

《表面活性剂湍流减阻》

图书基本信息

书名：《表面活性剂湍流减阻》

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内容概要

表面活性剂湍流减阻同时与湍流、流变学、流体动力学等多个方面密切相关，而且对其进行应用推广需要化工、机械、市政等不同领域知识的有机结合。《"十二五"国家重点图书:表面活性剂湍流减阻(英文版)》正是在这一背景下，基于表面活性剂湍流减阻流动研究领域最新的实验、数值模拟和理论分析方面的研究成果，详细阐述有关表面活性剂湍流减阻流动的湍流特性、流变学物性、理论、特殊技术以及实际应用方面的问题。

书籍目录

Preface

1 Introduction

1.1 Background

1.2 Surfactant Solution

1.2.1 Anionic Surfactant

1.2.2 Cationic Surfactant

1.2.3 Nonionic Surfactant

1.2.4 Amphoteric Surfactant

1.2.5 Zwitterionic Surfactant

1.3 Mechanism and Theory of Drag Reduction by Surfactant

Additives

1.3.1 Explanations of the Turbulent DR Mechanism from the Viewpoint of Microstructures

1.3.2 Explanations of the Turbulent DR Mechanism from the Viewpoint of the Physics of Turbulence

1.4 Application Techniques of Drag Reduction by Surfactant Additives

1.4.1 Heat Transfer Reduction of Surfactant Drag-reducing Flow

1.4.2 Diameter Effect of Surfactant Drag-reducing Flow

1.4.3 Toxic Effect of Cationic Surfactant Solution

1.4.4 Chemical Stability of Surfactant Solution

1.4.5 Corrosion of Surfactant Solution

References

2 Drag Reduction and Heat Transfer Reduction Characteristics of Drag-Reducing Surfactant Solution Flow

2.1 Fundamental Concepts of Turbulent Drag Reduction

2.2 Characteristics of Drag Reduction by Surfactant Additives and Its Influencing Factors

2.2.1 Characteristics of Drag Reduction by Surfactant Additives

2.2.2 Influencing Factors of Drag Reduction by Surfactant Additives

2.3 The Diameter Effect of Surfactant Drag-reducing Flow and Scale-up Methods

2.3.1 The Diameter Effect and Its Influence

2.3.2 Scale-up Methods

2.3.3 Evaluation of Different Scale-up Methods

2.4 Heat Transfer Characteristics of Drag-reducing Surfactant Solution Flow and Its Enhancement Methods

2.4.1 Convective Heat Transfer Characteristics of Drag-reducing Surfactant Solution Flow

2.4.2 Heat Transfer Enhancement Methods for Drag-reducing Surfactant Solution Flows

References

3 Turbulence Structures in Drag-Reducing Surfactant Solution Flow

- 3.1 Measurement Techniques for Turbulence Structures in Drag-Reducing Flow
 - 3.1.1 Laser Doppler Velocimetry
 - 3.1.2 PIV
- 3.2 Statistical Characteristics of Velocity and Temperature Fields in Drag-reducing Flow
 - 3.2.1 Distribution of Averaged Quantities
 - 3.2.2 Distribution of Fluctuation Intensities
 - 3.2.3 Correlation Analyses of Fluctuating Quantities
 - 3.2.4 Spectrum Analyses of Fluctuating Quantities
- 3.3 Characteristics of Turbulent Vortex Structures in Drag-reducing Flow
 - 3.3.1 Identification Method of Turbulent Vortex by Swirling Strength
 - 3.3.2 Distribution Characteristics of Turbulent Vortex in the x-y Plane
 - 3.3.3 Distribution Characteristics of Turbulent Vortex in the y-z Plane
 - 3.3.4 Distribution Characteristics of Turbulent Vortex in the x-z Plane
- 3.4 Reynolds Shear Stress and Wall-Normal Turbulent Heat Flux
- References
- 4 Numerical Simulation of Surfactant Drag Reduction
 - 4.1 Direct Numerical Simulation of Drag-reducing Flow
 - 4.1.1 A Mathematical Model of Drag-reducing Flow
 - 4.1.2 The DNS Method of Drag-reducing Flow
 - 4.2 RANS of Drag-reducing Flow
 - 4.3 Governing Equation and DNS Method of Drag-reducing Flow
 - 4.3.1 Governing Equation
 - 4.3.2 Numerical Method
 - 4.4 DNS Results and Discussion for Drag-reducing Flow and Heat Transfer
 - 4.4.1 The Overall Study on Surfactant Drag Reduction and Heat Transfer by DNS
 - 4.4.2 The Rheological Parameter Effect of DNS on Surfactant Drag Reduction
 - 4.4.3 DNS with the Bilayer Model of Flows with Newtonian and Non-Newtonian Fluid Coexistence
 - 4.5 Conclusion and Future Work
- References
- 5 Microstructures and Rheological Properties of Surfactant Solution
- 6 Application Techniques for Drag Reduction by Surfactant Additives
- Index

章节摘录

版权页：插图：1.3.2.4 Decoupling of Turbulent Fluctuations It has been indicated from many studies that the effect of drag reducer on turbulent flows also appears as the decreased correlation between the axial and radial fluctuations. This effect is named "decoupling." The decoupling of turbulent fluctuations can decrease the Reynolds stress. According to the quantitative relationship between Reynolds shear stress and the turbulent contribution to frictional drag coefficient deduced by Fukagata et al. (i.e., the FIK equation) (38) , a decrease of Reynolds shear stress directly results in a decrease of the friction factor of turbulent flow, and so turbulent DR. Actually, a decrease of Reynolds stress is caused by twofold effects, that is, the decoupling of turbulent fluctuations and turbulence suppression (17,33,39-41) .This postulation is also correct qualitatively. 1.3.2.5 Viscoelasticity All polymer and surfactant solutions with turbulent drag-reducing effects display viscoelastic rheological properties. With the development of viscoelastic fluid mechanics, some researchers proposed that the drag-reducing effect of polymer and surfactant solutions is the result of the interaction between viscoelasticity and turbulent vortices. The microstructures (polymer molecule chains or network structures in surfactant solution) in the drag reducer solution at a high-shear-rate region can absorb the turbulent kinetic energy of small vortices within the energy-containing range and store it. When the microstructures are diffused or convected to a low-shear-rate region, they will be relaxed to a random threadlike entanglement and the stored energy will be released to the low-wave-number vortices (large-scaled vortices) in the form of elastic stress waves, which greatly decreases the dissipation of turbulent kinetic energy and induces turbulent DR. The viscoelastic theory for the mechanism of turbulent DR by additives was proposed by DeGennes (42) . The viscoelasticity postulation not only explains the turbulent DR phenomenon in many polymer and surfactant solution flows with viscoelasticity, but also estimates the DR rate quantitatively. It is also a powerful tool for studying the mechanism of turbulent DR from the viewpoint of the physics of turbulence and developing new quantitative analysis theories for turbulent drag-reducing flows. However, this postulation was challenged by the "anisotropic stresses" hypothesis proposed by Toonder (43) .

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