

1.1^a. Concentration of a gas mixture.

A mixture of noble gases [helium (1), argon (2), krypton (3), and xenon (4)] is at a total pressure of 200 kPa and a temperature of 400 K. If the mixture has equal mole fractions of each of the gases, determine:

a) The composition of the mixture in terms of mass fractions.

Solution:

Basis: 100 kmole of the mixture

$$\begin{aligned}
 \text{ORIGIN} &:= 1 & \text{kmole} &:= 1000 \cdot \text{mole} \\
 \text{moles} &:= \begin{pmatrix} 25 \\ 25 \\ 25 \\ 25 \end{pmatrix} \cdot \text{kmole} & \text{MW} &:= \begin{pmatrix} 4 \\ 40 \\ 83.8 \\ 131.3 \end{pmatrix} \frac{\text{kg}}{\text{kmole}} & \text{mass} &:= \overrightarrow{(\text{moles} \cdot \text{MW})} \\
 \text{mass} &:= \begin{pmatrix} 100 \\ 1 \times 10^3 \\ 2.095 \times 10^3 \\ 3.283 \times 10^3 \end{pmatrix} \text{kg} & \text{total} &:= \sum_{i=1}^4 \text{mass}_i & \text{total} &:= 6.478 \times 10^3 \text{ kg} \\
 \text{mass_fraction} &:= \frac{\text{mass}}{\text{total}} & \text{mass_fraction} &:= \begin{pmatrix} 0.015 \\ 0.154 \\ 0.323 \\ 0.507 \end{pmatrix}
 \end{aligned}$$

b) The average molecular weight of the mixture.

Solution

$$\begin{aligned}
 \text{kmole} &:= 1000 \cdot \text{mole} \\
 M_{av} &:= \frac{\text{total}}{100 \cdot \text{kmole}} & M_{av} &= 0.065 \frac{\text{kg}}{\text{mol}}
 \end{aligned}$$

c) The total molar concentration.

Solution

$$\begin{aligned}
 P &:= 200 \cdot \text{kPa} & T &:= 400 \cdot \text{K} & \text{kPa} &:= 1000 \cdot \text{Pa} \\
 c &:= \frac{P}{R \cdot T} & R &:= 8.314 \cdot \text{kPa} \cdot \text{m}^3 \cdot \text{kmole}^{-1} \cdot \text{K}^{-1} \\
 c &:= 60.14 \frac{\text{mol}}{\text{m}^3}
 \end{aligned}$$

d) The mass density.

Solution

$$\begin{aligned}
 \rho &:= c \cdot M_{av} & \rho &= 3.896 \frac{\text{kg}}{\text{m}^3}
 \end{aligned}$$

Treybal Unit Operations Solution Manual

Christie J. Geankoplis



Treybal Unit Operations Solution Manual:

Environmental Engineering Unit Operations and Unit Processes Association of Environmental Engineering Professors, 1984
Advanced Physicochemical Treatment Processes Lawrence K. Wang, Yung-Tse Hung, Nazih K. Shammash, 2007-11-10
The past thirty years have witnessed a growing worldwide desire that positive actions be taken to restore and protect the environment from the degrading effects of all forms of pollution: air, water, soil, and noise. Because pollution is a direct or indirect consequence of waste, the seemingly idealistic demand for zero discharge can be construed as an unrealistic demand for zero waste. However, as long as waste continues to exist, we can only attempt to abate the subsequent pollution by converting it to a less noxious form. Three major questions usually arise when a particular type of pollution has been identified: 1. How serious is the pollution? 2. Is the technology to abate it available? and 3. Do the costs of abatement justify the degree of abatement achieved? This book is one of the volumes of the Handbook of Environmental Engineering series. The principal intention of this series is to help readers formulate answers to the last two questions above. The traditional approach of applying tried and true solutions to specific pollution problems has been a major contributing factor to the success of environmental engineering and has accounted in large measure for the establishment of a methodology of pollution control. However, the realization of the ever-increasing complexity and interrelated nature of current environmental problems renders it imperative that intelligent planning of pollution abatement systems be undertaken.

Transport Processes and Separation Process Principles Christie John Geankoplis, Allen Hersel, Daniel H. Lepek, 2018-05-02
The Complete Unified Up-to-Date Guide to Transport and Separation Fully Updated for Today's Methods and Software Tools
Transport Processes and Separation Process Principles Fifth Edition offers a unified and up-to-date treatment of momentum, heat, and mass transfer and separations processes. This edition reorganized and modularized for better readability and to align with modern chemical engineering curricula, covers both fundamental principles and practical applications and is a key resource for chemical engineering students and professionals alike. This edition provides New chapter objectives and summaries throughout. Better linkages between coverage of heat and mass transfer. More coverage of heat exchanger design. New problems based on emerging topics such as biotechnology, nanotechnology, and green engineering. New instructor resources: additional homework problems, exam questions, problem-solving videos, computational projects, and more. Part 1 thoroughly covers the fundamental principles of transport phenomena, organized into three sections: fluid mechanics, heat transfer, and mass transfer. Part 2 focuses on key separation processes, including absorption, stripping, humidification, filtration, membrane separation, gaseous membranes, distillation, liquid-liquid extraction, adsorption, ion exchange, crystallization, and particle size reduction, settling, sedimentation, centrifugation, leaching, evaporation, and drying. The authors conclude with convenient appendices on the properties of water, compounds, foods, biological materials, pipes, tubes, and screens. The companion website trine.edu/transport5ed contains additional homework problems that incorporate

today's leading software including Aspen CHEMCAD MATLAB COMSOL and Microsoft Excel

Water Treatment Unit Processes David W. Hendricks, 2006-01-13 The unit process approach common in the field of chemical engineering was introduced about 1962 to the field of environmental engineering. An understanding of unit processes is the foundation for continued learning and for designing treatment systems. The time is ripe for a new textbook that delineates the role of unit process principles in environmental engineering. Suitable for a two semester course, *Water Treatment Unit Processes* Physical and Chemical provides the grounding in the underlying principles of each unit process that students need in order to link theory to practice. Bridging the gap between scientific principles and engineering practice, the book covers approaches that are common to all unit processes as well as principles that characterize each unit process. Integrating theory into algorithms for practice, Professor Hendricks emphasizes the fundamentals using simple explanations and avoiding models that are too complex mathematically, allowing students to assimilate principles without getting sidelined by excess calculations. Applications of unit processes principles are illustrated by example problems in each chapter. Student problems are provided at the end of each chapter; the solutions manual can be downloaded from the CRC Press Web site. Excel spreadsheets are integrated into the text as tables designated by a CD prefix. Certain spreadsheets illustrate the idea of scenarios that emphasize the idea that design solutions depend upon assumptions and the interactions between design variables. The spreadsheets can be downloaded from the CRC web site. The book has been designed so that each unit process topic is self-contained with sidebars and examples throughout the text. Each chapter has subheadings so that students can scan the pages and identify important topics with little effort. Problems, references, and a glossary are found at the end of each chapter. Most chapters contain downloadable Excel spreadsheets integrated into the text and appendices with additional information. Appendices at the end of the book provide useful reference material on various topics that support the text. This design allows students at different levels to easily navigate through the book and professors to assign pertinent sections in the order they prefer. The book gives your students an understanding of the broader aspects of one of the core areas of the environmental engineering curriculum and knowledge important for the design of treatment systems.

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