



Thermal Cracking Processes Steam Jet Ejectors

Lecture 11

Steam Jet Ejector

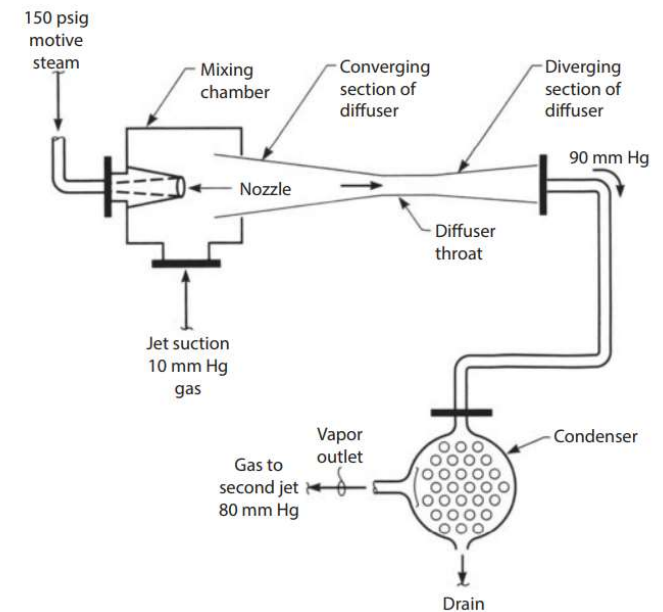
- The ejector gas load consists of two sources:

air in-leakage

- The amount of air sucked into the system is independent of throughput.

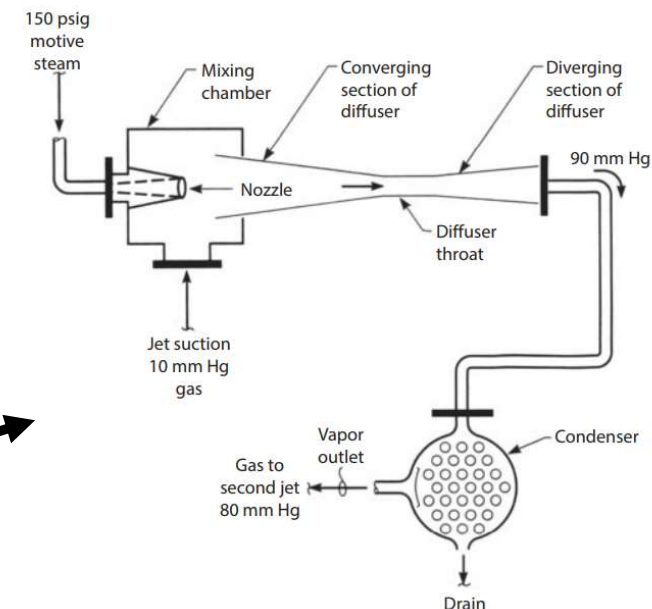
uncondensed gas

- The uncondensed gas that results from thermal cracking of the vacuum column charge in the preheat furnace is proportional to the load on the ejector interstage condensers and hence the feed rate.



Explain the Steam Jet Ejectors Operation

- The convergent-divergent steam jet is rather like a two-stage compressor with no moving parts [4]. The figure in the previous slide shows a simplified steam jet ejector, where high-pressure motive steam enters through a steam nozzle.
- As the steam flows through this nozzle, its velocity greatly increases as it flows to the condenser. The condenser condenses the steam at a low temperature and low pressure. The steam accelerates toward the cold surface of the tubes in the condenser, where its large volume will disappear as the steam turns to water. The motive steam accelerates to such a great velocity that it can exceed the speed of sound (i.e., sonic velocity). This high increase in velocity of the steam represents a tremendous increase in kinetic energy of the steam. The source of this kinetic energy is the pressure of the steam.
- As the high-velocity steam enters the mixing chamber (Figure), it produces an extremely low pressure. The gas flows from the jet suction nozzle and into the low pressure mixing chamber. The rest of the jet is used to boost the gas from the mixing chamber up to the higher pressure in the condenser, which is carried out in two compression steps: converging and diverging.



Demonstration for the Steam Jet Ejectors



Steam Jet Ejector

What will happen if an ejector is not overloaded at a normal gas rate?

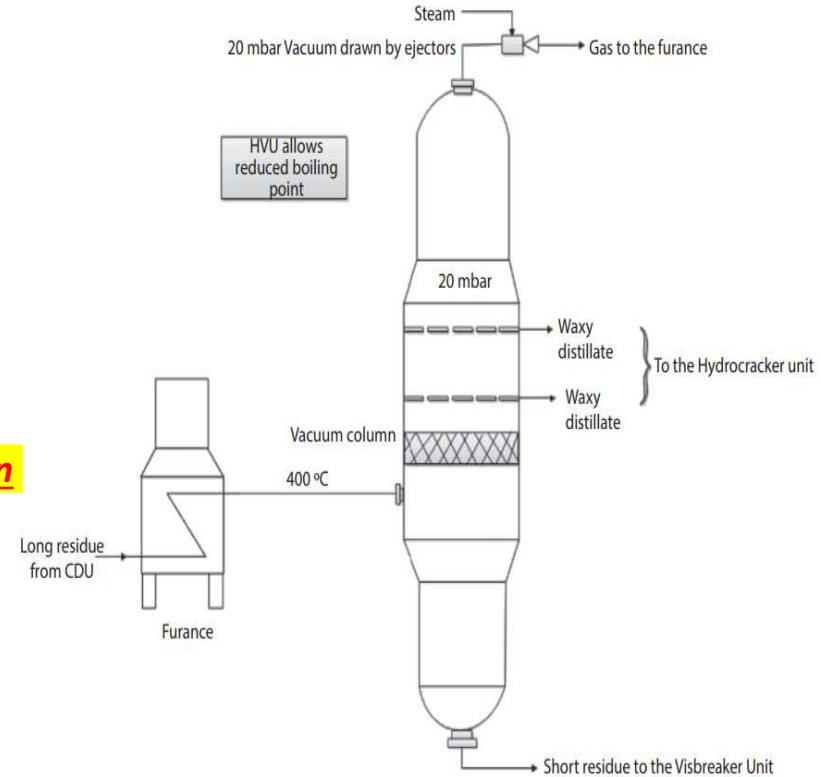
- If an ejector is not overloaded at a normal gas rate, reducing the gas load will not result in the greatly improved vacuum. The ejector is simply oversized at the lower charge rate and wastes steam without obtaining any appreciable benefit in lower vacuum tower pressure.

For what purpose steam jet ejectors are employed?

- Steam jet ejectors are employed to recompress low pressure steam to a higher-pressure steam. They are sometimes used to compress low pressure hydrocarbon vapors to higher-pressure hydrocarbon gas.

Vacuum Distillation Unit –Production of Waxy Distillate

- 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 vapors from the column are sucked into the venturi section of the nozzle by a stream of medium- or low-pressure steam.
- The vapor phase at the ejector exit is **partially condensed in an exchanger with cooling water.**
- The liquid phase flows to the overhead drum. The vapor phase goes from the condenser to another ejector-condenser stage.



Vacuum Distillation Unit – Production of Waxy Distillate

- 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 therefore reduce hydrocarbon-rich aqueous condensates in a system using ejectors.
- Systems with ejectors are flexible and easy to operate.
- The higher investments required by liquid ring pumps are offset by steam consumption and lower installation costs.

