

C S WEN

# THE FUNDAMENTALS OF AEROSOL DYNAMICS

World Scientific

# CONTENTS

## PREFACE

v

## CHAPTER 1. A SURVEY OF AEROSOLS

- |   |   |
|---|---|
| 1. The General Properties and Classifications of Aerosols | 1 |
| 2. The Size Distribution of Aerosol Particles             | 6 |
| 3. Shape and Structure of Aerosol Particles               | 8 |

## CHAPTER 2. THE MOTIONS OF VISCOUS FLUIDS

- |   |    |
|---|----|
| 1. Introduction   | 13 |
| 2. Two Exact Viscous Flow Fields                                      | 22 |
| 3. Setting up of Viscous Flows  | 25 |
| 4. Similarity in the Mechanics of Viscous Fluids and Aerosol Dynamics | 28 |
| 5. Viscous Force Dominated Flows                                      | 36 |

## CHAPTER 3. SOME LOW-REYNOLDS-NUMBER FLOWS

- |  |    |
|--|----|
| 1. Dynamics of Isolated Particles                          | 43 |
| 2. The Oseen Approximation                                 | 53 |
| 3. Flow due to Longitudinal Relative Motion of Two Spheres | 57 |
| 4. Flow due to Transverse Relative Motion of Two Spheres   | 61 |

## CHAPTER 4. KINETICS OF TWO SPHERES AT LOW REYNOLDS NUMBER AND LOW STOKES NUMBER

- |  |    |
|--|----|
| 1. Introduction  | 77 |
| 2. Mobility Functions for Two Spheres                                  | 79 |
| 3. Relative Motions of Two Spheres under the Influence of External and |    |

Interparticle Potential Forces	86
4. Relative Brownian Diffusion of Two Spheres and the Equation for the Pair-Distribution Function	90

## CHAPTER 5. SEDIMENTATION OF AEROSOL PARTICLES

1. Sedimentation in a Dilute Monodisperse Stable System	105
2. Solution of the Equation for the Pair-Distribution Function in a Polydisperse Stable System	116
3. Sedimentation in a Dilute Polydisperse Stable System	129
4. Discussion	146

## CHAPTER 6. COAGULATION OF AEROSOL PARTICLES

1. Coagulation in a Dilute Unstable System	149
2. The Rate of Coagulation in a Dilute Unstable System at Large Péclet Number	161
3. The Rate of Coagulation in a Dilute Unstable System When Convection and Brownian Motion Simultaneously Exist	174
4. Discussion	191

## CHAPTER 7. SOME OTHER PROBLEMS IN THE DYNAMICS OF AEROSOLS

1. Mass/Heat Transfer from a Particle Suspended in Flow Fields	199
2. The Effective Viscosity of a Dilute Suspension	212
3. The Effective Viscosity of a Sub-dilute Suspension	217
4. The Evolution of the Size Distribution of Aerosol Particles	227

REFERENCES	239
------------	-----

INDEX	243
-------	-----