UO-I SE Biotech sem III Choice May 2018 Q.P. code: 50517

Q.1a). kinematic viscosity $= \nu = 6$ stokes

$= 6 \times 10^{-4}\ m^2/s$.

Sp. gravity $= 1.6$

$\therefore \rho = 1.6 \times 1000 = 1600\ kg/m^3$.

$\nu = \frac{\mu}{\rho}$

$\therefore \mu = 6 \times 10^{-4} \times 1600$

$= 0.96 \times 10 = 9.6$ poise

Q.2a) $a_1 = \frac{\pi}{4} d_1^2 = \frac{\pi}{4} \times 20^2 = 314.16\ cm^2$

$a_2 = \frac{\pi}{4} \times 10^2 = 78.54\ cm^2$

$P_1 = 17.658\ N/cm^2 = 17.658 \times 10^4\ N/m^2$.

$\rho = 1000\ kg/m^2$

$\therefore \frac{P_1}{\rho g} = \frac{17.658 \times 10^4}{9.81 \times 1000} = 18$ m of water.

$\frac{P_2}{\rho g} = -30$ cm of Hg. $= -0.3 \times 13.6 = -4.08$ m of water

$h = \frac{P_1}{\rho g} - \frac{P_2}{\rho g} = 18 - (-4.08)$

$= 18 + 4.08 = 22.08$ m of water $= 2208$ cm of water

$Q = C_d \times \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$

$= 0.98 \times \frac{314.16 \times 78.54}{\sqrt{(314.16)^2 - (78.54)^2}} \sqrt{2 \times 981 \times 2208}$

$= 65.555$ lit/s.

Q.3a) Section 1. Section 2

$A_1 = 40 cm^2 = 40 \times 10^{-4} m^2$; $A_2 = 20 cm^2 = 20 \times 10^{-4} m^2$

$p_1 = 40 N/cm^2$ (gauge) ; $p_2 = 30 N/cm^2$ (gauge)

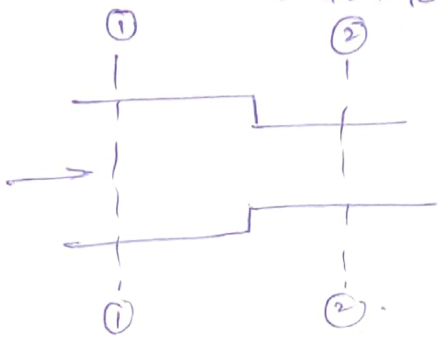
$= 40 + 10 = 50 N/cm^2$ (abs) ; $= 30 + 10 = 40 N/cm^2$ (abs)

$= 50 \times 10^4 N/cm^2$; $= 40 \times 10^4 N/cm^2$

$T = 15°C$

$= 288 K$

$R = 292 N.m/kg.k$



$\frac{p_1}{\rho_1} = RT_1$

$\therefore \rho_1 = \frac{p_1}{RT_1} = \frac{50 \times 10^4}{292 \times 288} \frac{kg}{m^3} = 5.945 kg/m^3$

mass flow rate $= \rho_1 A_1 V_1 = 0.5$

$0.5 = 5.945 \times 40 \times 10^{-4} \times V_1$

$\therefore V_1 = 21.02 m/s$

For isothermal proces, T is const.

$\therefore T_2 = 288 k$

$\frac{P_2}{\rho_2} = RT_2$

$\rho_2 = \frac{40 \times 10^4}{292 \times 288} = 4.756 kg/m^3$

mass flow rate $= \rho_2 A_2 V_2 = 0.5 = 4.756 \times 20 \times 10^{-4} \times V_2$

$\therefore V_2 = 52.565 m/s$

Q.4b) Case I:

P_1 = power required = 12 hp

$\dot{m}_1$ = feed rate = 15 T/hr.

D_{sa1} = vol. surface mean dia. of feed = 0.75 inch.

D_{sb1} = vol. surface mean dia. of product = 0.2 inch.

[P.T.O]

(3) Case II

$P_2 = ?$

$\dot{m}_1 = 10\ T/hr$

$D_{sa2} = 0.75$ inch

$D_{sb2} = 0.2$ inch.

Rittinger's law.

$$\frac{P}{\dot{m}_1} = k_r \left[\frac{1}{D_{sb}} - \frac{1}{D_{sa}}\right]$$

k_r : Rittinger's constant.

$$\therefore \frac{\frac{P_1}{\dot{m}_1}}{\frac{P_2}{\dot{m}_2}} = \frac{\left[\frac{1}{D_{sb1}} - \frac{1}{D_{sa1}}\right]}{\left[\frac{1}{D_{sb2}} - \frac{1}{D_{sa2}}\right]}$$

$$\frac{12/15}{P_2/10} = \frac{1/0.2 - 1/0.75}{1/0.15 - 1/0.75}$$

$\therefore P_2 = 11.64$ hp.