Alkylation or Polymerization

Propylene and butylenes can be polymerized to form a high-octane product boiling in the gasolineboiling range. The reactions involved are shown in Figure 5. In the first reaction two butylenesreact to form an octane. In the second reaction, two propylene molecules react to form a hexane.These reactions take place at 300-425°F and high pressures (400-1500 psi). The catalyst used is Phosphoric Acid on an inert support.

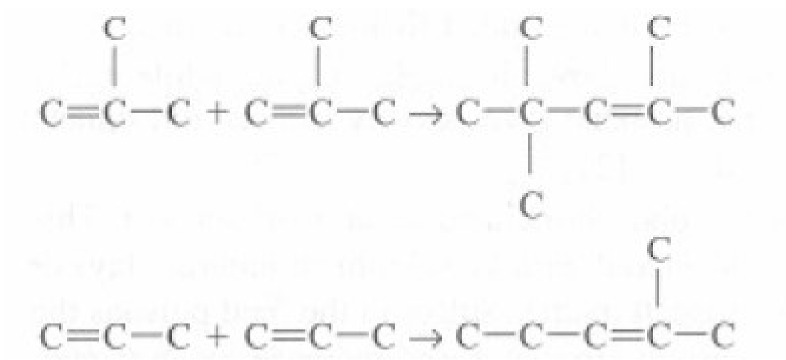

Figure 5: Polymerization reactions

Iso-merization

The rearrangement of ***straight chain*** HC molecules to form ***branched- chain*** products, pentanes and hexanes, which are difficult to reform, are iso-merized using aluminum chloride or precious metal catalyst to form gasoline- blending compounds of fairly high octane no.

The octane number of the LSR gasoline (C_5- 160 ^oF) can be improved by iso-merization to convert normal paraffins into their isomers. This results in a significant octane increase as n- pentane has an 61.7 RON and iso-pentane has 92.3 RON. In once through iso-merization the RON of LSR gasoline can be increased from 70 to about 82.

Reaction temperature of about 300-400 ^oF are preferred to higher temperature because the equilibrium conversion to isomers is enhanced at the lower temperature. Hence a very active catalyst is necessary to provide a reasonable reaction rate. Catalysts used contain platinum on various bases.

Process Variable

Activity: Ability to crack gas oil to lower boiling fractions.

Catalyst / oil ratio = C/ O = lb catalyst / lb feed.

$$\textbf{Conversion} = 100 * \left(\frac{\text{Volume of feed} - \text{Volume of cycle stock}}{\text{Volume of feed}} \right)$$

Cycle stock: portion of catalytic- cracker effluent not converted to naphtha and lighter products (generally the material boiling above 430 ^oF)

$$\textbf{Efficiency} = \left(\frac{\%\ \text{gasoline}}{\%\ \text{conversion}} \right) * 100$$

Recycle ratio = Volume recycle / volume fresh feed

Selectivity: The ratio of the yield of desirable products to the yield of undesirable products (coke and gas).

Space velocity: space velocity may be defined on either a volume (LHSV) or a weight (WHSV) basis. In a fluidized bed reactor the LHSV has little meaning because it is difficult to establish the volume of the bed. The weight of the catalyst in the reactor can be easily determined or calculated from the residence time and C/O ratio.

LHSV: Liquid hour space velocity in volume feed / (Volume catalyst) (hr)

WHSV: Weight hour space velocity in lb feed / (Lb catalyst) (hr)

If **(t)** is the residence time in hours then

$$WHSV = \frac{1}{(t)} \,(C / O)$$

With in the limits of normal operation increasing:

1) **Reaction temperature.**
2) **C/O ratio**
3) **Catalyst activity.**
4) **Contact time.**

Results are an increase in conversion while a decrease in space velocity increases conversion. Increase in conversion does not necessarily mean an increase in gasoline yield, as an increase in temperature, above certain level can increase conversion coke and gas yields, and octane number of the gasoline but decrease gasoline yield.