

FLUIDIZATION ENGINEERING (ELECTIVE - III)

Course Code: 15CH2119

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Prerequisites: The student should have knowledge of fluid mechanics and particulate solids.

Course outcomes: On successful completion of the course, the student should be able to

CO1: Explain the basics of fluidization.

CO2: Describe the various industrial applications of fluidization.

CO3: Explain the various fluidization regimes, classification of particles.

CO4: Describe the K-L bubbling model.

CO5: Describe the staging of fluidized beds, and calculation of the exchange coefficient.

UNIT I (10-Lectures)

Introduction: The phenomenon of fluidization; liquid like behaviour of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.

UNIT II (10-Lectures)

Industrial applications of fluidized beds: Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; Synthesis of phthalic anhydride; Acrylonitrile; Polymerization of olefins; FCCU; Fluidized combustion of coal; incineration of solid waste; Activation of carbon; gasification of waste; bio-fluidization.

UNIT III (10-Lectures)

Fluidization and mapping of regimes: Minimum fluidization velocity; Pressure drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart classification of particles; terminal velocity of particles; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems; Voidage diagram; Mapping of regimes of fluidization.

UNIT IV (10-Lectures)

Bubbles in dense bed: Single rising bubbles; Davidson model for gas flow at bubbles; Evaluation of models for gas flow at bubbles.

Bubbling Fluidized beds: Experimental findings; Estimation of bed porosities; Physical models: simple two phase model; K-L model.

High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization.

UNIT V (10-Lectures)

Solids Movement, Mixing, Segregation and staging: Vertical movement of solids; Horizontal movement of solids; Staging of fluidized beds.

Gas Dispersion and Gas interchange in Bubbling Beds: Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients.

Particle to Gas Mass Transfer: Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

TEXT BOOK

1. Fluidization Engineering, 2nd ed., D. Kunii and O. Levenspiel, Butterworth-Heinemann, London, 1999.