CHEMICAL PROCESS CALCULATIONS

Course Code :15CH1104

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Course Outcomes:

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

CO 1 Estimate composition, density of mixture and apply ideal gas law for gaseous mixtures.

CO 2 Explain vapor pressure, vapor pressure plots, Raoult's law and steam distillation.

CO 3 Describe the concept of humidity and solve related problems with and without using humidity chart.

CO 4 Solve material balance problems involving drying, bypass, recycle and purge.

CO 5 Calculate enthalpy, heat of reaction and theoretical flame temperature.

UNIT-I (12 Lectures)

STOICHIOMETRIC RELATION AND BEHAVIOR OF IDEAL GASES

Basis of calculations, methods of expressing compositions of mixtures and solutions, density and specific gravity, Baume and API gravity scales. Application of ideal gas law, gaseous mixtures, gases in chemical reactions.

UNIT-II (8 Lectures)

VAPOR PRESSURE:

Liquefaction and liquid state, vaporization, boiling point, effect of temperature on vapor pressure, Antoine equation, vapor pressure plots, vapor pressure of immiscible liquids and ideal solutions, Raoult's law. Non volatile solutes.

UNIT-III (8 Lectures)

HUMIDITY AND SATURATION

Relative and percentage saturation, dew point, wet bulb and dry bulb temperature, use of humidity charts for engineering calculations.

UNIT-IV (12 Lectures)

MATERIAL BALANCES

Tie substance, Yield, conversion, Processes involving Chemical Reactions, Drying, Crystallization, Processes involving recycle, bypass and purge.

UNIT-V (10 Lectures)

THERMOPHYSICS:

Energy balance, heat capacity of gases, liquid and mixture solutions. Kopp's rule, latent heats, heat of fusion and heat of vaporization, Trouton's rule, Kistyakowsky equation for non polar liquids, enthalpy and its evaluation.

THERMOCHEMISTRY:

Calculation and applications of heat of reaction, combustion and formation, Kirchhoff's equation, theoretical and actual flame temperatures.

TEXTBOOKS:

1. Hougen. O. A, Watson K.M. and Ragatz R.A. *"Chemical Process Principles, Part -I, Material and Energy Balance"*, 2nd Ed. John Wiley and Sons Inc, New York, 1963.
2. Himmelblau D.H. *"Basic Principles and Calculations in Chemical Engineering"*, 5th Edition, PHI, 2001.

REFERENCE:

1. Bhatt B.I. and Vora S.M. *"Stoichiometry"*, 3rd Edition, Tata McGraw Hill publishing company, Ltd. New Delhi,1996.