MASS TRANSFER OPERATIONS - I

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IIT Guwahati

INTENDED AUDIENCE : B.Tech in Chemical Engineering and allied disciplines

INDUSTRIES APPLICABLE TO : Almost all chemical industries including IOCL, OIL, ONGC, etc

COURSE OUTLINE :
This course will provide an overview of mass transfer operation at basic to an intermediate level. Coverage will be relatively broad. This course applies the concepts of diffusion and interphase mass transfer to the analysis of different mass transfer operations such as absorption and distillation. The goal is to provide students with the theoretical/analytical background to understand mass transfer operations as well as application and to tackle the sort of complex problems.

ABOUT INSTRUCTOR :
Prof. Bishnupada Mandal is currently a Professor and Head in the Department of Chemical Engineering at the Indian Institute of Technology Guwahati. Dr. Mandal has over 15 years of teaching and research experience at IIT Guwahati. He was Visiting Research Professor at The Ohio State Engineering, Columbus, USA during May-July 2017. He has served as Vice Chairman as well as Chairman, IIT-JEE for IIT Guwahati Zone. He had been a recipient of the prestigious BOYSCAST fellow award of Department of Science and Technology (DST) Govt. of India. His research interest includes CO2 capture and sequestration; wastewater treatment, etc. He has guided/guiding 21 PhD students. He has published 2 monographs 3 book chapters, 56 research papers in reputed international journals and more than 120 papers in conference proceedings. He has over 2450 citations and h-index is 25. Dr. Mandal has served as the Editorial Board Member of Heliyon (Elsevier) and reviewer of more than 40 ACS, Elsevier and RSC journals. He is serving as the Chairman, IIChE-GRC and Executive Council Member of IIChE. He has served OIL, Duliajan; NTPCL, Netra; GAIL (India) Limited and BHEL, Bangalore as a consultant..

COURSE PLAN :
Week 1: Introduction & Overview of Mass Transfer Operation, Molecular and Eddy Diffusion, Diffusion velocities and Fluxes, Fick's First and Second Law, Steady state molecular diffusion in fluids under stagnant and laminar flow conditions
Week 2: Diffusion through variable cross-sectional area, Gas phase diffusion coefficient measurement, Gas phase diffusion coefficient Prediction, and liquid phase diffusion coefficient measurement and prediction, Multicomponent diffusion and diffusivity in solids
Week 3: Mass transfer coefficient concept and classifications, Dimensionless groups and correlations for convective mass transfer coefficients, Mass transfer coefficient in laminar flow, Boundary Layer Theory and mass transfer coefficients in turbulent flow
Week 4: Mass transfer theories, Interphase mass transfer, Interphase mass transfer and material balance for operating line, Number of ideal stages in counter current operation: graphical and algebraic methods
Week 5: Introduction, classification, Sparged and agitated vessels design, Gas dispersed: Tray tower, Sieve Tray, Liquid dispersed: Venture scrubber, wetted wall column, Packed tower
Week 6: Introduction to absorption, Equilibrium in gas-liquid system, and minimum liquid rate, Design of packed column absorber based on the Individual Mass Transfer Coefficient, Design of packed column absorber based on the Overall Mass Transfer Coefficient
Week 7: Height Equivalent to a Theoretical Plate (HETP), Design of packed column absorber for dilute and concentrated gases, Absorption in plate column: Method of McCabe & Thiele-graphical determination of ideal trays and Introduction to multicomponent absorption
Week 8: Introduction to distillation, binary equilibrium diagrams and concept of relative volatility, Distillation in non-ideal systems and concept of enthalpy-concentration diagram, Flash distillation
Week 9: Batch and steam distillation, Continuous multistate fractionation, Number of trays by McCabe & Thiele for distillation
Week 10: Limiting cases: total reflux and minimum reflux, Reflux below its bubble point: Sub-cooled reflux and use of open steam, Multiple feeds, multiple product withdrawal or side streams
Week 11: Multistage batch distillation with reflux, The Ponchon-Savarit method
Week 12: Distillation in packed towers, Introduction to multicomponent distillation and multicomponent flash distillation, Minimum stages and minimum reflux in a multicomponent distillation, Multicomponent batch distillation