
Contents

Chapter 7. Removal of Natural Organic Matter	1
7.1. Natural organic matter: humic substances	1
7.2. Methods of quantification and assessment of organic substances in water	8
7.2.1. Total organic carbon	9
7.2.2. Absorbance of ultraviolet light at 254 nm (UV 254)	12
7.2.3. Specific UV absorbance	13
7.2.4. Liquid chromatography	16
7.2.5. Hydrophobic organic carbon	18
7.2.6. Fluorescence	25
7.3. Conditions for the removal of NOM	26
7.4. NOM removal techniques	29
7.4.1. Coagulation–flocculation	30
7.5. Adsorption on activated carbon	72
7.5.1. Mechanism of NOM removal by activated carbon	72
7.5.2. Implementation of activated carbon adsorption for NOM removal	75
7.6. Ozonation	103
7.6.1. Preozonation	103
7.6.2. Interozonation	106
7.7. Biological treatment	109
7.7.1. Biological treatment with PAC: operating principle of the Opaline® B process (Veolia)	109
7.7.2. Biological treatment combining ozone and GAC	114
7.8. Treatment of ion exchange resins	124
7.8.1. Use of resins for NOM removal: mechanism of NOM removal	124

7.8.2. Parameters affecting the performance of resins for the removal of NOM	125
7.8.3. Resin regeneration	127
7.8.4. The Opalix® process	127
7.9. NOM removal by high-pressure membranes	133
7.10. References	137
 Chapter 8. Filtration	 143
8.1. Rapid filters and very high-rate filters (TGV)	144
8.2. Multimedia filters	145
8.3. Direct filtration.	148
8.4. Pressurized filters	150
8.5. Filtration mechanisms.	151
8.5.1. General principle	151
8.5.2. Mechanisms involved in filtration	152
8.6. Implementation parameters	156
8.6.1. Materials	156
8.6.2. Material height/d ₁₀ ratio	161
8.6.3. ES ratio	164
8.7. Sizing parameters: filtration rate and material height	165
8.8. Operating parameters	168
8.8.1. Pressure loss in a clean filter	168
8.8.2. Pressure loss during clogging.	171
8.8.3. Estimation of the turbidity of filtered water in single-layer filters	174
8.8.4. Retention capacity	175
8.8.5. Filter washing conditions: theory and calculations	178
8.8.6. Cycle time	192
8.8.7. Main parameters involved in filter sizing.	192
8.9. Veolia filtration technologies: general information	193
8.9.1. Characteristics of open gravity filters	197
8.10. Regulation systems	222
8.10.1. Hydraulic regulators	222
8.10.2. Control valves	224
8.11. Recycling and microbiological risks	224
8.12. Monitoring the operation and performance of filters.	226
8.12.1. Turbidity	226
8.12.2. Particle count	228
8.12.3. Problems with the operation of filters	229
8.13. References	232

Chapter 9. Adsorption on Activated Carbon	235
9.1. Activation processes of activated carbon	235
9.1.1. Chemical activation	236
9.1.2. Physical activation	237
9.2. Physicochemical properties of activated carbon	238
9.2.1. Parameters influencing adsorption	239
9.3. Transport process in activated carbon: mass transfer	251
9.3.1. Adsorption mechanisms and isotherms	255
9.4. The different forms of conditioning of activated carbons	267
9.4.1. Powdered activated carbon	267
9.4.2. Micrograin activated carbon (μ grain)	268
9.4.3. Granular activated carbon	270
9.5. Adsorption reactors on activated carbon: removal process	270
9.6. PAC reactors: description of PAC reactors	272
9.6.1. Mass balance	275
9.6.2. GAC reactors in adsorption mode: GAC filters	283
9.6.3. Fluidized bed activated carbon reactors	296
9.6.4. GAC- μ grain-PAC comparison	304
9.6.5. Hybrid process with a PAC reactor associated with UF membranes	306
9.7. Veolia technologies: treatment process with PAC reactors	307
9.7.1. Implementation in a settler without PAC recirculation	308
9.7.2. Implementation with PAC recirculation	309
9.7.3. Opaline® C process: PAC-membrane hybrid	329
9.8. Micrograin activated carbon reactors	333
9.8.1. Integration of μ grain activated carbon in the treatment process	333
9.8.2. The Filtraflo® Carb	334
9.8.3. Opacarb® FL	342
9.8.4. Opacarb® MG	348
9.9. Fixed bed reactors – GAC filters	352
9.9.1. The GAC filter (Veolia)	354
9.9.2. GAC filters in series	361
9.9.3. Implementation modes for GAC filters	362
9.10. Pressurized GAC filters (Opacarb™ filters)	366
9.11. References	368
Index	373
Summaries of other volumes	375