

Process Equipment Design Paper - III

P. Pages : 2

Time : Three Hours



TKN/KS/16/7833

Max. Marks : 80

- Notes :
1. All questions carry equal marks.
 2. Answer **any four** questions.
 3. Assume suitable data wherever necessary.
 4. Illustrate your answers wherever necessary with the help of neat sketches.

1. a) Discuss the basic considerations in design of chemical process equipments. Also mention the different National and International standard codes for pressure vessel fabrication and their signification. **8**
b) Why lining of the vessel is done? What are different lining materials and how are they selected? **8**
c) A thin cylindrical pressure vessel of 500 mm diameter is subjected to an internal pressure of 2N/mm^2 . If the thickness of the vessel is 20 mm, find the hoop stress, longitudinal stress and maximum shear stress. **4**
2. a) What is safe reinforcement and why it is necessary? Discuss the area for area method of designing reinforcement for a nozzle. **10**
b) A vertical vessel with a cylindrical shell and hemispherical heads is to be installed in a closed shed. Internal diameter of the vessel is 1800 mm and its thickness is 12 mm. Tangent to tangent length of the vessel is 10.5 m. the vessel contains a liquid of density 800 kg/m^3 . The vessel is filled to 75% of its capacity. Determine the total weight of the vessel and the longitudinal stress in the cylindrical shell above and below the support which is at the lower head to shell junction. Permissible stress of the material is 1040 kg/cm^2 . Joint efficiency is 85%. Density of material is 7800 kg/m^3 . **10**
3. What are different techniques of fabrication of high pressure vessels? Explain the design criteria for monoblock pressure vessel. **20**
A thick walled vessel has an inside diameter of 30 cm and outside diameter 66 cm. The yield stress of material is 5400 Kg/cm^2 . Calculate the variation of tangential, radial stress when $p_i = p_{\text{max}}$ at which yielding of material occurs and at $P = 4300\text{ Kg/cm}^2$.
4. Explain in details of skirt bearing plate and anchor bolts. Also explain the criteria for selection of anchor bolts. **20**
Diameter of vessel : 3000mm
Height of vessel: 37.5m
Weight of vessel, attachments, etc : 200000kg
Diameter of skirt: 3000mm
Height of skirt : 4.8m
Wind pressure : 128.5 kg/m^2
 K_1 (shape factor for cylindrical vessel) = 0.7,
 K_2 (period of vibration is less than 0.5 sec) = 1, C_s (seismic coefficient) = 0.8.
Calculate thickness of skirt.

Permissible tensile stress = 1400 kg/cm^2 . Permissible compressive stress are $\frac{1}{3}$ yield point stress. Yield point stress = 2000 kg/cm^2

5. a) Explain the loss mechanism in storage tank. What are roof curb angles and wind girders. Explain their utility. **10**
- b) The engineer is working in Soybean oil refining industry of production 1 ton/day. The company has given a space of 17213.44 ft^2 to design the storage tank of 1 crore litre capacity. The plate size of $3 \text{ m} \times 1.5 \text{ m}$ in varying thickness are available. Assume the tank diameter as 30 m. ($a/r = 0.272$). The permissible stress of material is 1300 kg/cm^2 . The density of Soybean oil is 960 kg/cm^3 . Joint efficiency is 90%. There is no corrosion allowance. How many plates of size $3 \text{ m} \times 1.5 \text{ m}$ are required and of what thickness the engineer should bring. Carbon steel is used for tank fabrication. Density of material = 7700 kg/m^3 . Slope permissible in conical roof is 1 in 5, super imposed load = 125 kg/m^2 . Modulus of elasticity = $2 \times 10^4 \text{ kg/mm}^2$. **10**
6. a) How agitator shaft is designed in following conditions **10**
i) During operation. ii) At the starting of agitator.
- b) A centrifugal pump is driven by a motor through a single set of 5:1 reduction gear. H.P of motor is 15 H.P. while rpm is 1725. Load can be considered to be applied with minor shocks. Calculate the diameter of the shaft on the motor and the pump. Design stress of shaft material - 560 Kg/cm^2 . **10**
