THERMODYNAMIC PROCESSES

3.4.-TYPES OF THERMODYNAMIC PROCESSES

3.4.1-Isochoric process (Constant volume process)

3.4.2-Isobaric process (Constant pressure process)

3.4.3-Isothermal process (Constant temperature process)

3.4.4-Adiabatic process

3.4.5-Hyperbolic process

3.4.6-Polytropic process

THERMODYNAMIC PROCESSES

INTRODUCTION

When the system changes from one thermodynamic state to the final thermodynamic state due to change in pressure, temperature, volume etc, the system is said to have undergone thermodynamic process. The various types of thermodynamic processes are: isothermal process, adiabatic process, isochoric process, isobaric process and reversible process.

3.4-TYPES OF THERMODYNAMIC PROCESSES

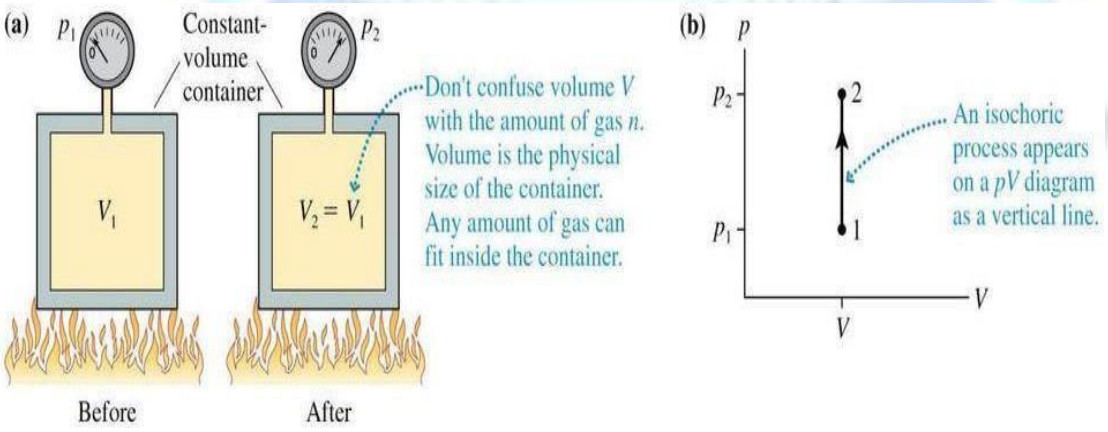
The important thermodynamic processes are:

A. Reversible non-flow processes

1. Isochoric process (Constant volume process)
2. Isobaric process (Constant pressure process)
3. Isothermal process (Constant temperature process)
4. Adiabatic process
5. Hyperbolic process
6. Polytropic process
7. Throttling process

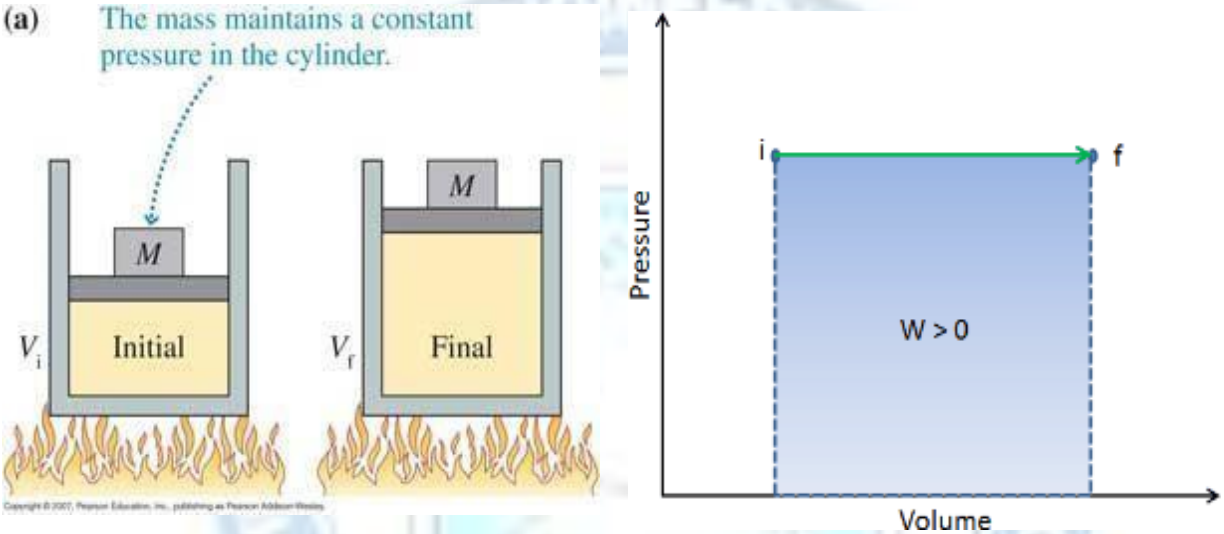
3.4.1-Isochoric process (Constant volume process)

In this process the volume of system remains constant. The main characteristic of this process is that the displacement work is eliminated. An example of this process is the heating or cooling of a gas stored in a rigid cylinder. Since the volume of the gas does not change, no external work is done, and work transferred W is zero.



3.4.2-Isobaric process (Constant pressure process)

The process, during which the pressure of the system remains constant, is called as isobaric process. If the temperature of a gas is increased by the addition of heat while the gas is allowed to expand so that its pressure is kept constant, the volume of the gas will be increase in accordance with Charles law. Since the volume of the gas increases during the process, work is done by the gas at the same time that its internal energy also changes. Therefore for constant pressure process, assuming constant specific heats and ideal gas behaviour,

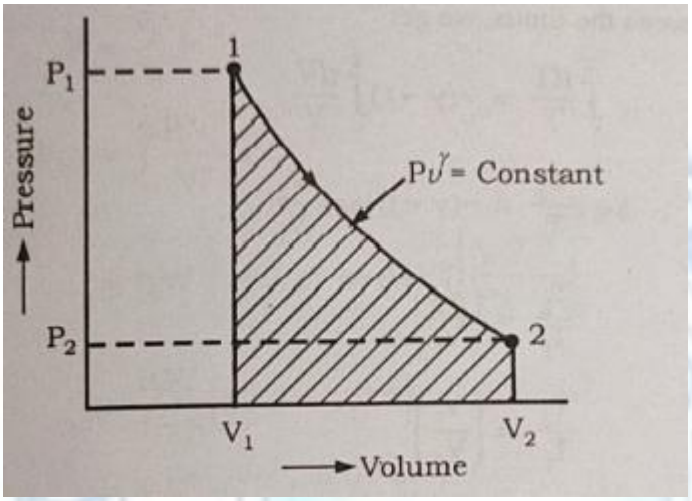


3.4.3-Isothermal process (Constant temperature process)

According to Boyle's law, when a gas is compressed or expanded at constant temperature, the pressure will vary inversely with the volume. Since the gas does work as it expands, if the temperature is to remain constant, energy to do the work must be supplied from an external source. When a gas is compressed, work is done on the gas and if the gas is not cooled during the process the internal energy of the gas will increase by an amount equal to the work of compression. Therefore if the temperature of the gas is to remain constant during the process gas must reject heat to the surroundings. Since there is no temperature increase in the system change in internal energy becomes zero. And the amount of work done will be the amount of heat supplied.

3.4.4-Adiabatic process

The process during which work is done and no heat is transferred across the system boundary is known as adiabatic process.



Condition for isentropic process:

1. The process should be frictionless.
2. No heat should be transferred.
3. Work should be done by the gas or on the gas.
4. In real practice, isentropic process is not possible.

3.4.5-Isentropic Process

If an adiabatic process is reversible then it is called Isentropic process i.e., reversible adiabatic process is known as isentropic process. For an adiabatic process to qualify as isentropic process, then it should be frictionless. All the other properties of this process are same as that of adiabatic process.

3.4.6-Polytropic process

It is found that in actual practice many processes approximate to a reversible process of the PV^n = Constant, where n is called polytropic index. Both vapours and perfect gases follow this type of process closely.