



Process Descriptions of Refinery Processes

Process Description of the Crude Distillation Unit

Lecture 4

Process Description of the Crude Distillation Unit

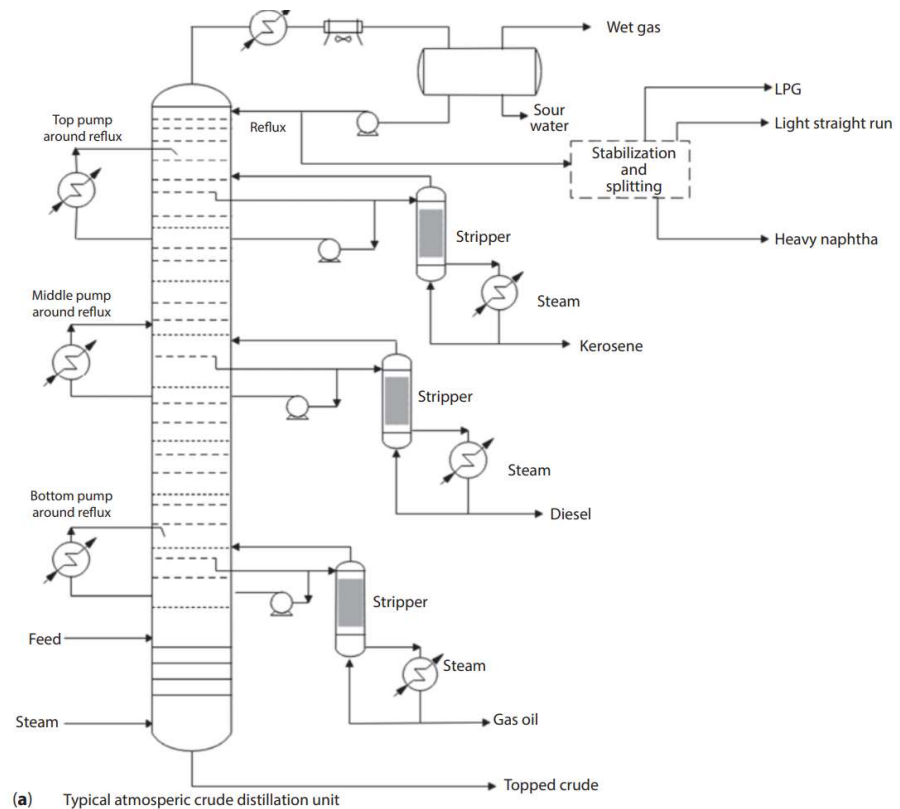
- Crude oil distillation columns are in various sizes and the capacities for processing the feed range from 5,000 to 10,000 barrels per day (700 to 1,400 metric tons per day) to 400,000 barrels per day (56,000 metric tons per day).
- The first stage in the processing of crude oil is referred to as crude distillation units (CDUs), crude topping units (CTUs), topping units, atmospheric crude distillation units, atmospheric pipe-stills, etc.

Typical refinery products.

Name/abbreviation	Major uses
Crude oil (Arab light)	To obtain various products, e.g., Liquefied Petroleum Gas (LPG), naphtha, gasoline, kerosene, diesel, fuel oil, tar and sulfur.
Natural gas (NG)	To produce hydrogen and various petrochemicals, e.g., methanol (CH_3OH), ethylene (C_2H_4), ammonia (NH_3), etc. As a heating source in boilers and furnaces. To drive gas turbines.
Liquefied Petroleum Gas (LPG)	Domestic use: for cooking and heating. Industrial use: to produce petrochemicals, intermediates and for blending in gasoline.
Chemical Feed Naphtha (CFN)	As feed to various petrochemicals and plastic industries (as an alternative to natural gas).
Motor Gasoline Component Naphtha (MGC)	Fuel for vehicles. For the manufacture of aviation gasoline, aromatics (e.g., Benzene C_6H_6 , Toluene C_7H_8), Xylene (C_8H_{10}), i.e. BTX).
Dual Purpose Kerosene, illuminating kerosene, Jet Fuels (DPK, KERO, JET A1)	Domestic use—cooking, illuminating, heating, Jet aviation fuel, manufacturing detergents, paint thinner, carbon black, etc.
Auto Diesel Oil (ADO)/Gas oil (GO)	As a heating oil in cold countries, fuel for trucks, trains power generators.
Heavy Fuel Oil (HFO)	Fuel for ships, power generators, boilers and furnaces.
Sulfur (solid)	For the manufacture of fertilizers, match sticks, explosives, sulfuric acid (H_2SO_4) and pharmaceuticals.
Benzene (C_6H_6) pure aromatic compound.	For the manufacture of petrochemicals, e.g., styrene, pesticides, dye intermediates, detergents, resins, solvents.

CDU Steps

- The CDU is accomplished in multi-draw columns (strippers) for which all the heat is supplied to the feed.
- The products are condensed and withdrawn as side products, as the hot vapor portion of the feed are contacted with colder liquid reflux flowing down the column.
- The reflux is provided at the top of the flask by pumping some of the condensed liquid back to the top tray (Figure beside).
- The reflux is also provided at intermediate locations in the column with pump around cooling circuits.
- The hot liquid portions of the crude oil feed are stripped with steam to remove dissolved light hydrocarbons before leaving the bottom of the column

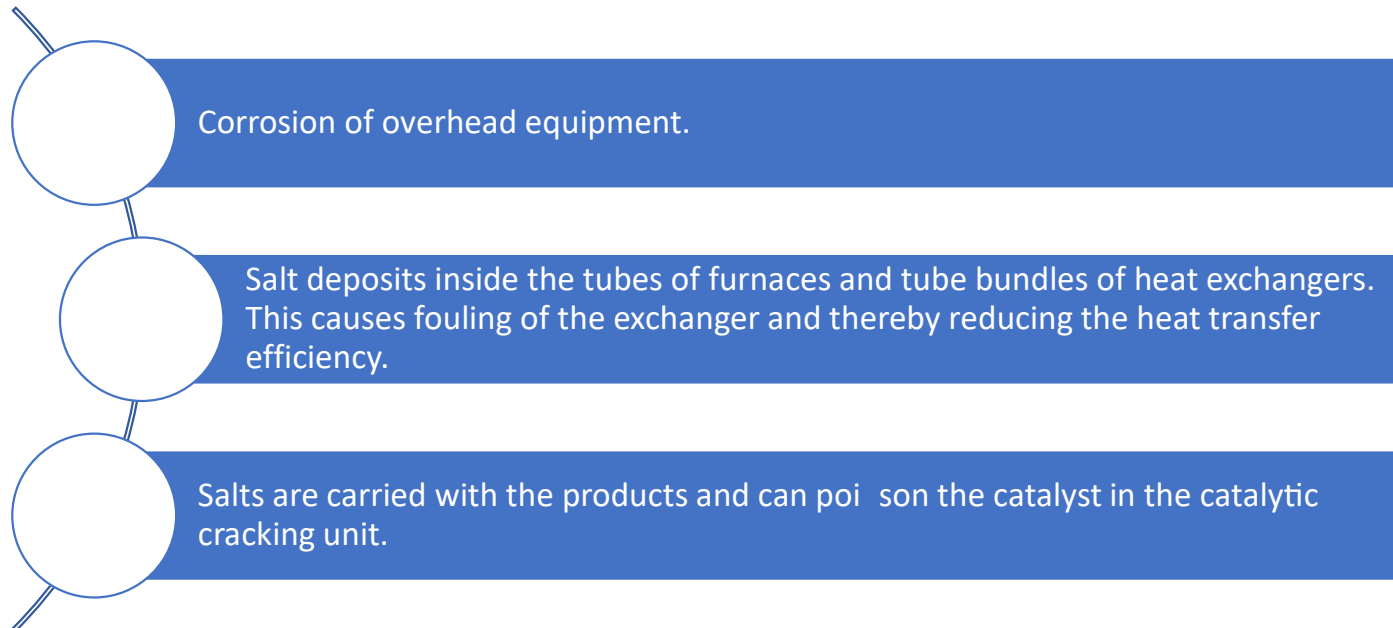


Crude Oil Desalting

- Crude oil carries with it some brine in the form of very fine water droplets emulsified in the crude.
- The salt content of the crude measured in pounds per thousand barrels (PTB) can be as high as 2000.
- Desalting of crude oil is an important part of the refinery operation as the salt content should be minimized to 5.7 and 14.3 kg/1000 m³ (i.e., 2 and 5 PTB).

What are the impacts of poor desalting?

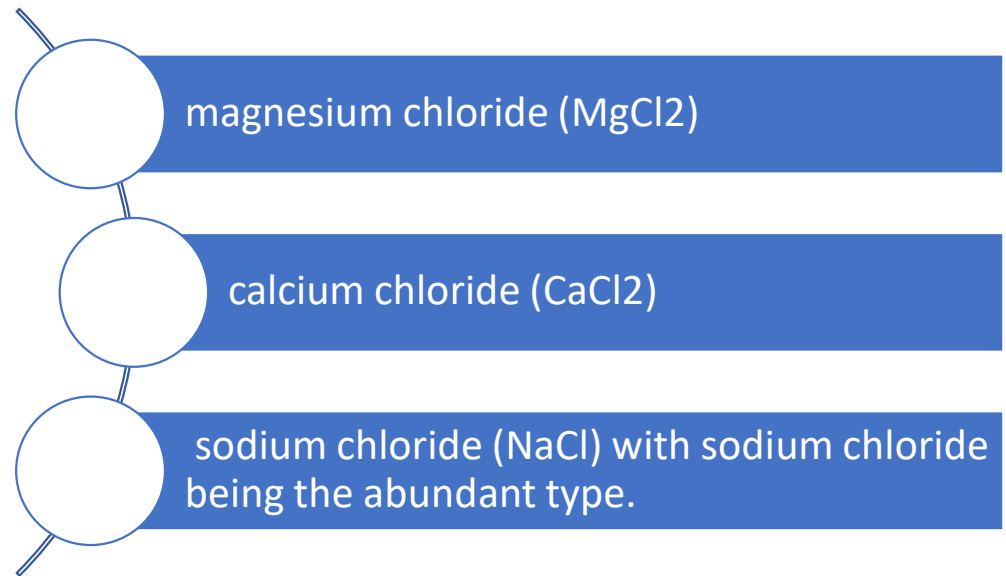
- Poor desalting of the crude could adversely impact on the following:



Types of Salts in Crude Oil

- Salts in the crude oil are mostly in the form of dissolved salts in fine water droplets emulsified in the crude.
- This is referred to as water-in-oil emulsion, where the continuous phase is the oil, and the dispersed phase is the water.
- The water droplets are relatively tiny such that they cannot settle by gravity.
- These fine droplets have on their surfaces the big asphaltene molecules with the fine solid particles coming from sediments, sand or corrosion products.
- The presence of these molecules on the surface of the droplets acts as a protector that prevents the droplets from uniting with each other in what is referred to as coalescence.
- Furthermore, the salts can be in the form of crystals that are suspended in the crude. Removing the salts requires that they must be ionized in the water. Therefore, wash water is added to the crude to enhance the desalting process

HCl dissolves in the overhead system water producing hydrochloric acid, which is extremely corrosive



These chlorides except NaCl hydrolyze at high temperatures to hydrogen chloride (HCl):

