

Reactor Characteristics

Introduction

Chemical, biological and physical processes in nature and in engineered systems usually take place in what we call "reactors." Reactors are defined by a real or imaginary boundary that physically confines the processes. Lakes, segments of a river, and settling tanks in treatment plants are examples of reactors. Most, but not all, reactors experience continuous flow (in and out). Sequencing batch reactors have a sequence of states including fill, react, and empty. It is important to know the mixing level and residence time in reactors, since they both affect the degree of process reaction that occurs while the fluid (usually water) and its components (often pollutants) pass through the reactor.

Chlorine contactor tanks are designed to maximize the contact time between chlorine and pathogens before the water is delivered to consumers. Thus the design objective is to maximize the time that it takes for water to travel from the tank influent to the effluent. Tracer studies can be used to determine the hydraulic characteristics of a reactor such as the disinfection contact tanks at water treatment plants. The results from tracer studies are used to obtain accurate estimates of the effective contact time. In this laboratory students will experiment with different reactor designs with the goal of maximizing the contact time.

Reactor Classifications

Dispersion

Mixing levels give rise to three categories of reactors; completely mixed flow (CMFR), plug flow (PFR) and flow with dispersion (FDR). The plug flow reactor is an idealized extreme not attainable in practice. All *real* reactors fall under the category of FDR or CMFR.

Boundary Conditions

The reactor inlet and outlet boundary conditions significantly affect the reactor response to the addition of a pulse of tracer. If dispersion is possible across a boundary, then the boundary is open. An example of a reactor with open boundaries is a section of a river. If a tracer is added to a section of a river it is possible for some of the tracer to move upstream, illustrating that an arbitrary section of a river is an open reactor (Figure 5-1). This is equivalent to letting the reactor be



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Table of Contents Environmwental Lab Manual In Civil Engineering

1. Understanding the eBook Environmwental Lab Manual In Civil Engineering
 - The Rise of Digital Reading Environmwental Lab Manual In Civil Engineering
 - Advantages of eBooks Over Traditional Books
2. Identifying Environmwental Lab Manual In Civil Engineering
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Environmwental Lab Manual In Civil Engineering
 - User-Friendly Interface
4. Exploring eBook Recommendations from Environmwental Lab Manual In Civil Engineering
 - Personalized Recommendations
 - Environmwental Lab Manual In Civil Engineering User Reviews and Ratings
 - Environmwental Lab Manual In Civil Engineering and Bestseller Lists
5. Accessing Environmwental Lab Manual In Civil Engineering Free and Paid eBooks
 - Environmwental Lab Manual In Civil Engineering Public Domain eBooks
 - Environmwental Lab Manual In Civil Engineering eBook Subscription Services
 - Environmwental Lab Manual In Civil Engineering Budget-Friendly Options
6. Navigating Environmwental Lab Manual In Civil Engineering eBook Formats

- ePub, PDF, MOBI, and More
- Environmental Lab Manual In Civil Engineering Compatibility with Devices
- Environmental Lab Manual In Civil Engineering Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Environmental Lab Manual In Civil Engineering
 - Highlighting and Note-Taking Environmental Lab Manual In Civil Engineering
 - Interactive Elements Environmental Lab Manual In Civil Engineering
- 8. Staying Engaged with Environmental Lab Manual In Civil Engineering
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Environmental Lab Manual In Civil Engineering
- 9. Balancing eBooks and Physical Books Environmental Lab Manual In Civil Engineering
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Environmental Lab Manual In Civil Engineering
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Environmental Lab Manual In Civil Engineering
 - Setting Reading Goals Environmental Lab Manual In Civil Engineering
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Environmental Lab Manual In Civil Engineering
 - Fact-Checking eBook Content of Environmental Lab Manual In Civil Engineering
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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