Contents

Part I Reductive Technologies

1 Geochemical Principles of Reductive Remediation Processes 3
Miroslav Černík and Josef Zeman

2 Nanoscale Zero-Valent Iron Particles for Water Treatment: From Basic Principles to Field-Scale Applications 19
Tanapon Phenrat, Petra Skácelová, Eleni Petala, Adriana Velosa, and Jan Filip

3 Other Chemical Reductive Methods 53
Jan Němeček, Stanisław Wacławek, and Miroslav Černík

4 Combination of Electrokinetics and nZVI Remediation 65
Miroslav Černík, Jaroslav Hrabal, and Jaroslav Nosek

5 *Field Study I:* In Situ Chemical Reduction Using Nanoscale Zero-Valent Iron Materials to Degrade Chlorinated Hydrocarbons 87
Vojtěch Stejskal and Nikola Vacková

6 *Field Study II:* Pilot Application of nZVI/DC-Combined Methods at Aargau Site 105
Vojtěch Stejskal, Jaroslav Nosek, Miroslav Černík, Petr Kvapil, and Pierre Matz

Part II Oxidative Technologies

7 Introduction to Oxidative Technologies for Water Treatment 119
Marta I. Litter

8 Ferrates as Powerful Oxidants in Water Treatment Technologies 177
Libor Machala, Petr Zajíček, Jan Kolařík, Tomáš Mackuľak, and Jan Filip

9 Radical Reactions and Their Application for Water Treatment . . . 203
Pavel Hrabák and Stanisław Wacławek

10 Photo-oxidation Technologies for Advanced Water Treatment 221
Rakesh Kumar Sharma, Bhavya Arora, Sriparna Dutta, and Manoj B. Gawande

11 The Use of Nanomaterials in Electro-Fenton and Photoelectro-Fenton Processes 257
Ignasi Sirés and Enric Brillas

12 *Field Study III:* Evidence Gained from Site Studies for the Performance of Ferrate(VI) in Water and Wastewater Treatment 289
Jia-Qian Jiang

13 *Field Study IV:* Arsenic Removal from Groundwater by Ferrate with the Concurrent Disinfecting Effect: Semi-Pilot On-site Application 299
Monika Heřmánková, Roman Vokáč, Jan Slunský, and Jan Filip

14 *Field Study V:* Combined Oxidation Technology Using Ferrates (Fe^{IV-VI}) and Hydrogen Peroxide for Rapid and Effective Remediation of Contaminated Water—Comprehensive Practically Focused Study 315
Petr Lacina and Michal Hegedüs

Part III Biotechnologies for Water Treatment

15 Biotechnologies for Water Treatment 335
Dietmar Schlosser

16 Enzyme-Based Nanomaterials in Bioremediation 345
Monika Čvančarová, Patrick Shahgaldian, and Philippe F.-X. Corvini

17 Bioelectrochemical Processes for the Treatment of Oil-Contaminated Water and Sediments 373
Matteo Daghio and Andrea Franzetti

18 *Field Study VI:* The Effect of Loading Strategies on Removal Efficiencies of a Hybrid Constructed Wetland Treating Mixed Domestic and Agro-Industrial Wastewaters 395
Michal Šereš, Tereza Hnátková, Petr Maršík, Tomáš Vaněk, Petr Soudek, and Jan Vymazal

19 ***Field Study VII:*** **Field Study of Three Different Injectable Oxygen Sources to Enhance Mono-Aromatic Solvents In Situ Biodegradation** 411
Ondřej Lhotský

20 **Nano-Bioremediation: Nanoscale Zero-Valent Iron for Inorganic and Organic Contamination** 425
Jaroslav Semerád, Martin Pivokonsky, and Tomáš Cajthaml

Part IV Biotechnologies for Soil Treatment

21 **Biotechnologies for Soil Treatment** 437
Petra Najmanová and Martin Halecký

22 **Mycoremediation of Contaminated Soils** 445
Tatiana Stella

23 **Composting Practices for the Remediation of Matrices Contaminated by Recalcitrant Organic Pollutants** 467
Ondřej Lhotský, Stefano Covino, and Tomáš Cajthaml

24 **Modern Bioremediation Approaches: Use of Biosurfactants, Emulsifiers, Enzymes, Biopesticides, GMOs** 495
Martin Halecký and Evguenii Kozliak

25 ***Field Study IX:*** **Pilot-Scale Composting of PAH-Contaminated Materials: Two Different Approaches** 527
Petra Innemanová and Tomáš Cajthaml

26 ***Field Study X:*** **Oil Waste Processing Using Combination of Physical Pretreatment and Bioremediation** 535
Petra Najmanová and Robert Raschman

Part V Ecotoxicology of Both Environmental Pollutants and Nanomaterials Used for Remediation

27 **Ecotoxicology of Environmental Pollutants** 549
Luděk Bláha and Jakub Hofman

28 **Ecotoxicity of Nanomaterials Used for Remediation** 573
Claire Coutris, Alena Ševců, and Erik J. Joner

Part VI Future Prospects

29 **Future Prospects for Treating Contaminants of Emerging Concern in Water and Soils/Sediments** 589
Carmen Mihaela Neculita, Lucie Coudert, Eric Rosa, and Catherine N. Mulligan

Part VII Technical Chapters

30 ***Tool I:*** **Characterization of nZVI Mobility in 1D and Cascade Columns by Ferromagnetic Susceptibility Sensor** 609
Petr Parma, Alena Ševců, and Miroslav Černík

31 ***Tool II:*** **Membrane Interface Probe** 619
Vladislav Knytl

32 ***Tool III:*** **Fracturing for Enhanced Delivery of In Situ Remediation Substances in Contaminated Sediments** 625
Jan Kukačka and Petr Kvapil

33 ***Tool IV:*** **Monitoring of nZVI Migration and Fate in the Groundwater Conditions** 633
Petra Skácelová and Jan Filip

34 ***Tool V:*** **Microbiological Methods for Monitoring nZVI Performance in Groundwater Conditions** 645
Alena Ševců, Iva Dolinová, Tomáš Cajthaml, Jana Steinová, and Roman Špánek