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Thermodynamics

Bs chemical Engineering

Q.No1:

System:

A set of the things in which working or interset in it is called system.

Surrounding:

A part of which seperate from the system is called sourrounding.

Adiabatic process:

A adiabatic process is a thermodynamics process in which no heat transfer from the system and no heat enter into the system.

$$Q = 0$$

The system can be consider to be perject insulated.

Isolated System:

In natural science an Isolated system is a physical system without any external change. neither matter nor energy can enter and exist but can only move around inside.

Extensive Property:

An extensive property of the matter that change as the amount of matter changes like physicals properties, an extensive property may be observed and measured without any chemical change occuring.

Q NO 2:-

Given Data:

$P = 7\,bar$

$\hat{h} = 2600\,KJ/kg$

Required:-

$x = ?$

$\hat{v} = ?$

$\hat{u} = ?$

Solution:-

$$\hat{h} = h_f + x h_{fg}$$

$$2600 = 697.1 + x(2064.9)$$

$$2600 - 697.1 = x(2064.9)$$

$$\frac{1902.9}{2064.9} = x$$

$$x = 0.925$$

$$\hat{v} = v_f + x v_{fg}$$

$$\hat{v} = 0.001108 + (0.921)(0.273 - 0.001108)$$

$$\hat{v} = 0.001108 + 0.25041$$

$$\hat{v} = 0.2571$$

(4)

$$\hat{u} = u_f + x u_{fg}$$

$$= 696.3 + (0.925)(2571.4 - 696.3)$$

$$= 696.3 + (1726)(1908)$$

$$= 696.3 + 1726.1908$$

$$\hat{u} = 2420 \text{ kJ/kg}$$

QNO3:-

$m = 10.0\ kg$

$P_1 = 20\ bar$

$v_1 = 1.0\ m^3$

$P_2 = 100\ bar$

$Pv = Pv^{1.5} = \text{Constant}$

$T = ?$

$$P_1 = \frac{20\ bar \mid 100\ kPa}{1\ bar} = 2000\ kPa$$

$$= 2\ MPa$$

$$\hat{v}_1 = \frac{1\ m^3}{10\ kg} = 0.1\ m^3/kg$$

by using steam table when $P = 2\ MPa$

$\hat{v}_f = 0.0012$ $\hat{v}_g = 0.0996$ $\hat{v}_1 > \hat{v}_g$ at 2mpa

$T(^\circ C)$	$\hat{v}\ (m^3/kg)$
212.4	0.0996
T	0.1
225	0.1030

$$y = \left[y_2 - y_1 \left(\frac{x - x_1}{x_2 - x_1} \right) \right] + y_1 \quad (6)$$

$$T = (225 - 212.4)\left(\frac{0.1 - 0.0996}{0.1038 - 0.0996} \right) + 212.4$$

$$T = 213.6^\circ C$$

b) $\hat{\omega} = ?$

$$P_2 = \frac{100\,bar \mid 100\,kpa}{1\,bar} = 10000\,kpa = 10\,Mpa$$

$$\hat{V}_2 = P_1 V_1^{1.5} = P_2 V_2^{1.5} \Rightarrow V_2^{1.5} = \frac{P_2 V_2^{1.5}}{P_1}$$

$$\hat{V}_2 = \left(\frac{P_1 V_1^{1.5}}{P_2} \right)^{\frac{1}{1.5}}$$

$$\hat{V}_2 = \left[\frac{2\,Mpa \mid \left(0.1\,m^3/kg \right)^{1.5} \mid 1}{100\,Mpa} \right]^{\frac{1}{1.5}}$$

$$\hat{V}_2 = \left[0.2 \times (0.1)^{1.5} \right]^{\frac{1}{1.5}} m^3/kg$$

$$= (0.2 \times 0.0316)^{1/1.5} = (0.2 \times 0.0316)^{0.667}$$

$$\hat{V}_2 = 0.0342\,m^3/kg$$

$$\hat{\omega} = -\int_{0.1}^{0.0342} P_E \, d\hat{v} = -\int_{01}^{0.0342} P \, d\hat{v}$$

$$P V^{1.5} = P_1 V_1^{1.5} \Rightarrow P = \frac{P_1 V_1^{1.5}}{\hat{V}^{1.5}}$$

$$P = \frac{2\,mpa \mid \left(0.1\,m^2/kg \right)^{1.5} \mid \left(kg/\hat{V}\,m^3 \right)^{1.5}}$$

④

$$P = \frac{0.0632}{\hat{v}^{1.5}}\ MPa$$

$$\hat{w} = -\int_{0.1}^{0.0342} \frac{0.0632}{\hat{v}^{1.5}}\, d\hat{v}$$

$$\hat{w} = \int_{0.1}^{0.0342} 0.0632\, \hat{v}^{-1.5}\, d\hat{v}$$

$$= \frac{-0.0632}{-0.5}\left| \frac{1}{0.0342^{0.5}} - \frac{1}{0.1^{0.5}} \right|$$

$$\frac{0.2830\ MPa\ m^3}{kg} \left| \frac{1000\ kPa}{1\ MPa} \right| \frac{1\ kN}{1\ kPa \cdot m^2}$$

$$\hat{w} = 283.8\ KJ/kg$$

④ $q = ?$

$$\Delta\hat{U} = \hat{q} + \hat{w}$$

$P_1 = 2\ mpa \quad T_1 = 213.6^{\circ}C$

$u_1 = ?$

u_1	$T(^{\circ}C)$
2600.3	212.4
u_1	213.6
2620.3	225

8)

$\hat{u}_1 = 2602.97 \text{ kJ/kg}$

$P_2 = 10 \text{ MPa} \quad \hat{v}_2 = 0.034 \frac{m^3}{kg}$

$\hat{u}_2$ (kJ/kg)	$\hat{v}_2$ (m^3/kg)
3045.8	0.0328
$\hat{u}_2$	0.0342
3144.5	0.0356

$\hat{u}_2 = 3095.15 \text{ kJ/kg}$

$\Delta \hat{u} = \hat{u}_2 - \hat{u}_1$

$= 492.18 \text{ kJ/kg}$

$\hat{q} = \Delta \hat{u} - \hat{w}$

$\hat{q} = (492.18 - 283.8) \text{ kJ/kg}$

$\hat{q} = 208.38 \text{ kJ/kg}$ **Ans**