TOMSK
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Classes of Refining Processes

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Plan

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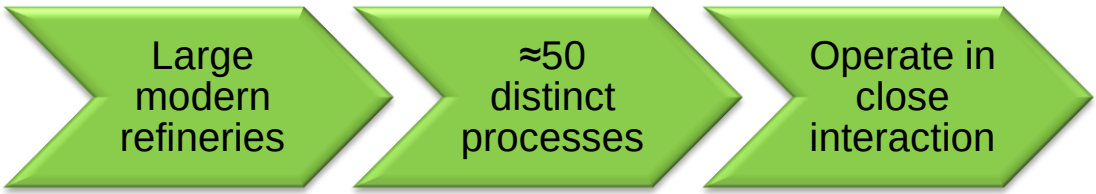
- Classes of Refining Processes
- Conversion Processes
- Upgrading Processes

Classes of Refining Processes

The physical and chemical transformations that crude oil undergoes in a refinery take place in numerous distinct processes, each carried out in a discrete facility.



Classes of Refining Processes

Table 1 – Important Classes of Refining Processes

Class	Function	Examples
Crude Distillation	♦ Separate crude oil charge into boiling range fractions for further processing	♦ Atmospheric distillation ♦ Vacuum distillation
Conversion ("Cracking")	♦ Break down ("crack") heavy crude fractions into lighter refinery streams for further processing or blending	♦ Fluid catalytic cracking (FCC) ♦ Hydrocracking
Upgrading	♦ Rearrange molecular structures to improve the properties (e.g., octane) and value of gasoline and diesel components	♦ Catalytic reforming ♦ Alkylation, Isomerization

Classes of Refining Processes

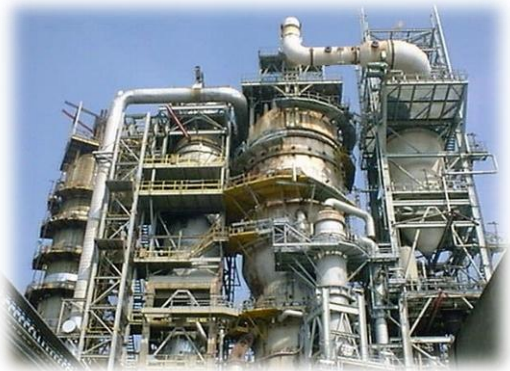
Table 1 – Important Classes of Refining Processes

Class	Function	Examples
Treating	♦ Remove hetero-atom impurities (e.g., sulfur) from refinery streams and blendstocks ♦ Remove aromatics compounds from refinery streams	♦ FCC feed hydrotreating ♦ Reformer feed hydrotreating ♦ Gasoline and distillate hydrotreating ♦ Benzene saturation
Separation	♦ Separate, by physical or chemical means, constituents of refinery streams for quality control or for further processing	♦ Fractionation (numerous) ♦ Aromatics extraction
Blending	♦ Combine blendstocks to produce finished products that meet product specifications and environmental standards	♦ Gasoline blending ♦ Jet and diesel blending
Utilities	♦ Refinery fuel, power, and steam supply; sulfur recovery; oil movements; crude and product storage; emissions control; etc.	♦ Power generation ♦ Sulfur recovery

Fluid Catalytic Cracking Unit

Uses heat and catalyst to break or «crack» large gas oil molecules into a range of smaller ones:

- **gasoline,**
- **low quality diesel stocks,**
- **residual oil - slurry (fuel oil).**



Hydrocracking

Breaks or «cracks» diesel stock material into **gasoline blending stocks** using heat, catalyst and hydrogen under very high pressure.

Coker Unit

Processes **vacuum residue**, which is heated to over 500°C and put into the coke drums, where it undergoes thermal cracking.

Products include:

- **butane,**
- **lighter material,**
- **naphtha for Reforming,**
- **turbine and diesel fuel,**
- **gas oil for FCC,**
- **fuel grade petroleum coke.**

Reforming Unit

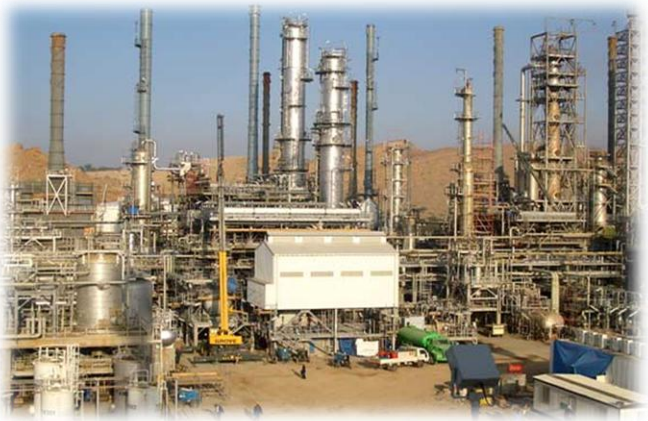
Using heat, catalyst and moderate pressure, the reformer changes the molecular structure of crude oil to produce a high octane **reformate**.

Alkylation Unit

Uses acid catalyst to combine small molecules into larger ones collectively called **alkylate**, which has a high octane numbers.

Isomerization

Rearranges the atoms in a molecule so that the product has the same chemical formula but has a different structure.



Hydrotreating

Removes impurities by using hydrogen to bind with sulfur and nitrogen.

Conversion Processes

Table 2 – Salient Features of Primary Conversion Processes

Features	FCC	Hydro-cracking	Coking
Primary Feeds			
SR Distillate	♦	♦	
SR Gas Oil	♦	♦	
SR Residual Oil			♦
Coker Gas Oil	♦		
FCC Slurry Oil		♦	♦
Process Type			
Catalytic	♦	♦	
Thermal			♦

Conversion Processes

Table 2 – Salient Features of Primary Conversion Processes

Features	FCC	Hydro-cracking	Coking
C/H Ratio Adjustment			
Carbon rejection	♦		♦
Hydrogen addition		♦	
Primary Functions			
Increase light product yield	♦	♦	♦
Produce additional FCC feed			♦
Remove hetero-atoms (including sulfur)		♦	
Sulfur Content of Cracked Products	Moderate to High	< 100 ppm	Very High

Upgrading Processes

Table 3 – Salient Features of Primary Upgrading Processes

	Reforming	Alkylation	Isomerization	Polymerization	Etherification
Primary Feeds					
SR Naphtha (med. and hvy.)	◆				
SR Naphtha (light)			◆		
Natural Gasoline			◆		
Iso-butane		◆			
C3 Olefin		◆		◆	
C4 Olefins		◆		◆	◆
Methanol / Ethanol					◆

Upgrading Processes

Table 3 – Salient Features of Primary Upgrading Processes

	Reforming	Alkylation	Isomerization	Polymerization	Etherification
Primary Products					
Gasoline Blendstock	Reformate	Alkylate	Isomerate	Poly Gasoline	MTBE
Other	Hydrogen				
Primary Functions					
Improve refinery yield of gasoline	♦	♦		♦	♦
Add octane to the gasoline pool	♦♦♦	♦♦	♦	♦	♦♦♦
Control gasoline pool octane	♦				
Produce refinery hydrogen	♦				