B. Tech. Seventh Semester (Food, Pulp & Paper, Oil & Paint & Petro. Chem. Tech.) (CGS)

11066 : Sp. Tech - IV (Petrochemical Tech.- IV) : 7 PC 03

P. Pages : 3 | AW - 3393

Time : Three Hours | Max. Marks : 80

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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. Discuss the reaction, mechanism wherever necessary.
6. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. Ethane gas cracking reaction take place in a batch reactor with a volume of 100 m^3 at a pressure of 20 atm and a temperature of 680°C. The endothermic heat of reaction is 1000k cal/k. mol. If the average molar heat capacity is 30 kcal/ kmol ° C. Calculate the relation between the conversion and the time under isothermal condition. **14**

Data Given : -

Pressure, P = 20 atm,
Molar heat capacity, M = 30 kcal/ kmol, ° C,
Ideal gas constant, R = 0.0832,
Volume of reactor, V = 100 m^3
molar flow rate, F = 100 m^3/hr.
Endothermic heat of reaction, ΔH_R = 1000 kcal / Kmol.

Rate constant, k = 9.4 hr^{-1}..
Initial temperature = 680°C.
Draw the conclusion from result obtained.

OR

2. Why steam cracking requires very high temperature? Discuss the effect of feed on steam cracking product pattern. **14**

3. Determine the liquid product in contact coking and liquid product in delayed coking operation, if following data is available. **13**

Feed : → Long Residue, CCR wt % = 11.6, °API = 18.9, sulfur wt % = 0.6
Contact coking → Light gases = 14.9%, Coke wt% = 13 %.

OR

4. Discuss the design aspect of regenerator and flue gas separator in FCCU. **13**

5. To conduct mass balance across the FCC unit with the assumption that the properties of the feed correspond to the desulfurized HVGO stream, calculate the total product flow rate across FCCU. **13**

Data given :
1) Desulphurised HVGO flow rate = 3012.41 bbl/day.
2) Specific gravity = 0.907051

3) Feed °API = 24.5
4) Feed Sulphur content = 0.5 wt%
5) Feed mass flow rate = 0.955961 mmlbs/day
6) Feed Sulphur mass flow rate = 0.000478
7) % LV conversion = 72.7
8) Products : -
   i) Gas wt% = 2.7, ii) $nC_3 = 2.7$,
   iii) $i-C_3 = 7.0$, iv) $nC_4 = 1.2$,
   v) $i-C_4 = 4.8$, vi) rest $C_4 = 7.3$,
   vii) Gasoline = 58.9, viii) LCO = 21,
   ix) HCO = 6.2

OR

6. What is an ideal operating conditions for catalytic reforming? Discuss in brief. 13

SECTION - B

7. What is the old route for phthalic anhydride synthesis? Why is it shifted to new route? Why scientist are still interested in old route? Hence give the reaction kinetics for phthalic anhydride synthesis. 14

OR

8. If HVGO is the feed for hydrotreater. 14
Assume that 2% of total light ends are lost to the gaseous product from feed. following data is given. (Also assume suitable data if needed).

a) For HVGO -
   i) SG = 0.93085 (° API = 20)
   ii) Flow rate = 3360 bbl/day
   iii) Sulfur content = 2.9121
   iv) Overall mass flow rate = 1.094 mmlbs/day
   v) Sulfur mass flow rate = 0.031865 mmlbs/day

b) Feed °API = 21, feed Sulfur wt % = 2.6
   °API of desulphurised HVGO product = 24.5

c) GOH
   i) SG = 0.907051
   ii) SU = 0.5 (wt%)

d) H_2
   i) SCF/barrel of H_2 required = 210
   ii) $H_2SG = 8.29 \times 10^{-5}$

e) VEH (vent)
   i) $SU_{VEH} = 66$
   ii) $H_2S.vent\,SG = 2.11166 \times 10^{-4}$.

f) Assume that 85% Sulfur removal is obtained on weight basis with respect $SU_{NH} = 0.08$ wt% (Naphtha).

g) $H_2S + LESG = 2.56419 \times 10^{-4}$ (light end).

h) Assume that average molecular wt of the gases are
$SG \& MW_{VEH} = 28$ (vent)
$SG \& MW_{LEH} = 34$ (Light end)
Assume multiplication factor $M_1 = 42 \times 8.33$ & $M_2 = \frac{1}{379}$
$\Rightarrow$ From above data calculate the flow rate of Hydrotreated gas oil (F_{GOH}) in product stream

9. Desulfurisation of heavy vacuum gas oil should give the gas oil as a product with less Sulfur content. But in practice plant give vent gases, naphtha, light gases and gas oil. Why? Hence discuss the process detail of HDS of HVGO. **13**

OR

10. If gas oil is the feed and product required is olefinic gases as well as gasoline, which refinery process will you suggest? Why? Discuss the process flow of same process in detail. **13**

11. What are the chemical engineering principles involved in styrene separation from its feed stock? Hence discuss the styrene separation technique in brief with trouble shooting involved. **13**

OR

12. Discuss the following in brief : - **13**
i) Removal of exothermic heat from reactors.

ii) Importance of alkylation process.

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