

Contents

<i>List of Contributors</i>	<i>xvii</i>
<i>Preface</i>	<i>xix</i>
I FUNDAMENTALS AND MICROBIOLOGICAL ASPECTS	1
1 Introduction to Air Pollution	3
<i>Christian Kennes and María C. Veiga</i>	
1.1 Introduction	3
1.2 Types and sources of air pollutants	3
1.2.1 Particulate matter	5
1.2.2 Carbon monoxide and carbon dioxide	6
1.2.3 Sulphur oxides	7
1.2.4 Nitrogen oxides	7
1.2.5 Volatile organic compounds (VOCs)	9
1.2.6 Odours	10
1.2.7 Ozone	11
1.2.8 Calculating concentrations of gaseous pollutants	11
1.3 Air pollution control technologies	11
1.3.1 Particulate matter	11
1.3.2 Volatile organic and inorganic compounds	12
1.3.3 Environmentally friendly bioenergy	17
1.4 Conclusions	17
References	17
2 Biodegradation and Bioconversion of Volatile Pollutants	19
<i>Christian Kennes, Haris N. Abubackar and María C. Veiga</i>	
2.1 Introduction	19
2.2 Biodegradation of volatile compounds	20
2.2.1 Inorganic compounds	20
2.2.2 Organic compounds	21
2.3 Mass balance calculations	24
2.4 Bioconversion of volatile compounds	25
2.4.1 Carbon monoxide and carbon dioxide	25
2.4.2 Volatile organic compounds (VOCs)	26
2.5 Conclusions	27
References	27

3	Identification and Characterization of Microbial Communities in Bioreactors	31
	<i>Luc Malhautier, Léa Cabrol, Sandrine Bayle and Jean-Louis Fanlo</i>	
3.1	Introduction	31
3.2	Molecular techniques to characterize the microbial communities in bioreactors	32
3.2.1	Quantification of the community members	32
3.2.2	Assessment of microbial community diversity and structure	34
3.2.3	Determination of the microbial community composition	39
3.2.4	Techniques linking microbial identity to ecological function	40
3.2.5	Microarray techniques	41
3.2.6	Synthesis	42
3.3	The link of microbial community structure with ecological function in engineered ecosystems	42
3.3.1	Introduction	42
3.3.2	Temporal and spatial dynamics of the microbial community structure under stationary conditions in bioreactors	43
3.3.3	Impact of environmental disturbances on the microbial community structure within bioreactors	45
3.4	Conclusions	47
	References	47
II	BIOREACTORS FOR AIR POLLUTION CONTROL	57
4	Biofilters	59
	<i>Eldon R. Rene, María C. Veiga and Christian Kennes</i>	
4.1	Introduction	59
4.2	Historical perspective of biofilters	59
4.3	Process fundamentals	60
4.4	Operation parameters of biofilters	62
4.4.1	Empty-bed residence time (EBRT)	62
4.4.2	Volumetric loading rate (VLR)	63
4.4.3	Mass loading rate (MLR)	63
4.4.4	Elimination capacity (EC)	63
4.4.5	Removal efficiency (RE)	63
4.4.6	CO ₂ production rate (P_{CO_2})	63
4.5	Design considerations	64
4.5.1	Reactor sizing	64
4.5.2	Irrigation system	66
4.5.3	Leachate collection and disposal	66
4.6	Start-up of biofilters	68
4.7	Parameters affecting biofilter performance	70
4.7.1	Inlet concentrations and pollutant load	70
4.7.2	Composition of waste gas and interaction patterns	71
4.7.3	Biomass support medium	72
4.7.4	Temperature	75
4.7.5	pH	78
4.7.6	Oxygen availability	79
4.7.7	Nutrient availability	80