ENVIRONMENTAL SEPARATION 2022 of HEAVY METALS

ENGINEERING PROCESSES

Edited by



Table of Contents

Prefe	ce xi	
Cont	ributing Authors xiii	
•	PRINCIPLES OF HEAVY METALS SEPARATION: AN INTRODUCTION	
	Heavy Metals: What Are They? 1 Heavy Metals Separation: Underlying Chemistry 3 Heavy Metals: What Are They? 1 Heavy Metals: What Are They Metals: What Ar	
	ADSORPTION OF ELEMENTAL MERCURY BY VIRGIN AND IMPREGNATED ACTIVATED CARBON	1
	ntroduction 15 Mercury Uptake by Virgin Activated Carbon 18 Mercury Uptake by Impregnated Activated Carbons 25 References 42	
	TRACE HEAVY METAL SEPARATION BY CHELATING ION EXCHANGERS	4
	ntroduction 45 Heavy Metal Removal from Aqueous Phase 47 Developments in Overcoming Shortcomings of Conventional Ion Exchange Processes 66 Heavy Metal Removal from a Solid Phase 71	

Sorption Kinetics of the CIM

Carbon Surface Chemistry

206

80

	Metal-Ion Separation 88 Closure 92 References 92					
4.	ELIMINATION OF HEAVY METALS FROM WASTEWATERS BY MAGNETIC TECHNOLOGIES					
	Separator Technology 98 Removal of Heavy Metals in Combination with Chemical Precipitation 106 Removal of Heavy Metals Using Microorganisms and Magnetic Separation 118 References 136					
5.	POLYELECTROLYTE ENHANCED REMOVAL OF METALS FROM SOILS AND OTHER SOLIDS					
	Introduction 141 Case Study 1: Mercury Removal from Debris 146 Case Study 2: Removal of Mercury from Soils 158 Case Study 3: Remediation of Lead-Contaminated Soils 163 Case Study 4: Removal of Toxic and Radioactive Metals from Paint Stripper Waste 168 Case Study 5: Application to the Mining and Mineral Processing Industry 169 Summary 174 Legend of Acronyms and Symbols 174 Acknowledgements 175 References 175					
6.	CASE STUDIES FOR IMMOBILIZING TOXIC METALS WITH IRON COPRECIPITATION AND ADSORPTION					
	Introduction 181 Theoretical Consideration of the Iron Coprecipitation/Adsorption Process 182 Case Study: Copper, Lead and Zinc Treatment 184 Case Study: Arsenic Treatment 193 Summary and Conclusions 201 Acknowledgements 202 References 202					
7.	REMOVAL OF HEAVY METALS BY ACTIVATED CARBON					
	Introduction 205					

8.

	Removal Mechanisms 207 Factors Affecting Metal Removal by Activated Carbon 208 SCF Modeling of Acid-Base Behavior and Heavy Metal Removal 218 Metal Removal Kinetics 229 Heavy Metal Removal by GAC Columns 230 References 261
8.	ARSENIC IN SUBSURFACE WATER: ITS CHEMISTRY AND REMOVAL BY ENGINEERED PROCESSES
	Introduction 265 Arsenic: Its Chemistry and Natural Occurrence 267 Arsenic Removal Technologies: Underlying Principles 273 Sorption Behaviors of As(III) 282 Experience at Albuquerque 286 Arsenic Removal: Experience in Indian Subcontinent 291 Development of a Polymeric/Inorganic Hybrid Sorbent 294 Conclusions 301 Acknowledgements 302 References 302
9.	Cr(III) SEPARATION AND RECOVERY FROM TANNERY WASTES: RESEARCH, PILOT AND DEMONSTRATION SCALE INVESTIGATION
	Introduction 307 The Environmental Impact of Trivalent Chromium on Water-Soil Compartments 309 The Tanning Process 310 Environmental Technologies for Cr(III) Control 312 Conservative Technologies for Pollutant Control 314 Metals Speciation in Tannery Wastes 315 Pretreatment of Tannery Sludge 316 Process 1: Re-Precipitation of Metals from Mixed Sludge Acidic Leachate 319 Process 2: Oxidation of Cr(III) to Cr(VI), Recovery and Separation of Metals by Ion Exchange 319 Process 3: Leaching of Sludge and Metals Recovery by Selective Ion Exchange 323 Process 4: Chromium Removal and Recovery from Segregated Tannery Wastewaters: The IERECHROM® Process 329 Case History 1: Application of the IERECHROM® Process in the Conventional Flowsheet of Tannery Wastewater Treatments 339 Case History 2: Direct Comparison of Three Alternatives for the Tannery Industry 342 Acknowledgements 343 References 343

10.	HUMASORB": A COAL-DERIVED HUMIC ACID-BASED HEAVY METAL SORBENT				
	Introduction	347			
	Humic Substan	ces 34	8		
	HUMASORB™	Technolo	gy	353	
	Conclusions	373			
	Deferences	277			

Index 375

About the Editor 381