

**A GENERIC APPROACH FOR TREATMENT OF
COMBINED WASTE WATERS OF SMALL SCALE
INDUSTRIAL CLUSTERS OF DELHI**

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**A GENERIC APPROACH FOR TREATMENT OF COMBINED WASTE
WATERS OF SMALL SCALE INDUSTRIAL CLUSTERS OF DELHI**

by

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Submitted

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Dedicated

to

My Teachers and My Family Members

CERTIFICATE

This is to certify that the thesis entitled “**A generic approach for treatment of combined waste waters of small scale industrial clusters of Delhi**” being submitted by Mr Asheesh Kumar Yadav to the Indian Institute of Technology, Delhi for the award of Doctor of Philosophy is a record of bonafide research work carried out by him. He has worked under our guidance and supervision and has fulfilled the requirements for the submission of this thesis. To the best of our knowledge the results contained in this thesis have not been submitted in part or in full to any other university or institute for the award of any degree or diploma.

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ABSTRACT

Present study is an attempt to develop a suitable low cost strategy for treatment of combined wastewaters of small scale industrial clusters of Delhi. Most of the small and tiny industries do not have their own effluent treatment plants because of technical, economical and space constraints. Realizing this practical problem, a few Common Effluent Treatment Plants (CETPs) have been installed as a cost effective option for compliance with the discharge standards for small scale polluting units in industrial clusters, which cannot afford the burden of installing costly pollution control system. The combined wastewater of the Delhi industrial area is very complex in nature due to large numbers of industries and the heterogeneous nature of production in these industrial units.

To begin with, an overview of common effluent treatment with special reference to Delhi's industrial areas is discussed. Characterization as well as study of changes in quantity and quality of combined waste waters of small scale industrial clusters of Delhi was performed. Principal component analyses for characteristics of wastewaters were also performed. It was found that source of various pollutants were not same in cluster, they comes from different industrial sources. Finally, combined wastewaters of three industrial areas of Delhi namely Wazirpur, Mayapuri and Okhla industrial area were treated with two unit processes i.e constructed wetlands (CW) and electrocoagulation. The main idea behind these unit processes selection was their treatment suitability to these and low cost of CW.

Electrocoagulation treatment study was started with Ni removal from aqueous solution using iron and aluminium electrode in order to see the effect of different initial conductivity, treatment time and initial metal concentration. It was found that higher initial conductivity and treatment time produce best results. Treatment of wastewater from Wazirpur industrial area by electrocoagulation using Al-electrodes 100 % Cr, 98.71% of Zn removal in 40 minutes, 83.94 % COD, 62.33 % of TDS and 83.66 % of sulfate removal was also achieved in a treatment time of 80 min. Similarly, electrocoagulation of Okhla and Mayapuri wastewater also produced significant results within a treatment time of 80 minutes.

In constructed wetlands, three plant species namely *Canna indica*, *Typha angustifolia* and *Cyperus alternifolius* were used. Constructed wetland planted with different plant species were tested for their heavy metal (Cr, Ni, Cu, Zn and Co) removal potential from aqueous and all three were found to be potent plant species for these heavy metal removal. However, their heavy metal accumulation capacities were found to be different. Maximum heavy metal were accumulated in roots followed by stem and leaves in all three plant species. The best results were produced by *Canna indica* as it accumulate Cr, Ni, Cu, Zn and Co at concentrations of 1.06, 1.48, 2.02, 2.46 and 1.35 mg/g in its roots, Also, increased height of gravel bed in CW increased the performance of CW, for instance in case of 5 feet (150 cm) gravel bed height in CW, removal of Cr, Ni, Cu, Zn and Co were found to 68.47, 97.29, 82.14, 98.76 and 63.81% while it was 51.85, 74.37%, 61.69, 77.29% and 42.05% respectively in case of 1 feet (30 cm) bed height CW.

Three types of CW i.e normal CW, sulfate reducing bacteria enriched constructed wetland (SRB-CW), sulfate reducing bacteria and iron shaving enriched constructed wetland (SRB-IS-CW) planted with the three plant species were investigated for treatment of Mayapuri, Wazirpur and Okhla industrial area wastewaters. The later two types of constructed wetland were innovative type developed in this study. Performance of SRB-CW and SRB-IS-CW were found to be much better than normal constructed wetland in every case which is significant contribution coming out of this study.

Finally, based on the experimental findings, a generic model for the treatment of combined wastewaters of small scale industrial clusters of Delhi is proposed. It is hoped that the newly developed innovative constructed wetlands using SRB and Iron shaving coupled with electrocoagulation treatment would provide a pragmatic cost-effective solution to the problem of small scale industrial effluents in Delhi.

CONTENTS

Acknowledgement

Abstract

List of Figures

List of Tables

CHAPTER 1: INTRODUCTION

1.0	Background.....	1
1.1	Common Effluent Treatment Plants- The Concept and Advantages.....	2
1.2	Current Status of CETPs in India.....	3
1.3	Studies on of CETP Indian Scenario	5
1.4	Objectives	9

CHAPTER 2: COMMON EFFLUENT TREATMENT PLANTS OF DELHI

2.0	Introduction.....	10
2.1	Technical and Operation related information about CETPs collected through different modes.....	11
2.1.1	Performance status of CETPs in different states in India.....	11
2.1.2	SSIs in Delhi and effluent disposal - a general view	12
2.2	Analytical work on characterisation and seasonal variations of combined wastewater of selected industrial areas	21
2.2.1	Study area and analytical methodologies.....	21
2.2.2	Results and discussion.....	21

CHAPTER 3: ELECTROCOAGULATION TREATMENT OF INDUSTRIAL WASTEWATER

3.0	Introduction.....	38
3.1	Electrocoagulation (EC).....	40
3.2	Material and methods.....	43
3.2.1	Wastewater characterization.....	43
3.2.2	Experimental Procedure.....	43
3.3	Results and Discussion.....	45

3.3.1	Removal of Ni from aqueous solution by electrocoagulation treatment.....	45
3.3.2	Removal of heavy metals from Wazirpur industrial wastewater in aluminium and iron electrode electrocoagulation.....	51
3.3.3	Removal of COD, TOC, TDS and Sulfate from Wazirpur industrial wastewater through electrocoagulation.....	53
3.3.4	Removal of heavy metals from Okhla industrial wastewater through electrocoagulation.....	55
3.3.5	Removal of COD, TOC, TDS and Sulfate from Okhla industrial wastewater through electrocoagulation	57
3.3.6	Removal of heavy metals from Mayapuri industrial wastewater through electrocoagulation.....	58
3.3.7	Removal of COD, TOC, TDS and Sulfate from Mayapuri industrial wastewater through electrocoagulation.....	60
3.3.8	General discussion on removal of heavy metals, COD, TOC, TDS and Sulphate from wastewaters through electrocoagulation.....	62
3.4	Conclusions.....	65

CHAPTER 4: HEAVY METALS REMOVAL FROM AQUEOUS SOLUTION IN CONSTRUCTED WETLANDS

4.1	Introduction.....	66
4.2	Materials and methods.....	68
4.2.1	Constructed Wetlands Microcosm.....	68
4.2.2	Heavy metals and plant nutrients solutions.....	69
4.2.3	Plant species for Constructed Wetland.....	70
4.2.4	Experimental design.....	73
4.2.5	Biomass sample preparation and heavy metal analysis.....	74
4.2.6	Adsorption and desorption properties of gravel.....	74
4.3	Results and Discussion.....	76
4.3.1	Metal removal from synthetic solution by different hydrophytic planted species	76
4.3.2	Effect of bed height on metal removal in <i>Canna indica</i> planted constructed wetland microcosm.....	77
4.3.3	Heavy metal accumulation and their translocation	86
4.4	Adsorption and desorption properties of gravel.....	93
4.5	Conclusions	95

CHAPTER 5: TREATMENT OF INDUSTRIAL WASTEWATER IN CONSTRUCTED WETLANDS

5.1	Introduction.....	97
5.2	Use of sulfate reducing bacteria (SRB) and zero valent iron (ZVI) in treatment of wastewater.....	98
5.3	Potential of integration of SRB and ZVI for heavy metal removal from wastewater.....	100
5.4	Materials and methods.....	102
5.4.1	Constructed Wetlands Microcosm.....	102
5.4.2	Isolation and enrichment of sulfate reducing bacteria.....	102
5.4.3	Development of sulfate reducing bacteria enriched constructed wetlands microcosm (SRB-CW).....	102
5.4.4	Development of sulfate reducing bacteria enriched iron shaving containing constructed wetlands microcosm (SRB-IS-CW).....	103
5.4.5	X-ray diffraction study.....	104
5.4.6	Analysis.....	104
5.5	Results and Discussion.....	104
5.5.1	Treatment of Wazirpur industrial wastewater in normal constructed wetland planted with different plant species	105
5.5.2	Treatment of Okhla industrial wastewater in normal constructed wetland planted with different plant species	108
5.5.3	Treatment of Mayapuri industrial wastewater in normal constructed wetland planted with different plant species	110
5.5.4	General discussion on various pollutant removal from real wastewater of different industrial clusters in different plant species planted normal constructed wetlands.....	112
5.5.5	Removal of heavy metals from Wazirpur industrial wastewater in different plant species planted normal constructed wetland.....	114
5.5.6	Removal of heavy metals from Okhla industrial wastewater using different plant species planted normal constructed wetland.....	116
5.5.7	Removal of heavy metals from Mayapuri industrial wastewater using different plant species planted normal constructed wetland.....	119
5.5.8	General discussion on various heavy metal removal from wastewaters of	

	different industrial clusters in normal constructed wetlands planted with different species.....	121
5.5.9	Removal of heavy metals from Wazirpur industrial wastewater in SRB enriched constructed wetlands planted with diiferernt plant species (SRB-CW).	123
5.5.10	Removal of heavy metals from Okhla industrial wastewater in SRB enriched constructed wetlands (SRB-CW).....	125
5.5.11	Removal of heavy metals from Mayapuri industrial wastewater in SRB enriched constructed wetlands (SRB-CW).....	128
5.5.12	Discussion on heavy metal removal from wastewaters of different industrial clusters in SRB enriched constructed wetland (SRB-CW).....	130
5.5.13	Treatment of Wazirpur industrial wastewater in SRB and IS enriched CW (SRB-IS-CW).....	132
5.5.14	Treatment of Okhla industrial wastewater in SRB and IS enriched CW planted with different plant species (SRB-IS-CW).....	137
5.5.15	Treatment of Mayapuri industrial wastewater in SRB and IS enriched CW planted with different plant species (SRB-IS-CW).....	143
5.5.16	X-ray diffraction study.....	148
5.5.17	Discussion on heavy metal removal from wastewaters of different industrial clusters in SRB-IS constructed wetlands.....	149
5.5.18	Discussion on pollutant removal from wastewaters of different industrial clusters in SRB-IS CW.....	151
5.5.19	Conclusions.....	153
	CHAPTER 6: SUMMARY AND CONCLUSIONS.....	154
	REFERENCES.....	164
	APPENDIX.....	198
	BIODATA.....	209