

BE (Mech) Part IV 8th Semester Final Examination 2012

Circulative Fluidized Bed Technology (ME 804/3)

(ELECTIVE - II)

Time 3 Hrs

Full Marks 70

Answer Q 1 or Q 2 and any FIVE questions from Q 3 to Q 9

1. (a) Show, in tabular form, the functions of fluids and solids in some practical plants.
(b) Draw the sketches of a packed bed, a falling cloud duct, the agitation of solids by a rotating drum, a spouted bed and a flowing packed bed.
(c) Compare, in the tabular form, alternative gas-solid contacting methods. 15
2. (a) Discuss, with a neat sketch, the working of pressurized circulating fluidized bed combustion for combined cycle application.
(b) Describe, with a neat sketch, a circulating fluidized bed pre calciner for making cement. 15
3. (a) Draw a self-evident diagram showing typical axial distribution of the cross-section average voidage of a fast bed.
(b) Show by a diagram that the voidage profile is governed by the pressure balance around the CFB loop. Show the pressure profiles at two different circulation rates.
(c) How does the radial voidage profile behave over the cross-section of a bed.? 11
4. (a) What are the different heat transfer situations involved in a CFB boiler?
(b) Cold primary air at 30°C is entering a bed of 200 μm sand (2500 kg/m³) fluidized at 6 m/s. The specific heats of gas and solid particles are 1.15 and 1.26kJ/kgK, respectively. The local bed density is 200 kg/m³. The average solid velocity is about 0.15 m/s. The viscosity, density and thermal conductivity of the gas at 850°C are 43.2 x 10⁻⁶ N.s/m², 0.3177 kg/m³, and 0.072W/mK, respectively. Find the height within which the primary air will reach within 95% of a bed temperature of 850°C. 11
5. (a) What is the mechanism of bed-to-wall heat transfer in a CFB boiler?
(b) Show, by drawing diagrams, the effect of various design and operating parameters on bed-to-wall heat transfer in a CFB boiler. 11
6. Describe in detail with relevant equations the cluster renewal model for bed-to-wall heat transfer in fast fluidized beds. 11
7. A bed of particles of mean size 427 μm was found to have a density, when loosely packed, of 1620 kgm⁻³; the density of the individual particles was 2780 kgm⁻³ and their sphericity was 0.73. Calculate the minimum fluidizing velocity when fluidized by air under ambient conditions, where the air density is 1.21 kgm⁻³ and the viscosity is 1.82 x 10⁻⁵ kgm⁻¹s⁻¹. 11
8. (a) How does the choice of alternate types of distributor affect the heat transfer between the bed and the distributor?
(b) Show, by drawing a sketch, the flow pattern around a single horizontal tube.
(c) Compare bed-to-surface heat transfer coefficient in deep and shallow beds. 11
9. (a) What are the different types of cyclone gas-solid separator? Give sketches.
(b) Show in a sketch the typical dimension of a vertical axis tangential entry reverse flow cyclone. What is the standard proportion of vertical reverse flow cyclones?
(c) What are the six different steps for the design of a cyclone for a CFB boiler? 11