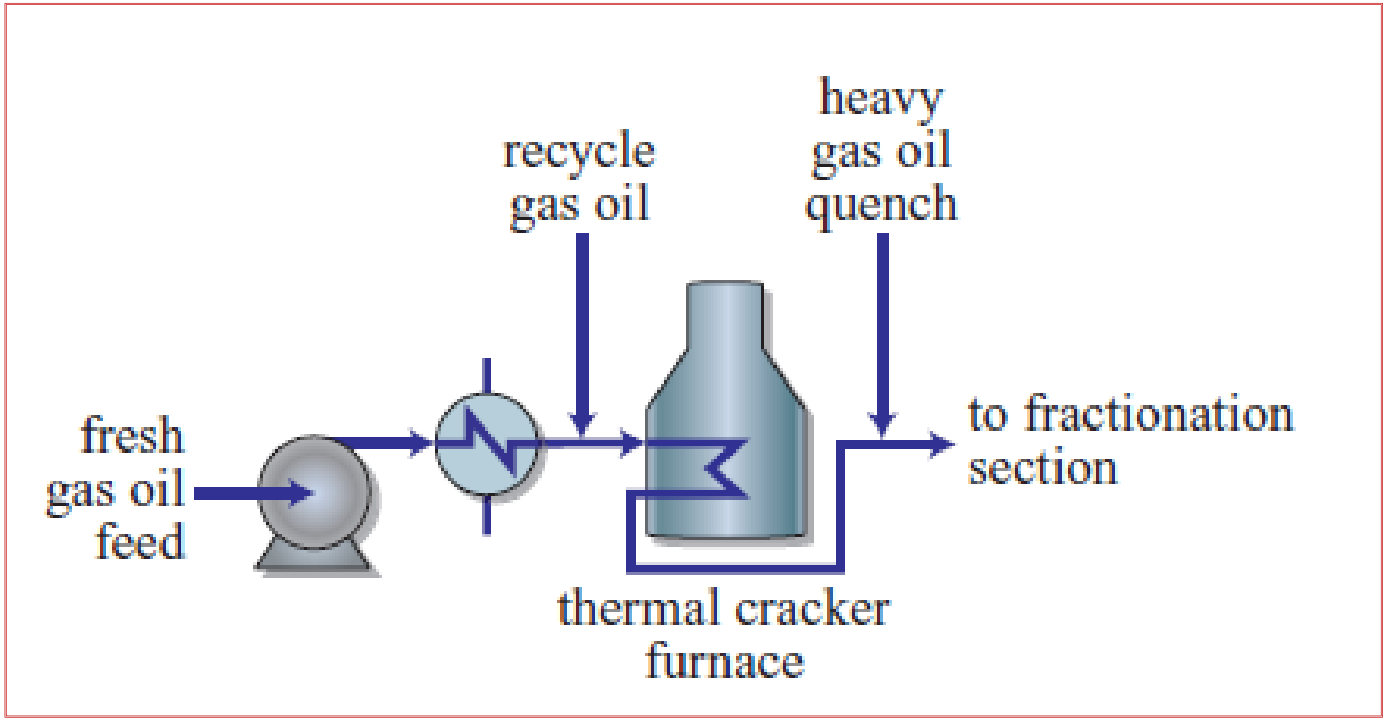
Refining Operations
Thermal Conversion Processes

THERMAL CRACKING

- ✓ Thermal cracking is the thermal decomposition of straight-run and recycled heavy gas oils at temperatures between about 450°C and 540°C under moderate pressure conditions.
- ✓ Large oil molecules are thermally decomposed into smaller, lower boiling molecules.
- ✓ Thermal cracking enables a refiner to produce cracked naphtha and cracked light gas oil products from heavy gas oils, thus reducing the amount of heavy oils produced. Thermal cracking, as practised commercially, normally involves the recycle of unconverted heavy gas oils, usually to near extinction.
- ✓ Products from a thermal cracker are:
  - thermal tar;
  - unconverted heavy gas oil;
  - Light gas oil;
  - naphtha;
  - gas.

Refining Operations
Thermal Conversion Processes

THERMAL CRACKING



Simplified flow diagram of reactor section of a thermal cracker

Refining Operations
Thermal Conversion Processes

VISBREAKING

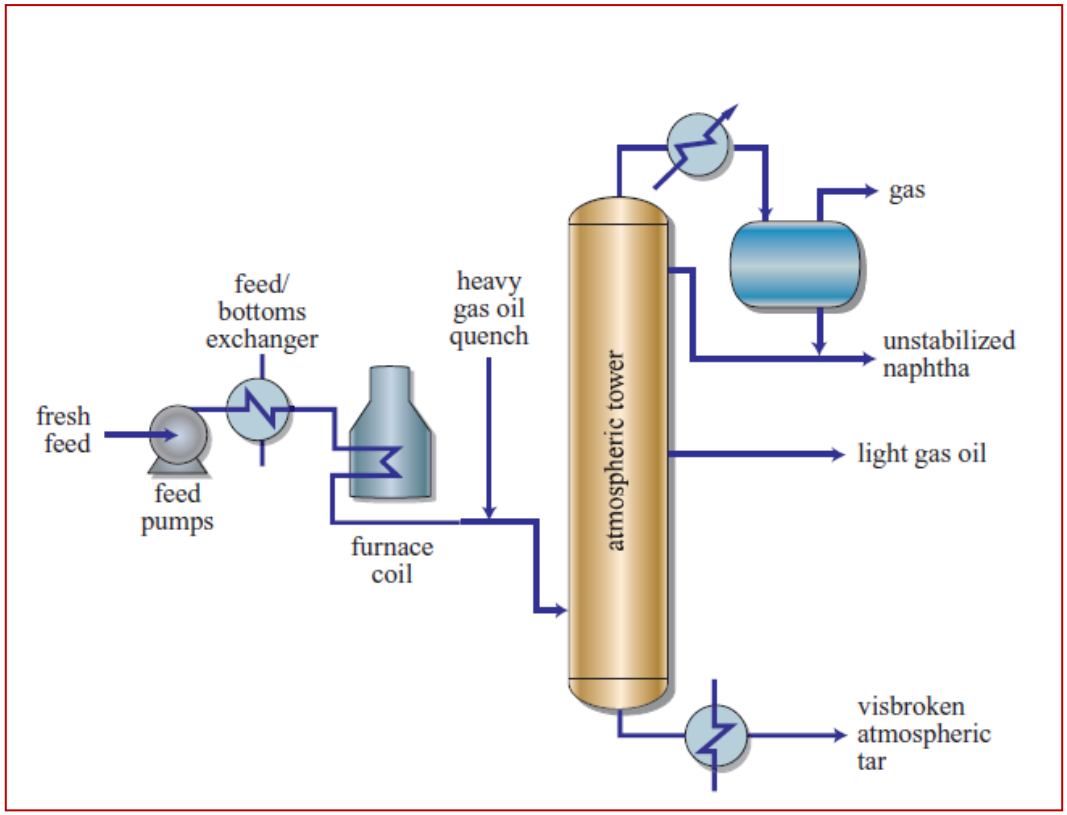
- ✓ Visbreaking is the thermal decomposition of viscous crude oil straight-run vacuum or atmospheric residues at temperatures between about 430 and 485°C. The term visbreaking evolved as a short form of '*viscosity breaking*', as one of the chief objectives of the process was to reduce the viscosity of a crude residue by thermally decomposing or cracking large oil molecules into smaller ones.

- ✓ Visbreaking enables a refiner to reduce the amount of fuel oil produced, because in addition to reducing viscosity over the reaction, some conversion to lighter products also occurs and the amount of cutter stock required to meet a given viscosity is consequently reduced.

- ✓ Products from a visbreaker are:
  - visbroken tar;
  - gas oils;
  - naphtha;
  - gas.

Refining Operations
Thermal Conversion Processes

VISBREAKING



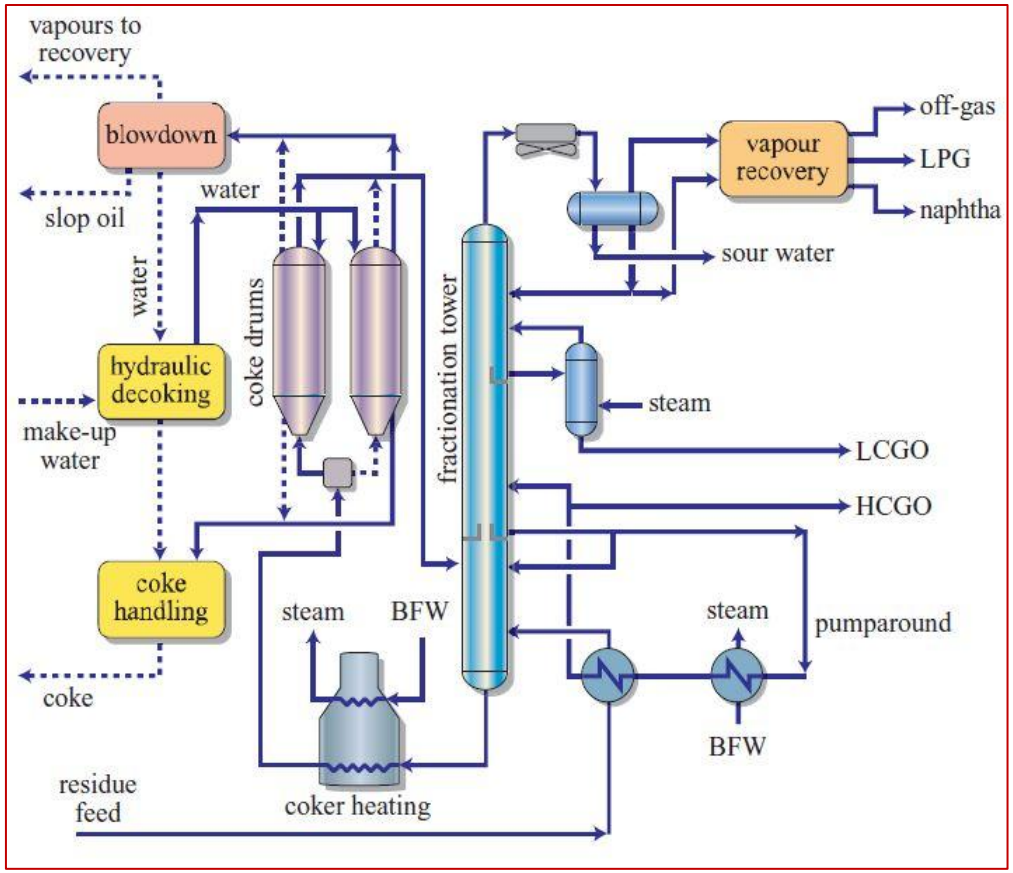
Simplified flowsheet of a coil visbreaker

Refining Operations
Thermal Conversion Processes

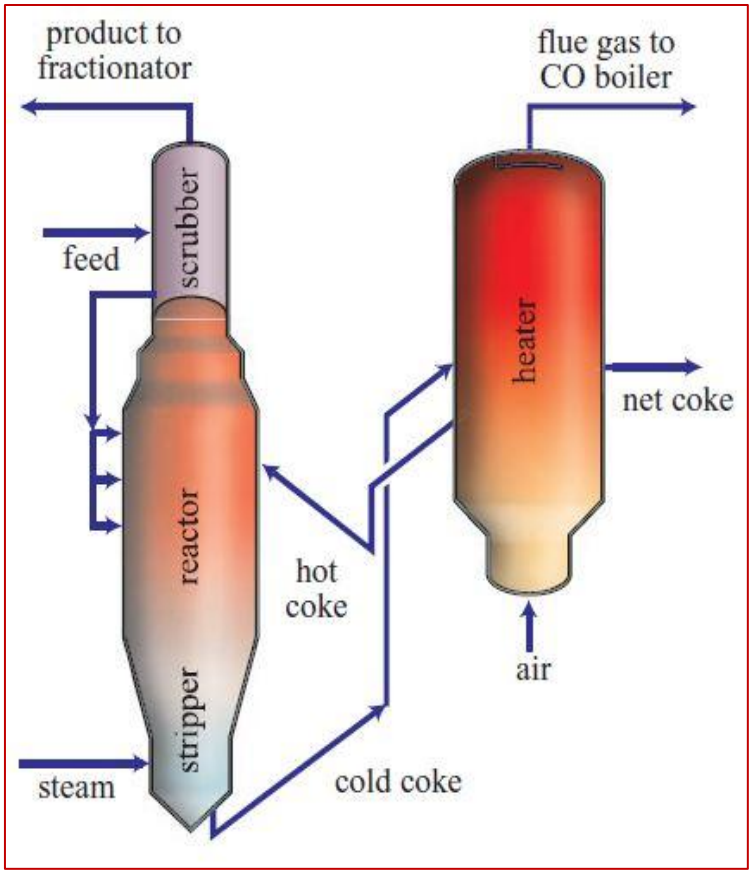
COKING

- ✓ Coking is a thermal cracking process in which a low value residual oil, such as an atmospheric or vacuum residue, is converted into valuable distillate products, off-gas and petroleum coke.
- ✓ It allows the refiner to significantly reduce the production of low value fuel oil.
- ✓ Two different classes of coking processes are implemented commercially:
  - Delayed coking, a semi continuous process;
  - Fluid Coking consists of a class of coking processes that are less widely practiced compared to delayed coking.

Refining Operations
Thermal Conversion Processes



Simplified Delayed Coking Flow Scheme



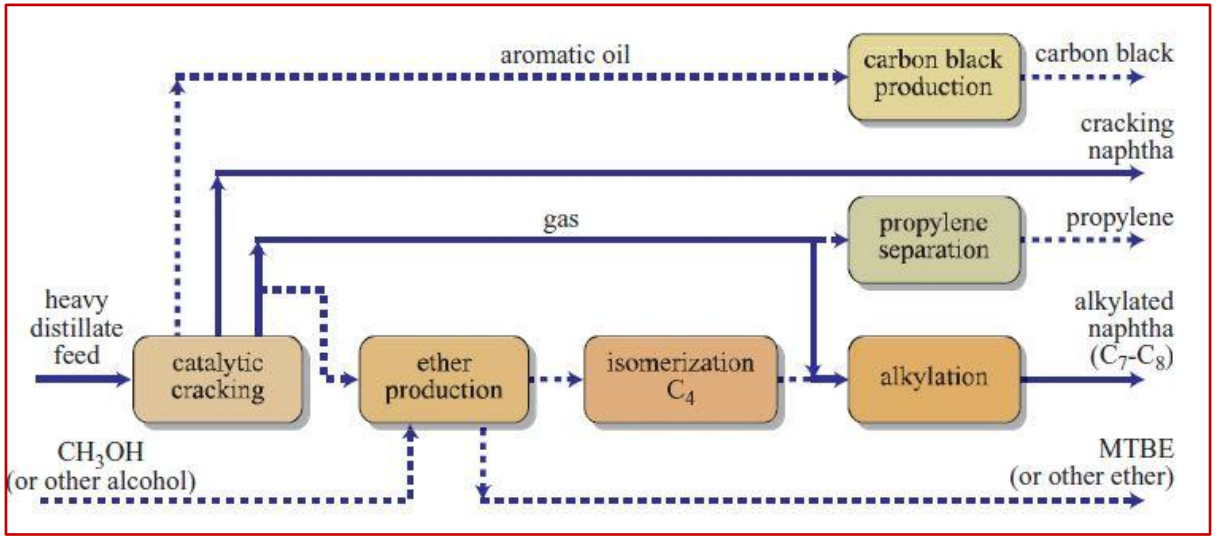
Simplified Fluid Coking Scheme

Refining Operations
Catalytic Conversion Processes

CATALYTIC CRACKING

- ✓ It remains the principal process used to convert heavy oil fractions into lighter products, especially gasoline and uses a catalyst to speed up the cracking reaction. Catalysts include zeolite, aluminum hydrosilicate, bauxite and silica-alumina.

- ✓ Typical feedstocks for catalytic cracking are the high boiling distillates obtained from vacuum distillation, and deasphalted or hydrogenated residues.



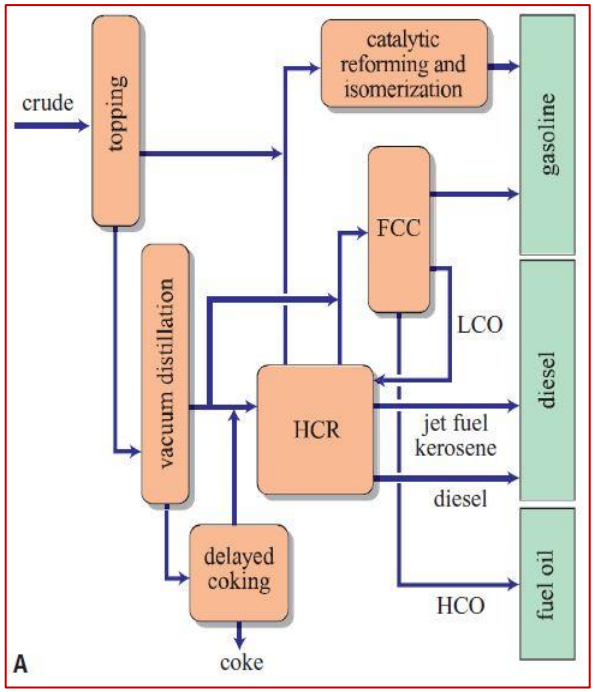
Processes downstream of catalytic cracking

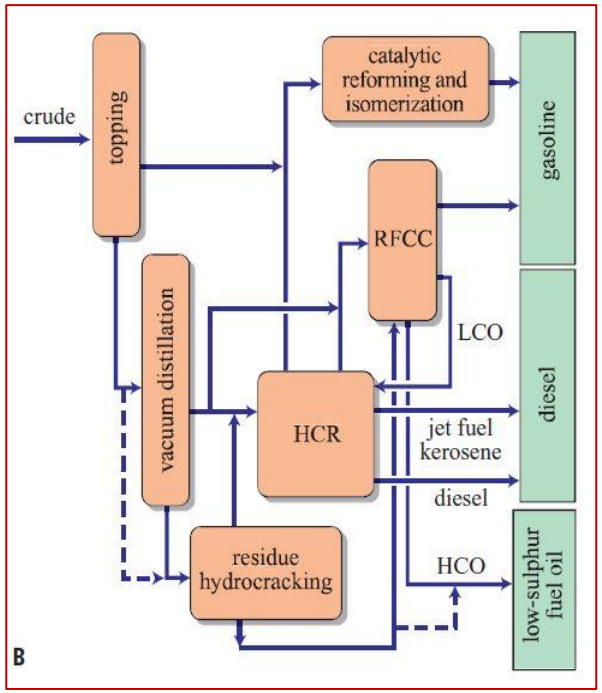
Refining Operations
Catalytic Conversion Processes

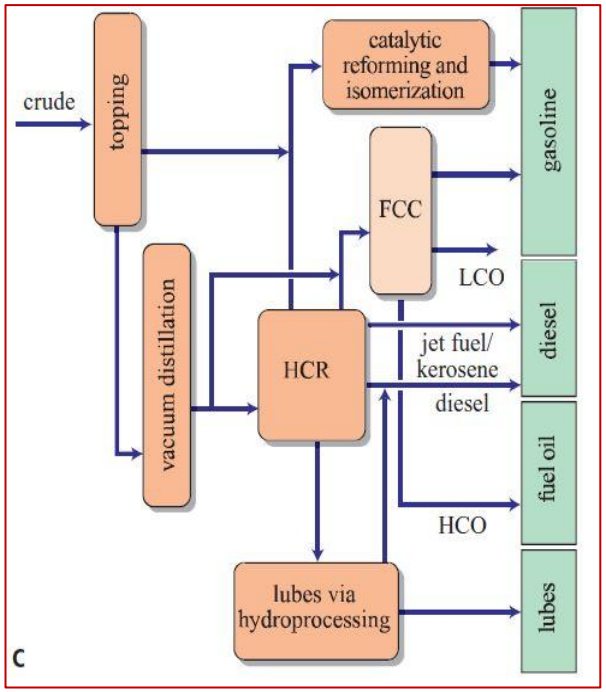
HYDROCRACKING

- ✓ Hydrocracking is a catalytic process that converts heavy oils to lighter fractions primarily by means of aromatic saturation, cracking, and isomerization reactions in the presence of hydrogen.
- ✓ It is one of two major conversion processes used in modern refining.
- ✓ Hydrocracking has been widely accepted because of its capability to produce superior quality products:
  - Highest quality middle distillates;
  - Naphthas with high naphthene content for catalytic reformer feed;
  - Lube oil base stocks;
  - Feedstocks for FCC (Fluid Catalytic Cracking) units and pyrolysis processes for ethylene production.

Refining Operations
Catalytic Conversion Processes







Hydrocracking Configurations:

A) Balanced middle distillates and gasoline production from heavy crudes with high sulphur content;
B) Balanced middle distillates and gasoline production from heavy crudes with high sulphur content;
C) Production of high-quality fuels and high-grade lubes.