

Removal of Organochlorine Pesticide from Water Environment

> Sudhakar Yedla Anil K. Dikshit



CONTENTS

| Preface Acknowledgemen | | v ix |
|---------------------------|---|---------|
| Chapter 1 | INTRODUCTION | 1 |
| Chapter 2 | PESTICIDE POLLUTION | 4 |
| | 2.1 Pesticides 4 2.2 Occurrence and Environmental Pollution 5 2.3 Toxic Effects of Pesticides 8 2.4 Permissible Limits of Pesticides 10 2.5 Available Removal Techniques 11 2.5.1 Chemical Oxidation 11 2.5.2 Volatilization, Ion exchange and Reverse Osmosis 12 2.5.3 Biological Methods 12 2.5.4 Adsorption 14 2.6 Water Treatment Technology for Pesticide Removal: Case Study of Removal of Endosulfan from Drinkin Water 15 2.6.1 Endosulfan in Environment 15 2.6.2 Proposed Methodology 16 | |
| Chapter 3 | SELECTION OF APPROPRIATE ADSORBENT | 20 |
| | 3.1 Analysis of Pesticides 20 3.1.1 Choosing Appropriate Solvent for Extraction of Pesticide 20 3.1.2 Extracting Pesticide from Water 21 3.1.3 Analyzing Pesticide 22 3.2 Selecting Adsorbent 23 3.2.1 Preparing Various Adsorbents 23 3.2.2 Kinetic Evaluation 24 3.2.3 Assessing Adsorption Capacity 26 | |
| Chapter 4 | CHARACTERIZATION OF ADSORBENT AND ITS PRE-TREATMENT | 34 |

| | 4.1 Physical and Chemical Characteristics of Wood Charcoal 34 4.2 Pre-treatment of Wood Charcoal 35 4.2.1 Carrying Out Pre-Treatment 36 4.2.2 Assessing Effectiveness of Pre-Treatment 37 |
|-----------|--|
| Chapter 5 | BATCH ADSORPTION AND DESORPTION STUDIES 39 |
| | 5.1 Kinetic Studies 39 5.1.1 Conducting Kinetic Experiments 40 5.1.2 Developing Kinetic Profiles 40 5.1.3 Determining Adsorption Rate Constants 40 5.1.4 Assessing Adsorption Equilibrium Time 43 5.2 Equilibrium Studies 46 5.2.1 Conducting Equilibrium Experiments 47 5.2.2 Isotherms for Low Adsorbate Range 47 Determining Saturation Adsorption Capacity of the |
| | Adsorbate 47 Comparing Experimental and Theoretical Isotherms 48 5.2.3 Isotherms for Higher Adsorbate Range 50 |
| | Determining Saturation Adsorption Capacity of the Adsorbate 50 Comparing Experimental and Theoretical Isotherms 50 |
| | 5.3 Determining Rate Limiting Step 51 5.3.1 Using Adsorption Kinetic Data 53 5.3.2 Using the Effect of Initial Concentration 54 5.3.3 Using the Effect of Different Adsorbent Sizes 56 5.3.4 Using the Effect of Different Agitation Rates 58 5.3.5 Using Interruption Tests 59 5.4 Elucidating Removal Mechanism 60 5.5 Batch Desorption Studies 62 5.5.1 Conducting Desorption Experiments 63 5.5.2 Choosing Appropriate Eluent for Adsorbent Regeneration 64 5.5.3 Optimizing Duration of Desorption 64 |
| Chapter 6 | IMPACT OF EXOGENOUS PARAMETERS ON BATCH ADSORPTION 67 |
| | 6.1 Effect of pH 67 6.2 Effect of Ionic Strength 69 6.3 Effect of Chloride Concentration 69 6.4 Effect of Ca²⁺ and Mg²⁺ 70 6.5 Effect of Urea and Single Super Phosphate 73 6.6 Effect of Dissolved Organic Matter 73 |

Chapter 7

Chapter 8

References

| 6.7 Effect of Co-sorbates 75 | |
|--|-----|
| 6.7.1 Effect of Atrazine 75 | |
| 6.7.2 Effect of Monocrotophos 76 | |
| 6.8 Sequential Uptake 76 | |
| FIXED BED ADSORPTION AND REGENERATION | Į |
| STUDIES | 78 |
| 7.1 Fixed Bed Adsorption System 78 | |
| 7.2 Conducting Breakthrough Studies 82 | |
| 7.3 Generating Design Data for Fixed Bed Reactor 86 | |
| 7.4 Deriving Theoretical Breakthrough Curves 93 | |
| 7.5 Regenerating the Spent Adsorbent in Fixed Bed React 96 | tor |
| 7.6 Evaluating Performance of Laboratory Scale Fixed Reactor 98 | Bed |
| MANAGEMENT OF ELUENT AND | |
| EXHAUSTED ADSORBENT | 99 |
| 8.0 General <i>99</i> | |
| 8.1 Volatilization <i>100</i> | |
| 8.2 Hydrolysis 101 | |
| 8.3 Biological Methods (Aerobic) 102 | |
| 8.3.1 Uptake of the Adsorbate by Viable Bacteria 102 | |
| 8.3.2 Shock of Bacteria for the Adsorbate 103 | |
| 8.3.3 Biotransformation 104 | |
| | 107 |
| | |