

Contents

List of contributors ix

Preface xi

Acknowledgments xiii

1. Water reuse from treated wastewater: insights gained from the Italian demonstration case studies of the Wider-Uptake EU project

Giorgio Mannina, Alida Cosenza and Hazal Gulhan

- 1.1 Introduction 1
- 1.2 A water reuse regulations 2
- 1.3 Italian demonstration case studies 4
- 1.4 Reclaimed water quality indices 9
- 1.5 Scenario analysis for Palermo University case study 9
- 1.6 The influence of operating conditions 10
- 1.7 Mathematical modeling 10
- 1.8 Conclusions and perspectives 12
- Acknowledgments 12
- References 12

2. Resource recovery from waste activated sludge by polyhydroxyalkanoate production

Giorgio Mannina and Antonio Mineo

- 2.1 Introduction 15
- 2.2 The circular bioeconomy approach: integrating the polyhydroxyalkanoate production in the wastewater treatment plants 17
- 2.3 The University of Palermo case study within the Wider Uptake project 19
- 2.4 Conclusions and perspectives 27
- Acknowledgments 28
- References 28

3. Reducing the sewage sludge production by applying oxic settling anaerobic and intermittent aeration process

Daniele Di Trapani, Paulo Marcelo Bosco Mofatto, Alida Cosenza and Giorgio Mannina

- 3.1 Introduction 33
- 3.2 A sewage sludge reduction processes 34
- 3.3 UNIPA demonstration case study 35
- 3.4 Layout comparison 39
- 3.5 Influence of operating conditions 40
- 3.6 Influence of plant configuration 45
- 3.7 Layout comparison on score level 47
- 3.8 Conclusions and perspectives 48
- Acknowledgments 49
- References 49

4. Slow-release fertilizers by biochar and zeolite enriched by treated wastewater for nutrient recovery

Sofia Maria Muscarella, Luigi Badalucco, Giorgio Mannina, Sara Paliaga and Vito Armando Laudicina

- 4.1 Introduction 53
- 4.2 Zeolite and biochar as nutrient adsorbents from treated wastewater 55
- 4.3 Mechanisms of nutrient adsorption by zeolite and biochar 59
- 4.4 Nitrogen and phosphorus in the soil-plant system 66
- 4.5 Nitrogen and phosphorus in wastewater 68
- 4.6 Nutrient-enriched zeolite as slow-release fertilizer 69
- 4.7 Nutrient-enriched biochar as slow-release fertilizer 72
- 4.8 Modeling nutrient desorption from zeolite and biochar 74
- 4.9 Conclusions and perspectives 76
- Acknowledgments 77
- References 77

5. Water reuse for greening urban areas: insights gained from the Czech Republic demonstration case study

Vadim Strogonov, Iveta Růžicková, Jaroslav Pollert,
Solomon Ofori and Jiří Wanner

- 5.1 Introduction 85
- 5.2 Why water reuse and what prevents it 86
- 5.3 Minimum requirements for water reuse 89
- 5.4 Law Limits in Czech Republic 92
- 5.5 Research of the water reuse 94
- 5.6 Cooperation with public and stakeholders 109
- 5.7 Current water reuse projects in the Czech Republic 111
- 5.8 Conclusions and perspectives 112
- List of abbreviations 114
- References 115

6. Fuel production from sewage sludge: insights from a demonstration in Ghana

Gordon Akon-Yamga, Wilhemina Quaye, George O. Essegbey,
William O. Oduro, Ahmed Issahaku, Justina A. Onumah,
Portia A. Williams and Abdalla Mahama

- 6.1 Introduction 117
- 6.2 Wood-based charcoal in Ghana 119
- 6.3 Circular bioeconomy to the rescue 121
- 6.4 Production of biochar from sludge: the Ghana demonstration 122
- 6.5 Non-technical barriers and challenges 126
- 6.6 Policy implications and recommendations 127
- 6.7 Conclusions and perspectives 129
- References 130

7. Circularity and efficiency assessment of resource recovery solutions

Anurag Bhambhani and Zoran Kapelan

- 7.1 Introduction 133
- 7.2 Circularity assessment 134
- 7.3 Efficiency assessment 138
- 7.4 Case study 145
- 7.5 Conclusions and perspectives 152
- Appendix A 153
- References 154

8. Transition to circular economy in the water sector: the case study of Corleone, Italy

Hazal Gulhan, Alida Cosenza, Daniele Di Trapani, Antonio Mineo,
Paulo Marcelo Bosco Mofatto and Giorgio Mannina

- Abbreviations 157
- 8.1 Introduction 158
- 8.2 Corleone wastewater treatment plant 158
- 8.3 The circular economy transition idea 159
- 8.4 Sewage sludge reduction: the influence of operating conditions 160
- 8.5 Greenhouse gases emissions 162
- 8.6 Plant performance 163
- 8.7 Mathematical modeling 165
- 8.8 Conclusions and perspectives 168
- Acknowledgments 168
- References 168

9. Roadmap development and preliminary applications to foster the transition to the circular economy in the water sector: the case study of Corleone

Daniele Di Trapani, Alida Cosenza, Hazal Gulhan and
Giorgio Mannina

- 9.1 Introduction 171
- 9.2 Roadmap approach for the transition towards circular economy: an overview 172
- 9.3 A proposal for a roadmap approach in the water sector 172
- 9.4 The roadmap database 177
- 9.5 Preliminary application of roadmap to the case study of Corleone (Italy) 179
- 9.6 Conclusions and perspectives 180
- Acknowledgments 181
- Abbreviations 181
- References 181

10. Governance assessment and business models for reuse of treated wastewater in agriculture: an Italian case study

Alida Cosenza and Giorgio Mannina

- 10.1 Introduction 183
- 10.2 Governance assessment and business model development for the circular economy based on water resources 184

10.3	Italian case study—Corleone	186
10.4	Business model exploration in the Corleone case study	188
10.5	Conclusions and perspectives	191
	Acknowledgments	191
	References	192

11. Assessing water smartness and sustainability: the case study of Corleone (Italy)

Hazal Gulhan, Alida Cosenza, Karen Nessler Seglem,
Herman Helness and Giorgio Mannina

11.1	Introduction	193
11.2	The approach within WIDER UPTAKE	193
11.3	Framework testing application: the case study of Corleone	195
11.4	Conclusions and perspectives	214
	Acknowledgments	215
	Abbreviations	215
	References	215

12. Scenario analysis toward the implementation of a roadmap for transitioning to a circular economy in the case study of Corleone

Alida Cosenza, Daniele Di Trapani, Rita Ugarelli,
Herman Helness and Giorgio Mannina

12.1	Introduction	217
12.2	Approach within Wider Uptake	218
12.3	Case study	219
12.4	Interactions with key actors	220
12.5	Scenario analysis and alternative solutions	221
12.6	Main outcomes and recommendations	226
12.7	Conclusions and perspectives	227
	Acknowledgments	228
	References	228

Index 231