P P SAVANI UNIVERSITY

Seventh Semester of B. Tech. Examination

December 2021

SECH4011 Process Equipment & Design-II

01.12.2021, Wednesday **Time: 09:00 a.m. To 11:30 a.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1 (i) How to optimize the pipe diameter? **[10]**

(ii) Write the equation for pressure drop in pipe.

(iii) What is equivalent length of pipe?

(iv) Write classification of low measuring devices.

(v) Define: vena contracta.

OR

Q - 1 (i) Write advantages and disadvantages of orifice meter. **[10]**

(ii) Write advantages and disadvantages of rotameter.

Q - 2 Carbon dioxide is to be conveyed from the top of the stripper of ammonia plant to urea plant. Calculate the pipe size required based on following data. **[10]**

Flow rate of CO_2 = 1000 t/day

Total length of pipe = 800 m

Available pressure at inlet of pipe = 24 kPa g

Discharge pressure CO_2 from pipe required = atmospheric

No. of 90° elbows in pipe line = 8 (K_i = 0.75)

No. of butterfly valve = 1 (K_i = 0.24)

No. of flow nozzle = 1

Temperature of gas = 60 °C

Viscosity of CO_2 gas = 0.016 cP

$$Re = \frac{4\dot{m}}{\pi D_i \mu} \quad \rho = \frac{pM}{RT}$$

$$\frac{\Delta p}{L} = 4.07 \times 10^{10} G^{1.84} \mu^{0.16} D_i^{-4.84} \rho^{-1}$$

$$\Delta p_{fi} = \frac{K_i \rho v^2}{2}$$

Nominal Size	Schedule No.	ID of Pipe, mm
677 mm	—	677
600 mm (24 in)	20	590.55
500 mm (20 in)	20	488.95

Q - 3 (i) Write industrial application of extraction. **[10]**

(ii) Write a short note on choice of solvent for extraction.

SECTION – II

Q - 1 Design an orifice meter based on the following data. **[10]**

Name of fluid = water
Flow rate = 100 000 kg/h
Inside diameter of pipe = 154 mm (6 in, SCH-40 pipe)
Operating temperature = 32 °C
Density of water at 32°C = 995.026 kg/m^3
Viscosity of water at 32°C = 0.765 mPa.s or cP
Manometer fluid = Mercury
Density of Mercury at 32°C = 13 516.47 kg/m^3

$$C_o = 0.5959 + 0.0312\beta^{2.1} - 0.184\beta^8 + 0.0029\,\beta^{2.5}\left(\frac{10^6}{Re_D}\right)^{0.75}$$

$$+ 0.09\,L_1\beta^4(1-\beta^4)^{-1} - 0.0337\,L_2\beta^3$$

$$\dot{m} = C_o Y A_o \sqrt{\frac{2\,g_c\,\Delta p\,\rho}{1-\beta^4}}$$

$L_1 = l$, $1/D = 1$, $L_2 = l2/do = 1$, $\beta = 0.5$, $do/D = 0.5$

Q - 2 (i) Explain standard fixed roof storage tank. **[10]**

(ii) Explain vapor lift roof type storage tank.

OR

Q - 2 Write down advantages and disadvantags of standard fixed roof storage tank. **[10]**

Q - 3 (i) Factors affecting design of agitated vessel. **[10]**

(ii) List out different types of agitators and explain any two in detail.

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