TOMSK POLYTECHNIC UNIVERSITY

PROFESSIONAL COURSE IN ENGLISH

"FUNDAMENTALS OF PETROLEUM REFINING"

Unit 7. Vaccum Distillation of Crude

Assistant teacher, Candidate of Engineering Science
Belinskaya Nataliya Segeevna

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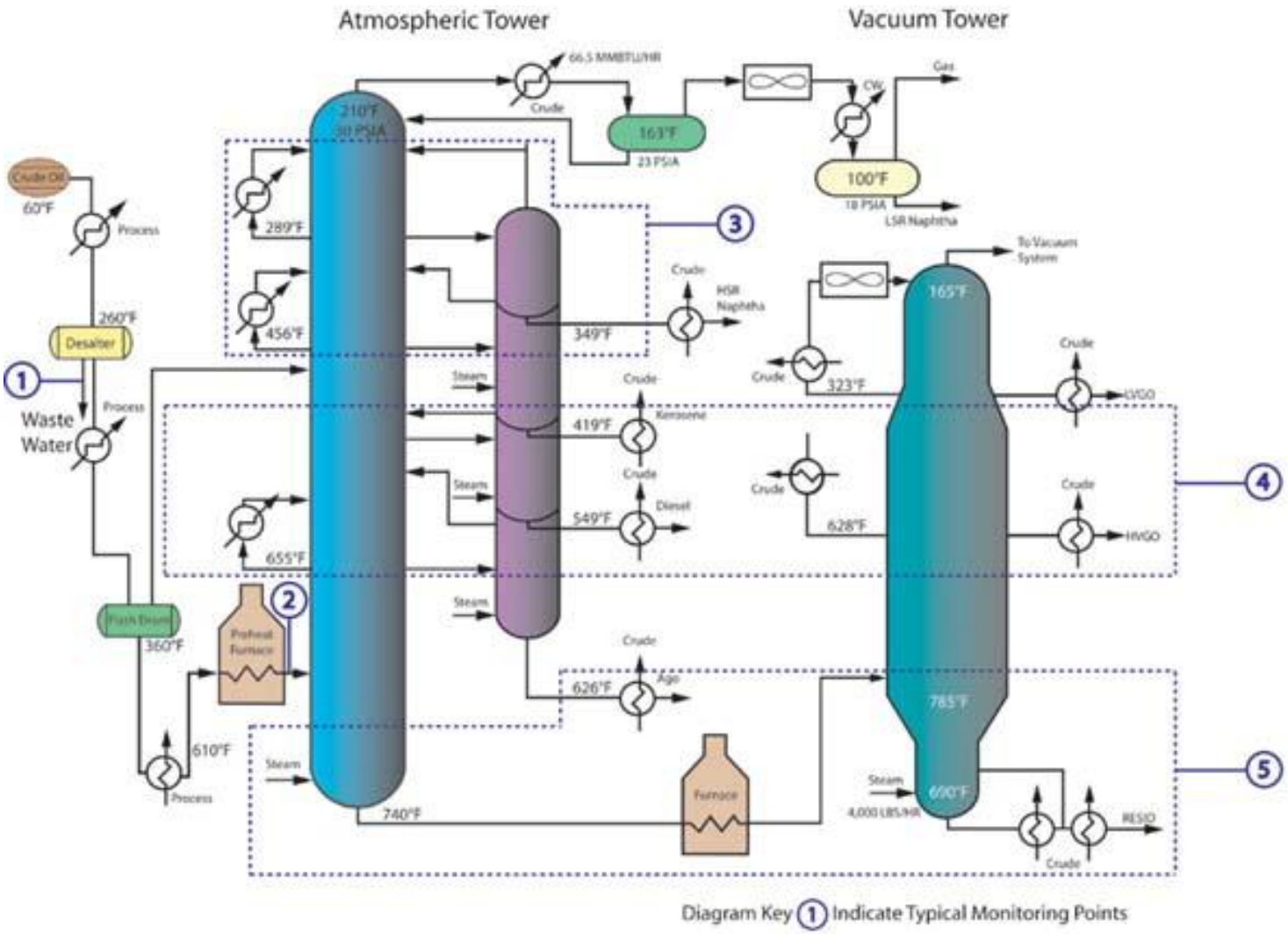
Introduction

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

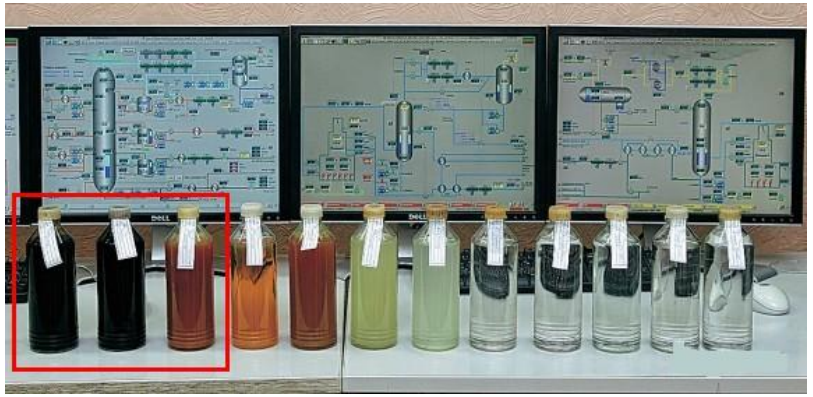
Introduction



Vacuum distillation products

The vacuum unit distillates are

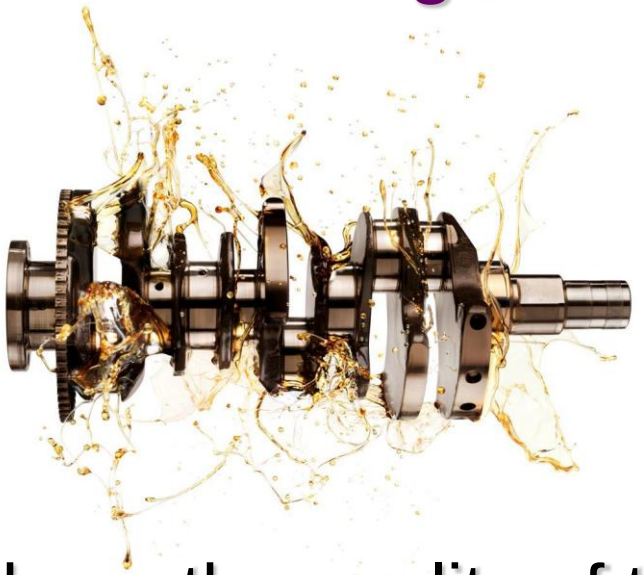
- light vacuum gas oil
- medium vacuum gas oil
- heavy vacuum gas oil
- vacuum residue



- 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**.



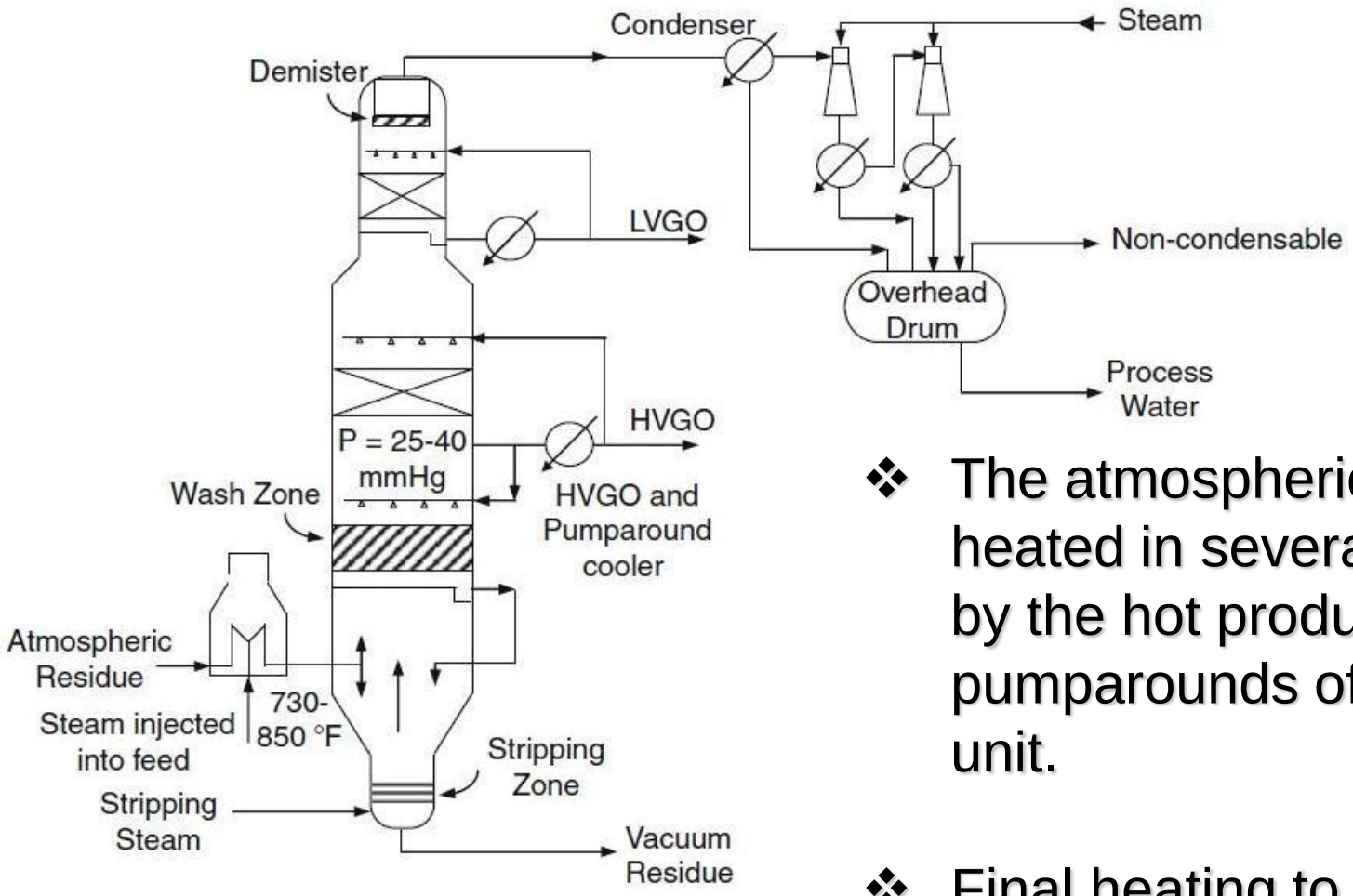
- This depends on the quality of the crude oil feed to the refinery as only special types of crude can produce lube grade feed stocks.

Process Description

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

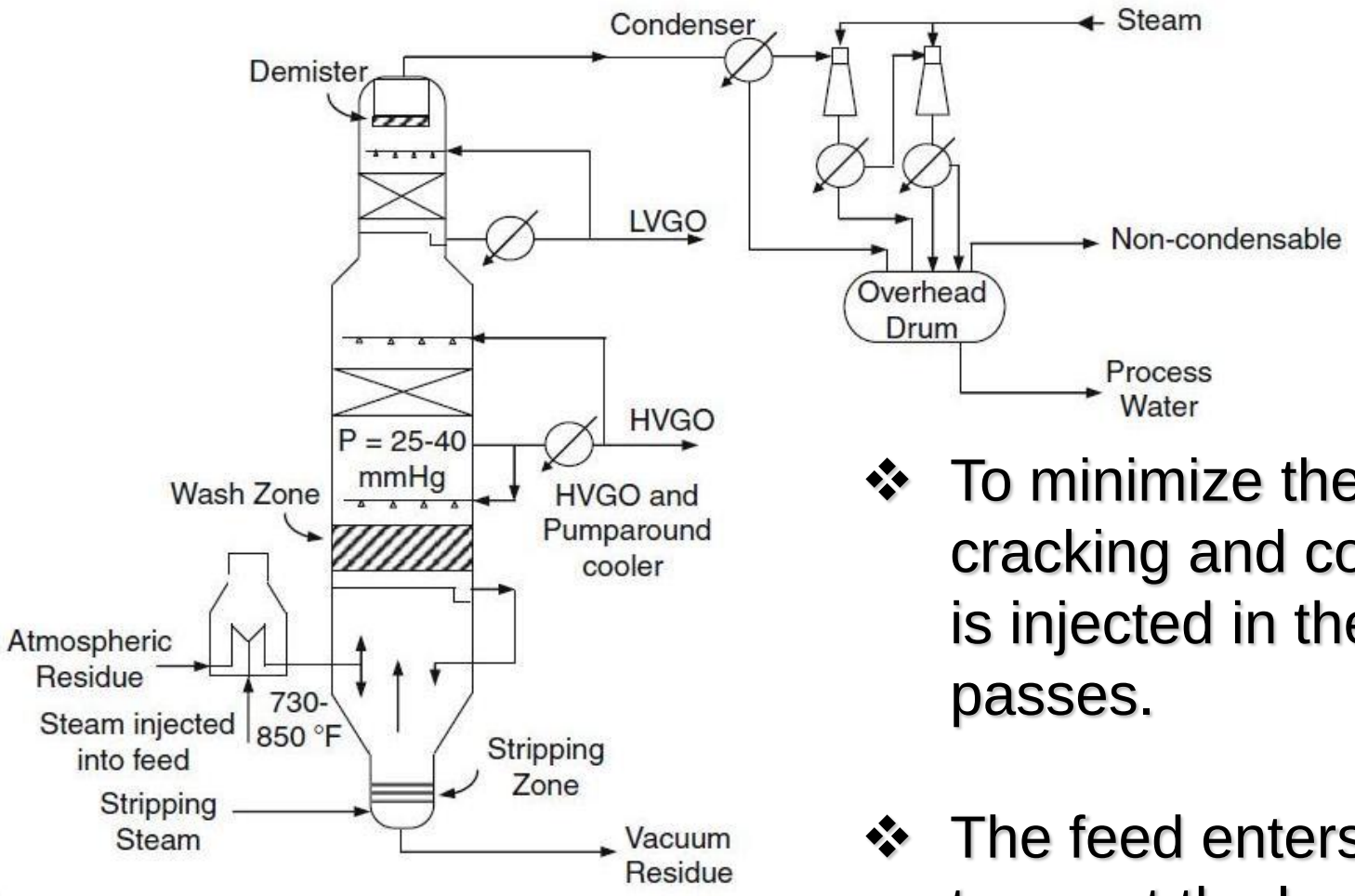
- If the atmospheric residue is sent to storage, the temperature should not be below 150 ºC to control the viscosity necessary for proper flow.

Process Description



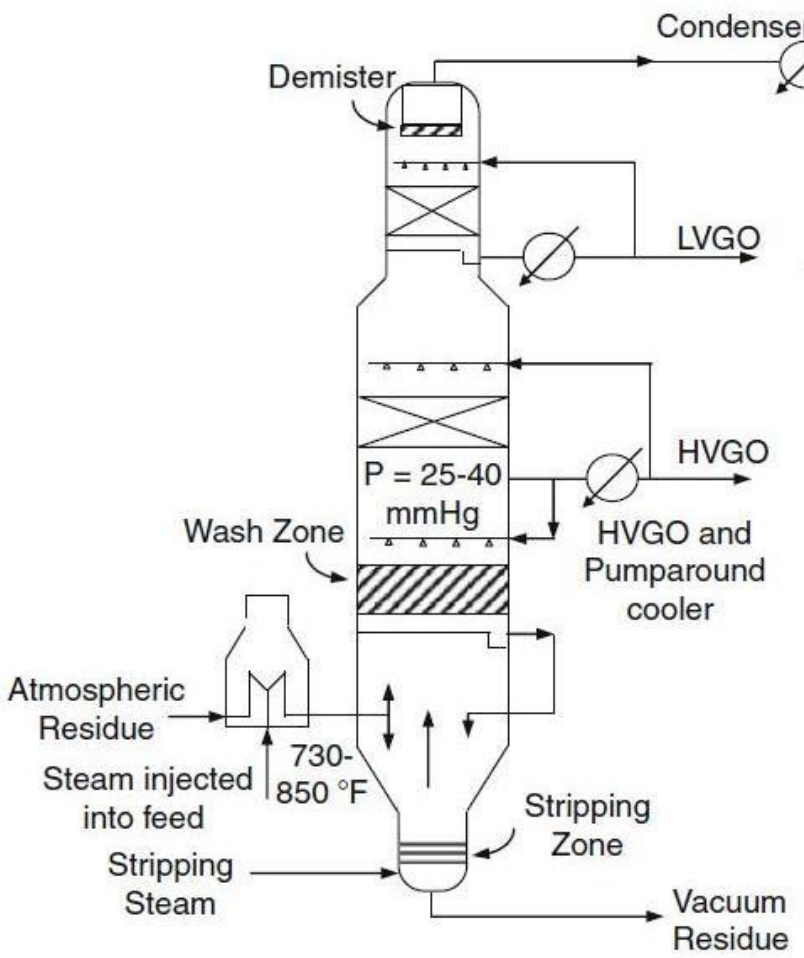
- The atmospheric residue is heated in several exchangers by the hot products and pumparounds of the vacuum unit.
- Final heating to 380–415 ºC is done in a fired heater.

Process Description



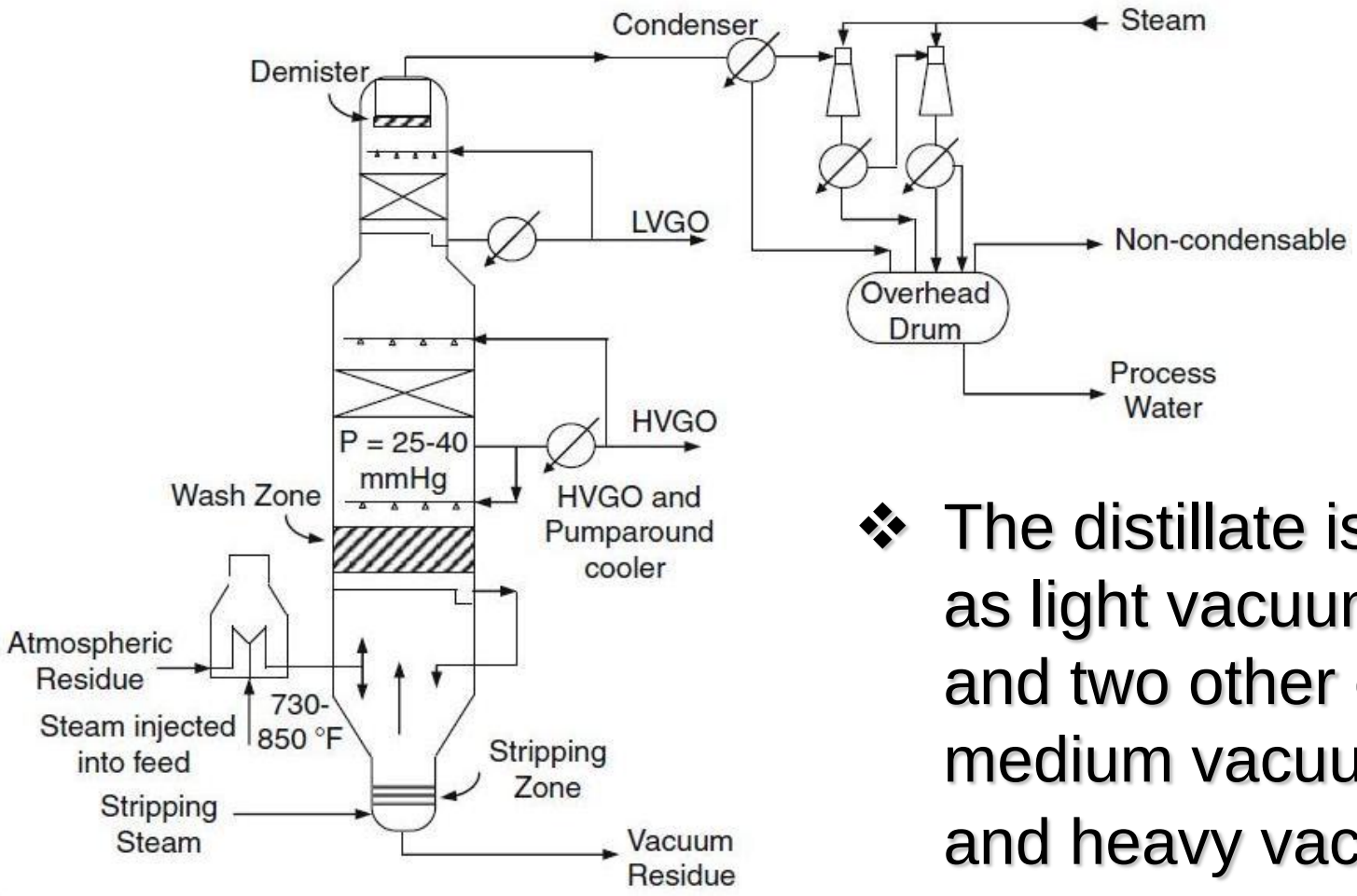
- To minimize thermal cracking and coking, steam is injected in the heater tube passes.
- The feed enters the vacuum tower at the lower part of the column.

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