

# Wastes of sugar industry and their eco-friendly disposal

---



By:

Nadeem Abas

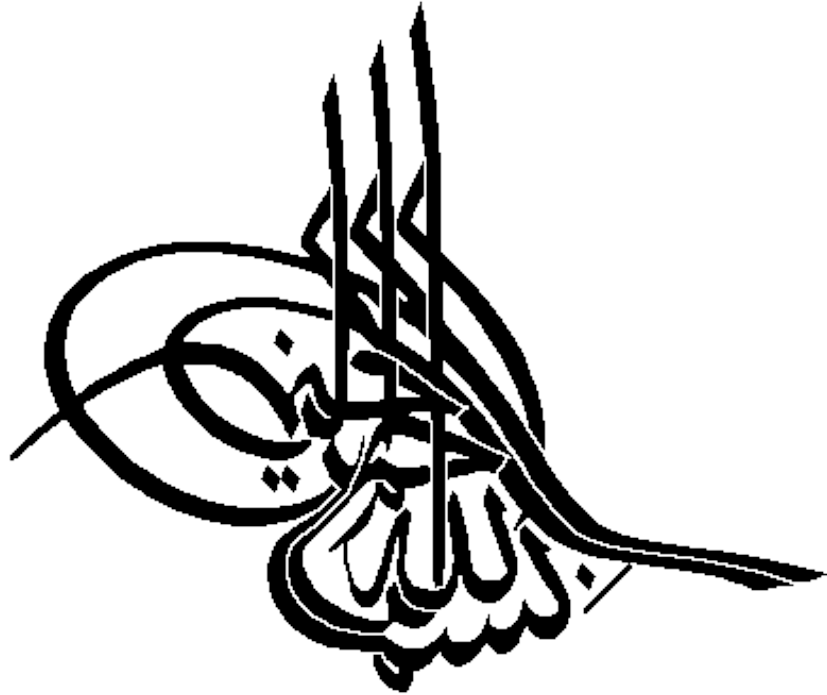
ID: 14003140004

**SUPERVISOR:**

Dr. Sohail Nadeem

---

DEPARTMENT OF CHEMISTRY  
SCHOOL OF SCIENCE  
UNIVERSITY OF MANAGEMENT AND TECHNOLOGY,  
LAHORE, PAKISTAN  
2016



*In the name of*

*Allah,*

*The most Compassionate,*

*The most merciful*



---

## **RESEARCH COMPLETION CERTIFICATE**

Certified that the research work contained in this thesis titled, “**Wastes of Sugar Industry and their Eco-Friendly Disposal**” has been carried out and completed by **NADEEM ABAS, ID: 14003140004**. The quantum and the quality of the work contained in this thesis is adequate for the award of Degree of MS/M.Phil.

---

**Supervisor**

---

**External Examiner**

---

**Dr. Sammia Shahid**  
**Chairperson,**  
Department of Chemistry,  
UMT, Lahore.

---

**Dr Muhammad Azhar Iqbal**  
**Dean**  
School of Science,  
UMT, Lahore.

---

## **DECLARATION**

I NADEEM ABAS S/O ALLAH DITTA ID: 14003140004 Session **2014-2016** hereby declare that the matter printed in the thesis titled “ **Wastes of Sugar Industry and their Eco-Friendly Disposal**” is my own work and has not been printed, published and submitted as research work, thesis or publication in any form in any University, Research institution etc. in Pakistan or Abroad.

*Dated:* \_\_\_\_\_

\_\_\_\_\_  
**(NADEEM ABAS)**

# DEDICATION

**“I dedicate this thesis to my Parents, Brothers and sisters who have supported me, friends, and my advisor and who taught me to be creative, attentive, and courageously lead me and make me done this work.”**

---

## **ACKNOWLEDGEMENT**

This thesis becomes a reality with the kind support and with the help of many individuals. I would like to express my many thanks to all of them.

For most, I want to offer this endeavor to my ALLAH ALMIGHTY for the wisdom he bestowed upon me, the strength, peace of my mind and good health in order to finish this research.

I am highly indebted to my respected and helpful advisor DR. SOHAIL NADEEM for their guidance and continuous supervision as well as for providing necessary information regarding this research and also for their support in completing this endeavor.

Many thanks for the committee members of the UNIVERSITY OF MANAGEMENT AND TECHNOLOGY, DR SAMMIA SHAHID chairperson of the Chemistry department and Dean DR. MUHAMAMD AZHAR IQBAL for their support and best wishes.

I am extremely thankful to my friend/colleague AAMIR SHEHZAD, KAFEEL AHMED, SAMI ULLAH, MUHAMMAD UMAIR, FARHAN AJMAL who motivated and encourages me to do this work and helped me during my studies and thesis writing. My respected and beloved father ALLAH DITTA who was always by my side whenever I need him and my mother who always inspired me for this responsibility. I am very much thankful to my friend AAMIR SHEHZAD who have guide me allot and gave me bright ideas about my work and studies.

I am really thankful to my all friends for their help and encouragement. They are always in need of any help I always grateful to them. My special thanks for all class members of university of management and technology, Lahore.

My thanks and appreciation also goes to my colleagues and people who have willingly helped me out with their abilities. Over all I feel very lucky to be in UMT and I always remember that I have studied in such a great and prosperous institute.

---

## **ABSTRACT**

The wastewater of sugar industry has been analyzed for various parameters including  $P^H$ , Electrical conductivity, TDS, TSS, Hardness, BOD, COD, and heavy metals such as Zn, Pb and Fe. A very cheaper method has been devised for treatment of mentioned parameters which was based on rice husk, wheat straw and animal charcoal. The results obtained were very fruitful and Zn, Fe and Pb have been successfully removed up to 77.77% from the wastewater of sugar industry. Adsorption of Pb, Zinc and iron by using three different inexpensive adsorbent having to be more preferable preferences for waste water management. Iron and Lead have been frequently estimated in higher numbers in sugar industry waste-water. Adsorption competences different as role of  $P^H$  By using heavy metal's aqueous solution with animal charcoal, wheat straw, and rice husk adsorption isotherms have been investigated. Adsorption isotherms have been dependable along with Langmuir's adsorption model. Here it were compared undertaken the adsorption effectiveness of animal charcoal, wheat straw, and rice husk. The consequence of  $P^H$ , constituent part size also special adsorbent on the adsorption isotherm of animal charcoal, wheat straw, and rice husk were premeditated into batch system. In point of fact the percentage of removing Zn, Fe as well as lead reached highest to 75%, 56% and 77.77%, ( $Pb > Zn > Fe$ ) correspondingly. The results shown by animal charcoal treatment in the reducing the wastes from effluents were better than other two treatments.

# CONTENTS

|                 |    |
|-----------------|----|
| Acknowledgement | iv |
| Abstract        | v  |
| Contents        | vi |
| List of Tables  | ix |
| List of Figure  | ix |

|  |             |
|--|-------------|
| <b>CHAPTER 1: INTRODUCTION</b>                   | <b>1-25</b> |
| 1.1 Background.....                              | 1           |
| 1.2 Sugar industry.....                          | 1           |
| 1.3 Processing of sugar cane.....                | 2           |
| 1.4 Juice extraction.....                        | 3           |
| 1.5 Juice clarification.....                     | 3           |
| 1.6 Juice evaporation.....                       | 4           |
| 1.7 Crystallization and centrifuging.....        | 5           |
| 1.8 Back-end refineries.....                     | 5           |
| 1.9 Energy in the mill.....                      | 5           |
| 1.10 Types of sugars.....                        | 6           |
| 1.10.1 Monosaccharides.....                      | 6           |
| 1.10.2 Disaccharides.....                        | 7           |
| 1.11 History.....                                | 8           |
| 1.11.1 Ancient times as well as middle ages..... | 8           |
| 1.12 Modern history.....                         | 9           |
| 1.13 Sugar industry in Pakistan. ....            | 11          |
| 1.14 Use of sugar in daily life .....            | 12          |

|   |    |
|---|----|
| 1.15 Chemistry of Sugar .....   | 13 |
| 1.16 Natural polymer of sugars .....  | 14 |
| 1.17 Wastes of sugar industry .....   | 14 |
| 1.17.1 Bagasse.....   | 14 |
| 1.17.2 Waste water of sugar industry .....                                      | 15 |
| 1.17.3 Wastes of sugar industries.....  | 15 |
| 1.17.4 Machinery wastes.....  | 16 |
| 1.18 Physico-chemical and biological characteristics of sugar mill effluent.... | 16 |
| 1.19 Impact of sugar mill effluent to the environment.....                      | 17 |
| 1.20 Techniques used for waste water treatments.....                            | 17 |
| 1.20.1 Physical techniques .....  | 17 |
| 1.20.2 Temperature.....   | 17 |
| 1.21 Chemical techniques.....   | 18 |
| 1.21.1 Analytical methods.....  | 18 |
| 1.21.2 Dissolved oxygen.....  | 18 |
| 1.21.3 Total solids.....  | 19 |
| 1.21.4 Total suspended solids.....  | 19 |
| 1.21.5 Total dissolved solids.....  | 19 |
| 1.21.6 Biological oxygen demand.....  | 20 |
| 1.21.7 Chemical oxygen demand.....  | 20 |
| 1.21.8 Sulphate.....  | 21 |
| 1.22 Waste management.....  | 21 |

|   |              |
|---|--------------|
| 1.23 Disposal solutions.....                | 21           |
| 1.23.1 Incineration.....                    | 21           |
| 1.23.2 Recycle .....                        | 22           |
| 1.24 Reuse.....                             | 22           |
| 1.24.1 Biological reprocessing.....         | 22           |
| 1.24.2 Energy recovery.....                 | 23           |
| 1.24.3 Pyrolysis.....                       | 23           |
| 1.24.4 Resource recovery.....               | 24           |
| 1.24.5 Sustainability.....                  | 25           |
| 1.24.6 Avoidance and reduction methods..... | 25           |
| 1.24.7 Problem statement.....               | 25           |
| 1.25 Objectives.....                        | 25           |
| <b>CHAPTER 2: LITERATURE REVIEW</b>         | <b>26-51</b> |
| <b>CHAPTER 3: EXPERIMENTAL</b>              | <b>52-62</b> |
| 3.1 Sources of samples.....                 | 52           |
| 3.2 Materials .....                         | 52           |
| 3.3 Apparatus .....                         | 52           |
| 3.4 Chemical.....                           | 52           |
| 3.5 Total hardness.....                     | 53           |
| 3.5.1 Preparation of reagents .....         | 53           |
| 3.5.2 Procedure .....                       | 53           |
| 3.5.3 Calculation.....                      | 53           |
| 3.6 P <sup>H</sup> measurement .....        | 54           |
| 3.6.1 Preparation of solution .....         | 54           |

|  |    |
|--|----|
| 3.6.2 Operating procedure .....                                      | 54 |
| 3.7 Biological oxygen demand.....                                    | 54 |
| 3.7.1 Preparation of solutions.....                                  | 54 |
| 3.7.2 Procedure .....  | 55 |
| 3.7.3 Calculations .....   | 56 |
| 3.8 Total suspension .....   | 56 |
| 3.9 Determination of total suspended solids.....                     | 56 |
| 3.9.1 Computation.....   | 56 |
| 3.10 Determination of total dissolved solids.....                    | 57 |
| 3.10.1 Personal history.....   | 57 |
| 3.10.2 Procedure .....   | 57 |
| 3.11 Conductivity.....   | 57 |
| 3.11.1 Experiment.....   | 57 |
| 3.12 Chemical oxygen demand.....                                     | 57 |
| 3.12.1 Summation.....  | 57 |
| 3.12.2 Preparation of solution.....                                  | 57 |
| 3.12.3 Procedure.....  | 58 |
| 3.12.4 Computations.....   | 58 |
| 3.13 Treatment of toxic metals of waste water of sugar industry..... | 58 |
| 3.14 Lead content (Pb).....  | 58 |
| 3.14.1 Process .....   | 58 |
| 3.14.2 Computations.....   | 59 |
| 3.15 Iron content (Fe).....  | 59 |
| 3.15.1 Summation.....  | 59 |
| 3.15.2 Reagents as well as preparation of sample solution            | 59 |

|  |              |
|--|--------------|
| 3.15.3 Procedure.....  | 60           |
| 3.15.4 Computation.....  | 60           |
| 3.16 Zinc content (Zn).....                                    | 61           |
| 3.16.1 Summation.....  | 61           |
| 3.16.2 Reagents as well as preparation of sample solution..... | 61           |
| 3.16.3 Procedure.....  | 61           |
| 3.16.4 Computation.....  | 62           |
| <b>CHAPTER 4: RESULTS &amp; DISCUSSION</b>                     | <b>63-83</b> |
| 4.2 Total suspended solids.....                                | 65           |
| 4.3 Total diffused solids .....                                | 66           |
| 4.4 Total solids .....   | 65           |
| 4.5 Biological oxygen demand .....                             | 68           |
| 4.6 Chemical oxygen demand.....                                | 69           |
| 4.7 Electrical Conductance.....                                | 70           |
| 4.8 P <sup>H</sup> .....                                       | 71           |
| 4.9 Total hardness.....  | 72           |
| 4.10 Calcium .....   | 74           |
| 4.11 Magnesium.....  | 76           |
| 4.12 Lead metal.....   | 78           |
| 4.13 Zinc metal.....   | 80           |
| 4.14 Iron metal.....   | 82           |
| <b>Conclusion</b> .....  | 84           |
| <b>Suggestion</b> .....  | 85           |
| <b>References</b> .....  | <b>86-92</b> |



# CHAPTER-1

## Introduction

### **1.1Background**

Water is vital to all structures of living and composes up fifty to 97% that burden of all plants and mammals and as regards seventy % of soul body (Poff and Allan 1995). The vital resource was water for manufacturing, agriculture, hauling and several further human movements. In the face of its values, water is the a good number defectively supervised reserve in the human race.(Chutter 1998).In urban territories, the inconsiderate transfer to the extraordinarily to the low quality of water (Mathuthu, Mwanga *et al.* 1997). The water bodies are majority in the regions of crafting outlook are the end functions of overflow on the loose from trade enterprises.