Title:Liquefaction of gases

Course:B.Sc part 2 Chemistry (Hons.)

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LIQUEFACTION OF GASES

The Joule Thomson effect is of great practical importance in the liquefaction of gases.

Two processes - Linde's process and Cloude's process

Joule-Thomson effect

- ***When a gas under high pressure is allowed to expand under adiabatic conditions through a porous plug into a region of low pressure, there occurs a change in its temperature. This phenomenon is termed Joule-Thomson effect.***
- The difference in temperature observed is proportional to the pressure difference maintained.
- A gas gets cooled by Joule Thomson adiabatic expansion only if its temperature below a certain characteristic temperature. This temperature is called its **inversion temperature (*T*$_i$)**.

$$T_i = \frac{2a}{Rb}$$

LINDE'S PROCESS:

- Linde's process is based on **Joule-Thomson effect.**

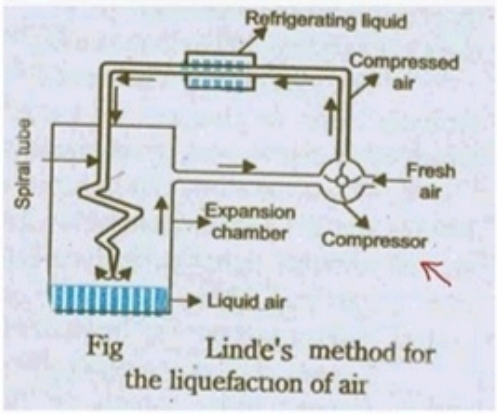


Fig Linde's method for the liquefaction of air

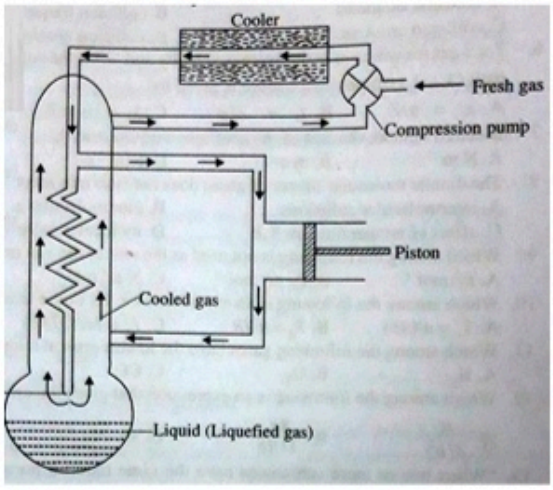
- The pure gas is compressed to about 200 atmospheres and passed through a water-cooled pipe to remove the heat of compression.
- It is then passed through a spiral pipe having a jet at the end. Through the jet, the gas expands out into a region of low pressure.
- In this process, it gets cooled by Joule-Thomson effect. This cooled gas passes up over the spiral, thereby externally cooling the incoming compressed gas, and is returned to the compression pump.
- Repetition of this cycle liquefy the gas.

Claude's process:

In Claude's process for the liquefaction of a gas, the required low temperature is produced by allowing the gas

(i) to perform mechanical work in an adiabatic expansion engine and

(ii) to expand adiabatically through a narrow jet into a region of low pressure, below its inversion temperature (Joule Thomson effect).



In both cases, cooling occurs because some work is done by the gas in overcoming the intermolecular attraction at the cost of the kinetic energy of its molecules.