

CONTENT

| | Page |
|---|------|
| Preface | iii |
| 1. Introduction to Humic Substances | 1 |
| I History | 1 |
| II Classification | 2 |
| III Distribution | 4 |
| IV Synthesis | 5 |
| V Uses | 6 |
| References | 7 |
| 2. Extraction, Fractionation, and Purification of Humic Substances | 9 |
| I Introduction | 9 |
| II Extraction | 9 |
| III Fractionation and Purification | 17 |
| IV Summary | 22 |
| References | 23 |
| 3. Characterization of Humic Substances by Chemical Methods | 29 |
| I Introduction | 29 |
| II Ultimate Analysis | 29 |
| III Nitrogen Distribution | 32 |
| IV Oxygen-Containing Functional Groups | 37 |
| V Chemical Methods of Functional Group Analysis | 37 |
| VI Distribution of Oxygen in Functional Groups | 48 |
| VII Summary | 51 |
| References | 51 |
| 4. Characterization of Humic Substances by Physical Methods | 55 |
| I Introduction | 55 |
| II Spectroscopic Characteristics | 55 |
| III Electrometric Titrations | 94 |
| IV Molecular Weight | 99 |
| V Viscosity | 110 |
| VI Electron Microscopic Examination | 111 |
| VII Thermal Analysis | 111 |
| VIII Radiocarbon Dating | 126 |
| IX Summary | 128 |
| References | 129 |
| 5. Chemical Structure of Humic Substances | 137 |
| I Introduction | 137 |
| II Hydrolysis | 138 |
| III Oxidative Degradation | 143 |
| IV Reductive Degradation | 161 |
| V The Method of Barton and Schnitzer | 173 |
| VI Biological Degradation | 189 |
| VII Concepts of Molecular Structure | 192 |
| VIII Summary | 197 |
| References | 198 |
| 6. Reactions of Humic Substances with Metal Ions and Hydrous Oxides | 203 |
| I Introduction | 203 |
| II Definition of Metal Complexes and Chelates | 204 |

| | | |
|------|--|-----|
| III | Potentiometric Method | 206 |
| IV | Ion-Exchange Equilibrium Method | 212 |
| V | Mass Action Quotient | 225 |
| VI | Polarographic Method | 228 |
| VII | Conductance Measurements | 228 |
| VIII | Colloid Chemistry of Metal-HA and -FA Complexes | 230 |
| IX | Reactions of Metal Hydroxides and Oxides with HA and FA | 233 |
| X | Preparation of Model Metal-FA Complexes | 235 |
| XI | Methods to Characterize Metal-HA and -FA Complexes | 241 |
| XII | Geochemical Enrichment by Humic Substances | 246 |
| XIII | Summary | 247 |
| | References | 249 |
| 7. | Reactions Between Humic Substances and Clay Minerals | 253 |
| I | Introduction | 253 |
| II | Mechanisms of Reactions | 254 |
| III | Reactions Between FA and Montmorillonite | 257 |
| IV | Evidence for Interlamellar Adsorption of FA by Soil Clay | 275 |
| V | Summary | 278 |
| | References | 278 |
| 8. | Reactions of Humic Substances with Organic Chemicals, N-Containing Compounds and Physiological Properties of Humic Substances | 281 |
| I | Introduction | 281 |
| II | Reactions with Pesticides | 282 |
| III | Reactions with Dialkyl Phthalates | 293 |
| IV | Reactions with N-Containing Compounds | 296 |
| V | Physiological Properties of Humic Substances | 298 |
| VI | Summary | 302 |
| | References | 302 |
| | Author Index | 305 |
| | Subject Index | 317 |