Benzene/Toluene (93-7)

Benzene and toluene production is a subject of some complexity. Both products may be blended with gasoline rather than produced for chemical markets. Recent U.S. legislation limits the benzene content in gasoline, but this has very little effect on the benzene supply/demand balances. Both benzene and toluene may be produced from a number of different feedstocks, each with different processing requirements. In addition, toluene itself may be converted to produce benzene.

Catalytic reformate, pyrolysis gasoline, and coke oven light oil are the primary sources of the light aromatic hydrocarbons - benzene, toluene, and mixed xylenes (BTX). Aromatics and nonaromatics in these feedstocks can have very similar boiling points or form azeotropes; the aromatics are typically separated from the feedstocks by a solvent extraction system. Liquid-liquid extraction systems are usually employed to simultaneously extract the BTX products, while extractive distillation is appropriate for recovering a single aromatics product from a concentrated feedstock. In general, toluene is available in the main feedstocks at a higher ratio to benzene and xylenes than required. Other benzene sources are therefore dealkylation of toluene and disproportionation of toluene to benzene and xylenes.

In addition to the conventional routes to benzene and toluene, this report also looks at developing or recently commercialized routes aiming to produce aromatics from lower paraffins or olefins including:

- Mobil’s catalytic process, which in theory is applicable to either ethane or propane, gives more economical yields with the former.

- BP’s CYCLAR catalytic process developed with UOP. This also can be applied to either ethane or propane, and light naphtha, but in this case the LPG seems more likely to be economical. This process has been proven in a 1,000 barrel per day demonstration-scale unit and there are plans for a commercial unit to be installed in Saudi Arabia by 1998.

- K.T.I.’s Pyroform process, also applicable to both ethane and propane and available either as a thermal or catalytic variant.

- Mitsubishi Oil/Chiyoda’s Z-forming process has been proven in a 200 barrel per day demonstration-scale unit. It is applicable to LPG and light naphtha.

- A joint development by IFP and Salutec and referred to as the Aroformer process, is still very much in the development stages. A 500 barrel per day demonstration unit is in the design stages.

Other processes (e.g. Aromax), employing more highly selective reform-
ing catalyst capable of producing high yields of benzene from light (C5-
C6) paraffinic naphthas, are being developed by a number of compa-
nies. Chevron’s AROMAX process has recently been commercialized.
This process employs a light naphtha feed.

Recently, Asahi Chemical Industry Co. In Tokyo, an affiliate of Sanyo
Petrochemical Co., announced the commercialization of the Alpha pro-
cess to produce aromatics from olefins.

The developing processes reviewed in the body of the report are ca-
pable of utilizing a variety of feedstocks ranging from ethane to light
naphtha. For an analysis of the cost of production of BTX from these
feeds, Chem Systems has analyzed five different feedstocks: ethane,
propane, C3/C4 mixture (LPG), normal butane, and light naphtha. For
each feedstock a technology that appears to be best suited to that par-
ticular feed has been chosen. Thus, for the ethane feedstock the Mobil
technology has been chosen; for the propane feedstock KTI’s technol-
gy (Pyroform process) has been used; for LPG UOP’s CYCLAR tech-
nology; for normal butane the Z-Forming process of Mitsubishi; and for
light naphtha the AROMAX is commercial, and therefore was the under-
standable choice. The production costs for these five cases have been
estimated for a 100 million pound per year (45,000 metric tons per year)
BTX facility built on the U.S. Gulf Coast.