PROFESSIONAL COURSE IN ENGLISH
“FUNDAMENTALS OF PETROLEUM REFINING”

Unit 7. Vaccum Distillation of Crude

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Introduction

- To extract more distillates from the atmospheric residue, the bottom from the atmospheric crude distillation unit is sent to the vacuum distillation unit.
Introduction
Vacuum distillation products

The vacuum unit distillates are

- light vacuum gas oil
- medium vacuum gas oil
- heavy vacuum gas oil
- vacuum residue

If the distillates are feed to down stream conversion process, their the sulphur, metal and asphaltene content should be reduced by [hydrotreating](#) or [hydroprocessing](#).

In some refineries the whole atmospheric residue is hydroprocessed before vacuum distillation.
Vacuum distillation products

- The vacuum unit can also be used to produce lubrication oil grade feed stocks.

- This depends on the quality of the crude oil feed to the refinery as only special types of crude can produce lube grade feed stocks.
Process Description

- The atmospheric residue can be sent directly to the vacuum unit after heat extraction in the crude preheat exchangers train.

- If the atmospheric residue is sent to storage, the temperature should not be below 150 °C to control the viscosity necessary for proper flow.
Process Description

- The atmospheric residue is heated in several exchangers by the hot products and pumparounds of the vacuum unit.
- Final heating to 380–415 °C is done in a fired heater.
Process Description

- To minimize thermal cracking and coking, steam is injected in the heater tube passes.
- The feed enters the vacuum tower at the lower part of the column.
Process Description

- As in case of atmospheric distillation, a 3–5 vol% overflash is maintained.
- This is to provide some fractionation between the heavy vacuum gasoil drawoff tray and the flash zone, thereby controlling its end point.
Process Description

- The distillate is withdrawn as light vacuum gasoil and two other cuts, medium vacuum gasoil and heavy vacuum gasoil.
Process Description

- Vacuum distillation columns are equipped with packing for fractionation and heat exchange zones.

- This is to reduce the pressure drop in the column which is necessary for creating a low vacuum in the lower section of the column.

- The bottom zone is equipped with valve trays.
Process Description

- The vapours from the flash zone go through a wash and fractionation zone where the heavy ends are condensed with heavy gasoil reflux.

- Further up, the column sections (consisting of a heat exchange and fractionation zone) are separated by sprays of liquid from the pumparound or the internal reflux.
**Process Description**

- Vacuum distillation units have a system to create the vacuum that uses either ejectors or a combination of ejectors and liquid ring pumps.

- Ejectors recompress the gases through a nozzle where vapours from the column are sucked into the venturi section of the nozzle by a stream of medium or low pressure steam.
Process Description

- The vapour phase at the ejector exit is partially condensed in an exchanger with cooling water.

- The liquid phase is then sent to the overhead drum.

- The vapour phase goes from the condenser to another ejector-condenser stage.
Process Description

- Liquid ring pumps are similar to rotor gas compressors.

- One pump can replace two or three stages of ejectors in dry or wet type vacuum distillation.

- They do not use steam and can significantly reduce hydrocarbon-rich aqueous condensates in a system using ejectors.
Process Description

- Systems with ejectors are much more flexible and rapid to put into operation.

- The higher investments required by liquid ring pumps are offset by reduced steam consumption and lower installation costs.
**Gas oils**

- Boiling range is 150 to 450 °C
- Carbon numbers range is $C_9$ to $C_{30}$

**Gas oils contain**

- Straight and branched chain alkanes
- Cycloalkanes
- Aromatic hydrocarbons
- Olefins
- Polyaromatic compounds

**Gas oils application**

- Fuel oil to substitute coal in
  - industrial furnaces
  - domestic heaters
  - ships
  - locomotives