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# Refinery configuration

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# • Plan

**What is refinery?**

**Refineries Configuration  
and Complexity**

**Topping refineries**

**Hydroskimming  
refineries**

**Conversion refineries**

**Deep Conversion  
refineries**



# ● What is refinery?

**Petroleum (oil) refineries** transform crude oils into refined products by separating crude oils into different fractions and then processing these fractions through a sequence of physical and chemical transformations.

## Most notably refined products are:

- ✓ LPG,
- ✓ gasoline,
- ✓ jet fuel,
- ✓ diesel fuel,
- ✓ petrochemical feedstocks,
- ✓ home heating oil,
- ✓ fuel oil,
- ✓ and asphalt.





# ● Refineries Configuration and Complexity

Refineries configuration and operating characteristics are determined by:

- ✓ refinery's location,
- ✓ vintage,
- ✓ crude oil composition,
- ✓ market requirements for refined products,
- ✓ quality specifications for refined products.

## Refinery configuration

is the specific set of refining process units in a given refinery, the size or capacity of the various units, their salient technical characteristics, and the flow patterns that connect these units.



# ● Refineries Configuration and Complexity

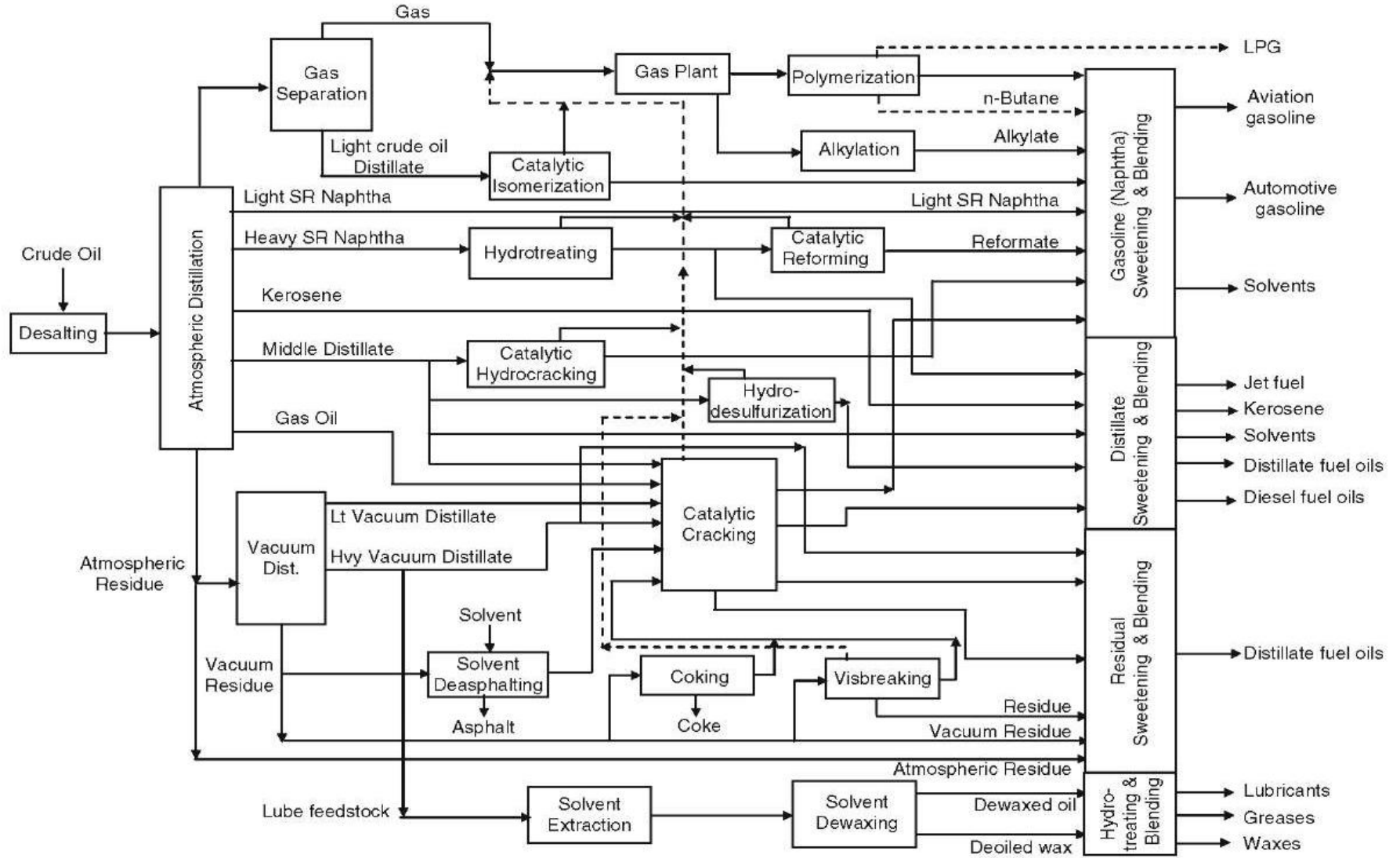


Figure 1. Scheme of modern oil refinery

# ● Refineries Configuration and Complexity

There is no two refineries have identical configurations!

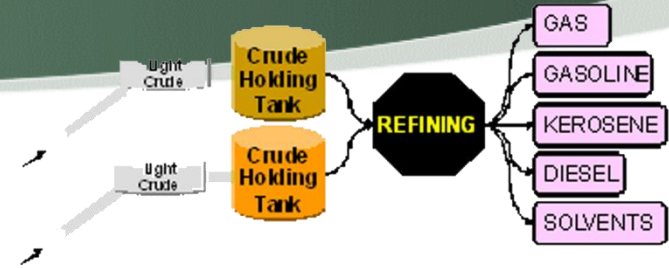


They can be classified into groups by refinery complexity.

*Table 1. Refinery Classification scheme*

Configuration	Complexity	
	Ranking	Range
Topping	Low	< 2
Hydroskimming	Moderate	2 – 6
Conversion	High	6 – 12
Deep Conversion	Very high	> 12

# ● Topping refineries



**Topping refineries** have only crude distillation and basic support operations.

- ✓ have no capability to alter the natural yield pattern of the crude oils that they process;
- ✓ simply separate crude oil into:



- ✓ have no facilities for controlling product sulfur levels;
- ✓ cannot produce ultra-low sulfur fuels.



# ● Hydroskimming refineries

**Hydroskimming refineries** include not only crude oil distillation and support services but also catalytic reforming, various hydrotreating units, and product blending.

- ✓ enable upgrading naphtha to gasoline and controlling the sulfur content of refined products;

## **Catalytic reforming**

upgrades straight run naphtha to meet gasoline octane specification and produces by-product hydrogen for the hydrotreating units.

## **Hydrotreating units**

remove sulfur from the light products (including gasoline and diesel fuel) to meet product specifications and/or to allow for processing higher-sulfur crudes.

- ✓ commonplace in regions with low gasoline demand;
- ✓ have no capability to alter the natural yield patterns of the crudes they process.



# ● Conversion (cracking) refineries


**Conversion (cracking) refineries** include not only all of the processes present in hydroskimming refineries but also catalytic cracking and/or hydrocracking.

These processes transform heavy crude oil fractions (primarily gas oils) into light refinery streams that go to gasoline, jet fuel, diesel fuel, and petrochemical feedstocks.

- ✓ have the capability to improve the natural yield patterns of the crudes they process;
- ✓ still produce some heavy, low-value products, such as residual fuel and asphalt.

# ● Deep Conversion (coking) refineries

**Deep Conversion (coking) refineries** include not only catalytic cracking and/or hydrocracking to convert gas oil fractions, but also coking.



**Coking units** “destroy” the heaviest and least valuable crude oil fraction (residual oil) by converting it into lighter streams that serve as additional feed to other conversion processes and to upgrading processes that produce the more valuable light products.

✓ destroy essentially all of the residual oil, converting them into light products.

# ● Refineries Configuration and Complexity

**Table 2. Refinery classes and characteristic yield patterns**

Refinery Category	Characteristic Processes	Product Yield Profile (vol%)		Comments
		Gasoline	Diesel & Jet	
<b>Topping</b>	Crude distillation	31	30	<ul style="list-style-type: none"> <li>◆ Product sulfur levels same as crude fraction sulfur levels</li> <li>◆ Product yields and quality determined solely by crude properties</li> <li>◆ Gasoline has low octane</li> </ul>
<b>Hydroskimming</b>	Crude distillation Reforming Hydrotreating	28	30	<ul style="list-style-type: none"> <li>◆ Product sulfur levels controllable by hydrotreating</li> <li>◆ Some capability to improve product yields and quality</li> <li>◆ Gasoline octane improved by reforming</li> </ul>
<b>Conversion</b>	Crude distillation FCC and/or hydrocracking Reforming Alkylation & other upgrading Hydrotreating	44	32	<ul style="list-style-type: none"> <li>◆ Product sulfur levels controllable by hydrotreating</li> <li>◆ Substantial capability for yield and quality improvement</li> </ul>
<b>Deep Conversion</b>	Crude distillation Coking FCC and/or hydrocracking Reforming Alkylation & other upgrading Hydrotreating	47	42	<ul style="list-style-type: none"> <li>◆ Product sulfur levels controllable by hydrotreating</li> <li>◆ Maximum yields of high-value refined products</li> <li>◆ Maximum capability for quality improvement</li> <li>◆ Essentially all residual oil "destroyed"</li> </ul>