PHYSICS

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miso study

01. Isothermal Process

An isothermal process is one, in which the pressure and volume of the system change but temperature remains constant.

To carry out isothermal process, a perfect gas is contained in a cylinder having ***conducting walls*** and the gas is compressed or allowed to expand ***very slowly.***

When a gas is allowed to expand slowly, the temperature of the gas will remain unchanged. When the gas is compressed, heat will be produced. If the gas is compressed slowly then the temperature of the gas will remain unchanged.

Therefore, for an isothermal process to take place :

(i) *The cylinder should have conducting walls.*

(ii) *The gas should be compressed or allowed to expand very slowly.*

02. Equation of Isothermal Process

For one mole of an ideal gas,

$$PV = RT$$

In an isothermal process, temperature remains constant. Therefore, for an isothermal process,

$$PV = \text{constant}$$

The equation is called the ***equation of an isothermal process*** for an ideal gas.

If P_1 and V_1 are initial pressure and volume ; and P_2 and V_2 are their final values, then during an isothermal change,

$$P_1 V_1 = P_2 V_2$$

The internal energy is function of temperature only. Since temperature does not change during an isothermal process, there is no change in the internal energy of the gas *i.e.* $dU = 0$.

$$dQ = 0 + P\,dV$$

$$dQ = P\,dV$$

03. Work Done During Isothermal Process

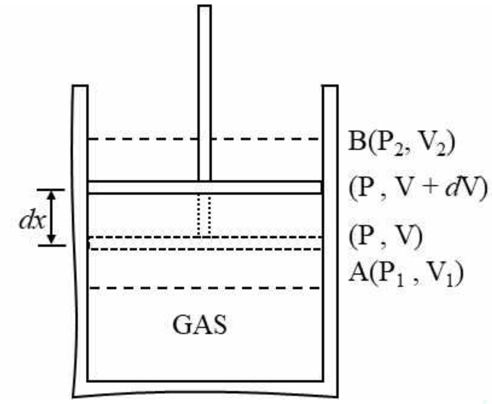
$$dW = P\,a\,dx = P\,dV \Rightarrow W = \int_{V_1}^{V_2} P\,dV$$

For one mole of an ideal gas,

$$P = \frac{RT}{V}$$

Therefore, $$W_{iso} = R\,T \int_{V_1}^{V_2} \frac{1}{V} dV = RT|\log_e V|_{V_1}^{V_2}$$

or $$W_{iso} = R\,T \log_e \frac{V_2}{V_1} = 2.303\,R\,T\,\log_{10} \frac{V_2}{V_1}$$



04. Adiabatic Process

An adiabatic process is one, in which pressure, volume and temperature of the system change but there is no exchange of heat between the system and the surroundings.

For carrying out adiabatic process, a perfect gas is contained in a cylinder having ***insulating walls*** and the gas is allowed to expand or compressed very ***quickly***.

For an adiabatic process to take place :

(i) *The cylinder should have insulating walls.*

(ii) *The gas should be compressed or allowed to expand very quickly.*

05. Equation of an Adiabatic Process

$$dU = C_v dT$$

No heat can enter or leave the gas *i.e.*

$$dQ = 0$$

$$dQ = dU + dW$$

$$C_v dT + P\ dV = 0$$

According to the perfect gas equation,

$$PV = RT$$

So

$$\frac{P_1^{\gamma-1}}{T_1^{\gamma}} = \frac{P_2^{\gamma-1}}{T_2^{\gamma}}$$

06. Work Done During Adiabatic Process

$$dW = (P\ a)\ dx = P\ dV$$

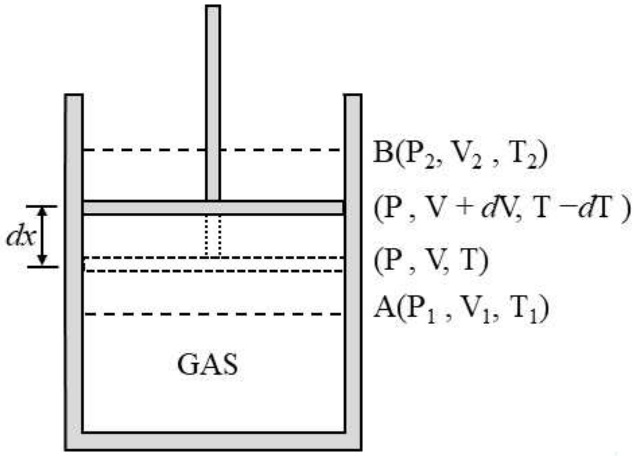
$$W = \int_{V_1}^{V_2} P\ dV$$

For an adiabatic change,

$$P = K\ V^{-\gamma}$$

$$W_{adi} = \frac{1}{\gamma - 1}|R\ T_1 - R\ T_2|$$

$$W_{adi} = \frac{R(T_1 - T_2)}{\gamma - 1}$$



If M is molecular weight of the gas, then the work done during an adiabatic process for one gram of the gas is given by

$$W_{adi} = \frac{R(T_1 - T_2)}{M(\gamma - 1)}$$

$$W_{adi} = \frac{r(T_1 - T_2)}{\gamma - 1}$$

Where r is gas constant for one gram of the perfect gas.