11051 : Pulp & Paper Technology - III : 6 PT 04

P. Pages : 4

Time : Three Hours

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Max. Marks : 80

Notes : 1. Due credit will be given to neatness and adequate dimensions.
2. Assume suitable data wherever necessary.
3. Diagrams and chemical equations should be given wherever necessary.
4. Illustrate your answer necessary with the help of neat sketches.
5. Use of slide rule logarithmic table, Steam table, Mollier's Chart, Drawing instrument, Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
6. Discuss the reaction, mechanism wherever necessary.
7. Duhring rule chart, enthalpy concentration chart is permitted.

SECTION – A

1. a) A horizontal belt pulp washer is processing 600.0 tonnes per day of (oven dry basis) pulp. The length of workable surface of the belt washer is 10.0 m and width is 8.0 m. Calculate the washer loading.   4

   b) When fertilizer is used in high quality chemical pulps what problems does paper maker face?   4

   c) Figure 1 shown below explains the efficiency of hydro-cyclones versus reject rate by volume. It is given that $\Delta P_1 = 50 \, kPa$, $\Delta P_2 = 150 \, kPa$ and $\Delta P_3 = 300 \, kPa$. Justify why efficiency falls at ΔP_1 and ΔP_3 pressure difference?   3
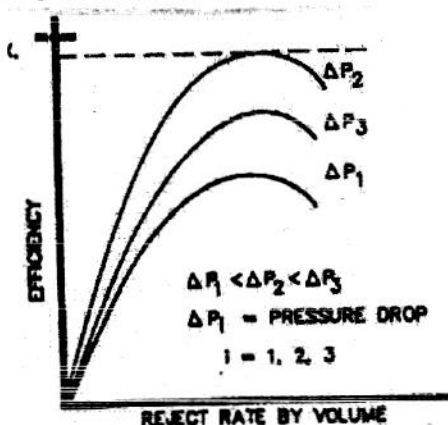

Fig. 1

   d) How does Pulmac Shive analyser measure the shive count?   2

OR

2. a) How would you measure soda losses in washed pulp? If the washers soda losses is high then what does it signify?   4

   b) With the help of a neat graph explain the effect of Kappa No. and minimum reject rate on shive removal efficiency of a screen.   5

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c) Explain with the help of a neat sketch the mechanism of contamination removal in reverse centricleaners. **4**

3. a) An evaporator is used to concentrate 4536 kg/Hr of 20.0% (wt %) solution of NaOH in water entering at 60°C (333 K) to a product of 50.0% (wt %) solids. The pressure of saturated steam used is 172.4 kPa and the pressure in the vapour space of the evaporator is 11.7 kPa. The overall heat transfer coefficient is $1560 \, w/m^2 - k$. Calculate the steam used, the steam economy and the heating surface are in m^2. **8**

b) When you are concentrating black liquor to high solids of 80.0% then which technical problems would you have to encounter? **5**

OR

4. a) What is boiling point rise in black liquor? How does this affect during concentration of black liquor? **4**

b) Why should tall oil soap be removed from black liquor? Figure 2 show below plots the effect of residual active alkali on tall oil soap solubility. How would you maintain residual effective alkali content. **5**
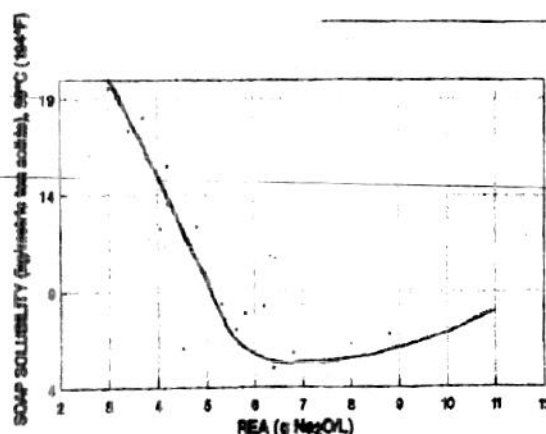

Fig-2

c) Why would you use mixed feed multiple effect evaporator to concentrate black liquor? Explain the advantages of using mixed feed arrangement. **4**

5. a) How is black liquor fired inside the recovery furnace? Write down the advantages and disadvantages of various methods followed. **4**

b) How is fume formation taking place in recovery furnace? Write down the chemical reactions involved during the formation of fume. **4**

c) How would you supply air in the recovery furnace? While sending air what precautions would you take? **6**

OR

6. a) Why causticizing efficiency of green liquor never reaches 100.0%? Explain with the help of causticizing curve. **8**

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c) Write down the chemical reaction of lime slaker. 2

SECTION – B

7. a) A single effect evaporator is being used to concentrate sulfite spent liquor entering the evaporator at 30.0°C with 16.0% concentration (wt %). The concentrated black liquor would be removed at 50.0% (wt %) concentration. Saturated steam is fed into the evaporator at 186.28 kPa and pressure in vapour space was maintained at 12.33 kPa. The specific heat of black liquor was $2.77 \, kJ/kg.°C$ and overall heat transfer coefficient is $1560 \, w/m^2.°C$. Neglecting BPR, heat of concentration calculate the steam consumption, steam economy and heat transfer area of evaporator. 6

b) With the help of a neat flow diagram explain the chemical recovery process of magnesium base sulfite spent liquor. 7

OR

8. a) Explain the use of cyclone type direct contact evaporator to concentrate sulfite spent liquor. 4

b) Explain the Tampella process of converting sulfite green liquor into sulfite cooking liquor. 6

c) Write down the elemental analysis of sulfite spent liquor using magnesium base. 3

9. a) Why bleaching of pulp becomes necessary? 4

b) How would you measure the brightness of pulp? 4

c) If 6.0 gm of wet pulp at 30.0% consistency used upto 23.0 ml of $0.1 \, N \, KMnO_4$. Calculate the theoretical amount of available chlorine required to bleach 2.0 tonnes of wet pulp. Also calculate the percentage chlorine applied on the pulp during bleaching. 5

OR

10. a) Explain with the help of chemical reaction the bleaching of pulp by chlorine. 7

b) Why alkali extraction has to be performed after every oxidative bleaching process? 5

c) In descending order write down the effectiveness of bleaching chemicals for particle bleaching. 1

11. a) Write down the operating parameters of ozone bleaching. 4

b) What do you understand by Total Chlorine Free (TCF) bleaching sequence? What are the benefits of TCF bleaching? Write down a TCF bleaching sequence. 6

c) What do you understand by reductive bleaching of pulp? Why reductive bleaching is not preferred for chemical pulps? 4

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OR

12. a)   What role does magnesium sulphate play during oxygen bleaching of pulp?   **4**

     b)   Write down the typical Absorbable Organic Halides (AOX) values for Kraft pulp bleaching effluent.   **4**

     c)   Draw the chemical structure of 2, 3, 7, 8 tetrachlorodibenzo – p – dioxin and 2, 3, 7, 8 tetrachlorodibenzo – p – furan. Write down the toxicological studies of these two chemicals.   **6**

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