a large portion of a separated wet gas is compressed and is recirculated to the furnace and reactor to increase the hydrogen concentration. The hydrogen tends to reduce coke formation and thus maintain catalytic activity. The remaining gas and liquid passed to conventional absorption and stabilizing columns, which produce fuel gas gasoline and hydroformate. The

latter contains about 20% of toluene and may be recirculated through the reactor for maximum conversion to obtain a two pass hydroformate containing 38% toluene.

3. **Alternate Catalytic Reforming Processes.**

Several catalytic reforming processes have been developed by various organizations. The processes differ in details, operating conditions, and type of catalyst used. Some of these processes are listed below.

Fluid Hydroforming Process uses a fluidized solids technique in the reactor and continuous regeneration of the molybdenum on alumina catalyst in a separate vessel.

Platforming is a fixed bed process using several reactors in series with intermediate reheating. This process is licensed by Universal Oil Products Co, uses a platinum on alumina catalyst.

Catforming is also a fixed process using a platinum catalyst. It is licensed by Atlantic Refining Co. other fixed bed catalytic reforming processes using a platinum catalyst are **Hydroforming, Ultraforming, & Powerforming.**

4. **Present day the method used to produce Toluene is by separating the aromatic Mixture.**

The methods used to separating benzene, toluene and xylene can be grouped into six classes:

a. Fractional distillation
b. Azeotropic distillation
c. Extractive distillation
d. Solvent extraction
e. Solid absorption
f. Crystallization

CHOICE OF THE PROCESS:

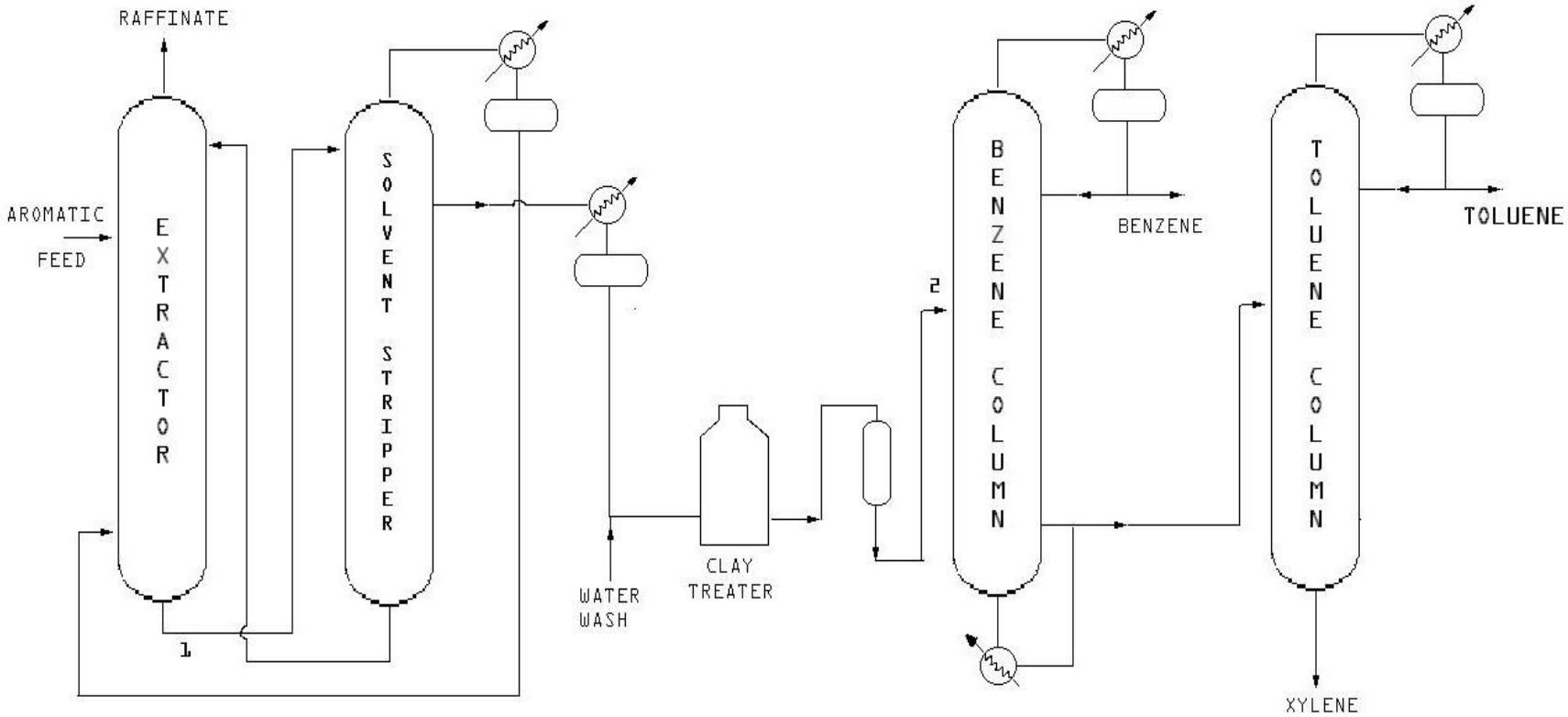
Solvent Extraction: The most important requirement for a solvent in a solvent extraction process are that it should have a high selectivity for aromatics against non- aromatics, that a two- phase system is obtained in a reasonable range of temperature, and that the phases should separate within a reasonable range of temperature and that phase should separate within a reasonable range of temperature; of course it must also be non-corrosive, non- reactive and thermally stable.

Sulphur dioxide extraction has commonly been used but more recently aqueous diethylene glycol has been employed (Udex process).

Process: The Udex plant consists essentially of an extractor, a water wash, a heater and a clay treater. The feed is contacted with the solvent counter currently. After extraction and treatment, the mixed aromatics are distilled in train of two towers for the separation of the three aromatics, benzene, toluene and xylene.

The selectivity of diethylene glycol- water system is increased by the addition of water; however addition of water decreases the solubility of aromatics. In practice the water content is normally kept within the range of 8 – 10%. Because of the low solubility, a rather high temperature (about $150^{o}C$) has to be used. As fairly high solvent ratios normally have to be used (8 – 15: 1 by weight), it is economically attractive to operate the stripper at a bottom temperature near the extraction temperature in order to save heat.

A typical Udex plant is illustrated in the following figure.


RAFFINATE
AROMATIC
FEED
EXTRACTOR
SOLVENT STRIPPER
1
WATER
WASH
CLAY
TREATER
2
BENZENE COLUMN
BENZENE
TOLUENE COLUMN
TOLUENE
XYLENE