LEACHATE STUDY OF SOIL USING LEATHER AS A WASTE MATERIAL

A PROJECT REPORT

Submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision

Of

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to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

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STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **"Leachate study of soil using leather as a waste material"** submitted for partial fulfilment of the requirements for the degree of Bachelor of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Mr Niraj Singh Parihar**. This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

Signature of Student

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Date:

CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"leachate study of soil using leather as a waste material"** in partial fulfilmentof the requirements for the award of the degree of Bachelor of Technology in Civil Engineering and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by **Kuldeep Rana (151688), Amit Sharma (151664),** during a period from July 2018 to June 2019 under the supervision of **Mr Niraj Singh Parihar**. Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat. The above statement made is correct to the best of our knowledge.

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ABSTRACT

Leachate is a derivative from municipal solid waste due to its physical, chemical, and biological changes and will be formed in landfills, incineration plants, composting plants, and transfer stations. It has high strength and toxicity. Leachate composition is linked to some parameters, containing attributes of waste, locality, seasons, dumpsite time and structure, retention time in holding cell at incineration plants, functioning modes of transfer stations, etc. Among the leachate origins, landfill leachate is of the most concern.

This investigation analysed that the performance of black cotton soil composed as a filter substance with leather as a waste matter. A physical model has been composed. The performance of filter stuff is to be evaluated at water application rate equivalent to maximum rainfall intensity of Vishakhapatnam.

The leather waste ash has been mixed to black cotton soil in different proportions and the leachate generated has been estimated using a physical model. Leather contains various heavy metals which are toxic to ground water if not arrested.

The black cotton soil absorbs major fraction of the heavy metals present in the leather mixed with the soil. The present study focus on black cotton soil as an absorbent of heavy metals.

Keywords: Leachate, Black cotton soil, infiltration

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CHAPTER 1

INTRODUCTION

A leachate is any liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed.
Leachate is a widely used term in the environmental sciences where it has the specific meaning of a liquid that has dissolved or entrained environmentally harmful substances that may then enter the environment. It is most commonly used in the context of land-filling of putrescible or industrial waste.

In the narrow environmental context leachate is therefore any liquid material that drains from land or stockpiled material and contains significantly elevated concentrations of undesirable material derived from the material that it has passed through. The storage of any waste material in a landfill poses potential problems. One problem is the possible contamination of soil, groundwater and surface water that may occur as leachate produced by water or liquid wastes moving into, through and out of the landfill, migrates into adjacent areas. This problem is important especially when industrial wastes are involved because many of these substances are resistant to biological or chemical degradation and, thus, are expected to persist in theiroriginal form for many years, perhaps even for centuries.

The chemical quality of leachatevaries as a function of a number of factors including the original nature of the buried waste materials and the various chemical and biochemical reactions that may occur as the waste materials decompose. The spatial variations in leachate composition mainly reflect differences in waste composition and infiltration of water through the top cover of the landfill.

1.2 Chapter Outline

The project report is presenting in five chapters. Brief details about each chapter are as follow:

Chapter 1: Introduction

This chapter gives an introduction of leachate preparing from the leather waste mixing in the black cotton soil also gives the idea that reflects differences in waste composition and infiltration of water through the top cover of the landfill.

Chapter 2: Literature review

This chapter presents a brief review of relevant literature of the work carried out by various investigators. The large amount of literature available on the leachate study of the various waste mixed with the soil and the leachate formed due to the leather waste. The research work done for the development of leachate models with the black cotton soil and the percentage content of the leather waste.

Chapter 3: Methodology

This chapter describes the various experiments done on the Black cotton soil, leather waste and mixture of the leather waste and black cotton soil. To study the behaviour of black cotton with the leather waste, we mix the leather waste in the black cotton soil at the three percentages of 2%, 6% and 10% and take the extreme rainfall of the Vishakhapatnam and observe the water (leachate) effect on the ground water quality.

Chapter 4: Results and discussions

The result of the leachate obtained from the mixture of the black cotton soil and the leather waste from the 14 days observation of the every model we prepared, we got the leachate from the model and we observed that with increase in the proportion of leather waste, black cotton soil start losing its permeability.

Chapter 5: Conclusion

This chapter presents an overall summary of the work carried out and brings out the salient conclusions. The heavy metals found in the leachate formed from the leather waste and the black cotton soil, the amount of the heavy metals and the effect of the heavy metals on the ground water quality is highlighted.

CHAPTER 2

LITERATURE REVIEW

2.1 General

The leather waste taken from the industrial waste is highly toxic in nature. Currently, in India there are still not proper disposal facilities. Generally, we see that the waste from the industries is dumped in the nearby rivers or in the empty space near the industries. This waste contains mainly heavy metals which percolates through the soil and contaminates the ground water which causes the various diseases.As this study can help us to know the various chemical and physical properties of the soils as we are doing our study in black cotton soil i.e. clayey soil in nature. It is found from previous studies that opened burnt tanned leather ash increases Ultimate Compressive Strength of the soil. Clays have been used to absorb the chromium ion from the tanned leather ash.

2.2 Studies on Soil

We took the black cotton soil for this research because of its characteristics. Black Cotton Soil is highly argillaceous, very fine grained.It contains a high proportion of calcium and magnesium carbonates and the most commonly heavy metals found at contaminated sites, in order of abundance are Pb, Cr, As, Zn, Cd, Cu, and Hg up to which level soil can absorb these metals we study about the different properties of the soil.The black cotton soil samples were collected from Vishakhapatnam tostudy its properties and do some tests like bulk density, stabilization, CBR and optimum moisture content. The soil obtained was in wet condition but for the uniform mix of the soil and the leather, it should be dried for 24 hours and after that sample is mixed uniformly and water is added according to the OMC.

Figure 2.1 Oven dried soil

2.3 Studies on Rainfall

Rainfall data of Vishakhapatnam was studied. The data consisted of Annual rainfall data, Monthly rainfall data, weekly rainfall data, daily rainfall data, and peak rainfall data. We have taken extreme rainfall data of month October from the Indian Meteorological Department Vishakhapatnam. We made conditions like these in our laboratory in JUIT waknaghat and checked the rate of discharge in leachate of soil using leather as waste.

2.4 Studies on Leather

For leachate of soil, leather is used as a waste. So, we need to study the type of leather we are using as waste and how we are using it as waste. There are two types of leather i.e. tanned leather and untanned leather, we used tanned leather as waste for leachate of soil because it contains heavy metals in high amount.

2.5 Studies on Model

We need to find the type of model which could satisfy our condition for leachate of soil and could withstand the rainfall of Vishakhapatnam. It should not get corroded by heavy metals and could withstand any type of condition. So there is a need to study the type of model, its dimension, area, volume. We studied different models for this purpose. On comparing we created a model which is cylindrical in shape and also can fulfil all requirements.

2.6 Objective of Study

The objective of our study is to find the leachate of soil mixed with tanned leather as a waste. The main aim of this study is to find the leachate of black cotton soil and we created conditions like Vishakhapatnam and rainfall of October month. Thus checking leachate of soil and the soil type is black cotton soil.

We took the black cotton soil for this research because of its cohesive nature.Black Cotton Soil is highly argillaceous, very fine grained and contain a high proportion of calcium and magnesium carbonates and the most common heavy metals found at contaminated sites, in order of abundance are Pb, Cr, As, Zn, Cd, Cu, and Hg up to which extent soil can absorb these metals. So we study about the different properties of the soil, we collect the soil from the Vishakhapatnam, study about its properties and do some test like bulk density, stabilization, CBR and optimum moisture content. The soil we get is in the wet condition but for the uniform mix of the soil and the leather we have to dry it for the 24 hours and after that we mix the sample uniformly and add water in it according to the OMC.

1.) To access the quality of leachate obtained through plain black cotton soil and tanned leather ash stabilized black cotton soil.

2.) To study the chemical characteristics of leachate generated when different fractions of leather waste was mixed in the soil.

3.) To determine the concentrations of various heavy metals contained in the leachate from open burnt and thermally treated tanned leather waste.

4.) To check the suitability of clay soil such as black cotton as absorbent of heavy metals.

5.) To compare leachate characteristics with prescribed EPA elements recommendation.

2.7 Scope of the work

According to many reports and journals many waste materials are disposed in water on in dry waste land. In water they are disposed in river, sea, lake, pond etc. These waste material contain harmful toxic element and compounds which mix with water and also infiltrate in soil causes soil lose its richness and it moves underground in soil through voids in soil with the help of water an moves to fertile soil an make it loose its fertility. Crops are also grown on

that soil and eat that crop which make us sick and cause many diseases. This type of contaminated food makes life of living being shorter and cause many problems to the environment.

So our scope is to test theleachate of soil and remove all heavy metals and toxic things from soil with the help of water by discharging water in soil at a rate which is similar to rate of rainfall.Here, we took rainfall data of October month of Vishakhapatnam, so we created conditions just like rainfall discharge of October month of Vishakhapatnam from Indian meteorological Department Data of October month and performed several tests for leachate like heavy metal testing to check leachate contamination of soil using tanned leather as waste.

Thus in this investigation we plan to conduct a detailed study on the leachate of black cotton soil mixing with tanned leather in certain proportions creating rainfall condition just like that of Vishakhapatnam.

CHAPTER 3

METHODOLOGY

Leachate is a liquid generally formed with the rainfall and the natural decomposition of waste that is filtered through the landfill to a collection system. The main purpose of the leachate collecting system is to collect all the sumps, non biodegradable substance, and waste liquid so that it can be properly and efficiently removed from the landfill.

Our study deals with the collection of leachate from the model as shown in the figure2.A and analyzes the quality of leachate obtained through plain black cotton soil and tanned leather ash stabilized black cotton soil. Also to study the chemical characteristics of leachate generated at different time intervals. Leather waste is taken from the Punjab hide co.124, leather complex Jalandhar.

3.1 Development of Model

- Prepared 3 models for collecting leachate, its specifications like diameter, height, and length of leg are shown. Shown in figure numbers: 3.2, 3.3, 3.4.

Figure 3.2 Model prepared for leachate collection

Figure 3.3 Base of the mould prepared

A kind of filter sheet was made which is used to collect all the leachate through this which is shown in figure 3.3. This ensures that soil will not be collected through this system and only leachate will be collected.

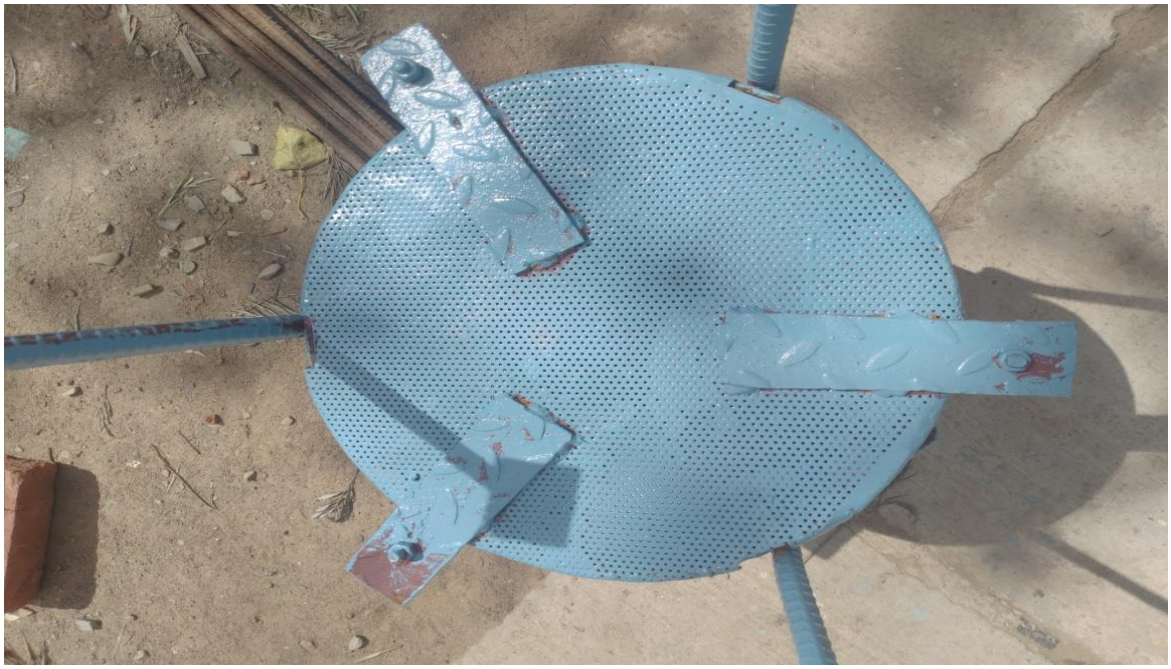

Figure 3.4 Bottom portion of the mould

3.2 Treating leather

Open Burnt tanned Leather using as a stabilizer.

Figure 3.5 Open burning of tanned leather

Burning of Tanned leather waste at 100°C.After burning all the leather we used this as the waste and mix it with Black cotton soil at different percentage of leather (2%,6%, 10%) with the soil.

3.3 Collection of Rainfall Data

Extreme Rainfall data of Vishakhapatnam, Andhra Pradesh over a period from 2013 to 2017.

Year	JAN		FEB		MAR		APRIL		MAY		JUNE	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2013	4.2	-5.2	5.0	-54	0.6	-97	51.4	15	20.2	-79	93.9	-29
2014	2.0	-77	0.0	-100	15	-10	26.8	-40	109	13	65.6	-51
2015	1.4	-84	1.5	-86	18	2	69.1	54	38.1	-61	313	136
2016	0.4	-95	3.7	-66	11	-36	10.8	-76	160	66	189	43
2017	0.0	-99	0.0	-100	15	-11	19.3	-57	42	-57	203	54

Table 3.1 Rainfall data of Vishakhapatnam from year 2013 to 2017

Year	JULY		AUG		SEP		OCT		NOV		DEC	
	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP	R/F	%DEP
2013	101.6	-43	141.5	-21	138.7	-25	445	118	72.6	23	7.3	70
2014	136.1	-24	239.7	35	146.8	-21	330	62	9.2	-84	10.7	149
2015	129.9	-27	205	15	261.1	41	47.8	-77	122.5	107	2.9	-33
2016	207.8	17	148	-17	284.2	53	95.4	-53	7.3	-88	1.1	-76
2017	126.5	-29	251.8	41	149.2	-20	127	-38	6.1	-90	0.0	-100

Table 3.2 Rainfall data of Vishakhapatnam from year 2013 to 2017

This rainfall data of extreme rainfall is taken out from the Indian meteorological department (IMD) of Andhra Pradesh. According to this data in October 2013 extreme precipitation held in Vishakhapatnam was 445.5mm.

3.4 CALCULATIONS

From data taken from the table 3.1 and 3.2

Maximum precipitation = 455.5mm

For one hour = (455.5)/ (31 *24)

= 0.6mm/hr

This value is so small that, this amount of precipitation is not possible.

Let

1mm/hr = 100cm/hr

0.6mm/hr = 60cm/hr

3.5 CALCULATING VOLUME OF MOULD

Weight of water = 0.26(3kg) = 0.78kg = 780g = 780 ml

Dry weight of soil = 3 kg = 3000 g

Weight of empty container = 3692 g

Total weight of container with soil and water = 5405 g

Weight of soil = 5405 – 3692 = 1713g

Radius of cylinder = 5.1cm

Height of cylinder = 11.6 cm

Volume of mould = $\pi r^2 h$ = 947.86 cm^3

3.6 CALCULATING DRY DENSITY

Bulk density of soil, γ_t = Weight of soil / Volume of mould

= 1713 g / 947.3.86 cm^3

Dry density of soil, $\gamma d = \gamma_t / (1+w)$

= (1713 / 947.3.86) / (1+ 0.26)

= 1.435 gm/cm^3

The dry soil is to be filled in three layers of same thickness of 5cm.

Each layer is tamped 25 times.

3.6 CALCULATING MASS OF SOIL

Quantity (mass) of dry soil to be used in each layer

=Volume of layer * dry density of soil

$= \pi r^2 h * 1.435$

$= 2862.77 * 1.435$

$= 4108.6$ gm

Total mass of dry soil i.e. for three layers = 4108.6 * 3 =12324.22 gm

3.7 Procedure to find OMC of soil using proctor test

Compaction test of soil is carried out using Proctor's test to understand compaction characteristics of different soils with change in moisture content. Compaction of soil is the optimal moisture content at which a given soil type becomes most dense and achieve its maximum dry density by removal of air voids.

Procedure for OMC using Proctor test

1. Take about 20kg of air-dried soil and sieve it through 20mm and 4.7mm sieve.

Calculate the percentage retained on 20mm sieve and 4.75mm sieve, and the percentage passing 4.75mm sieve.

2.If the percentage (%) retained on 4.75mm sieve is more than 20, large mould of 150mm diameter is used. On the other hand if it is less than 20%, 100mm of standard mould is used.

The following procedure is for the standardmould:

3.Mix the soil and pass through 4.75mm sieve in proportions.

4. Clean, wash and dry the base plate and the mould. Grease them lightly and smoothly.

5. Take the weight of the mould with the base plate.

6. Take about 16 – 18 kg of black cotton soil. Bring the water content to about 4% by adding water if the soil is sandy and to about 8% if the soil is clayey.

7. Keeps the soil in oven for oven drying for about 18 to 20 hours.

8. Attach the mould to the collar and place the mould on a solid base.

9. Take about 2.5kg of the oven dried black cotton soil, and then place it in the mould in 3 equal layers. Take about one-third the black cotton soil first, and compact it by giving 25 blows of the rammer. The blows should be uniformly distributed over the surface of soil.

10. Before placing the second layer,the top surface of the first layer be scratched with spatula. Again the same procedure will be done with the second layer of the soil i.e. compaction with rammer. Likewise, place the third layer and compact it.

11. The amount of the soil used should be just sufficient to fill the mould ad leaving about 5 mm above the top of the mould to be struck off when the collar is removed.

12. Using a straight edge remove the collar and trim all the excess soil.

14. Clean and wash the base plate and the mould from outside and weight it.

1**5.** Removal of the soil from the mould.

16. After the removal of soil from the mould take the soil sample and determine the water content of the soil.

17. Now again add about 3% of the water to a fresh portion of the black cotton soil, and repeat all the steps from 10 to 14.

Figure 3.6 Weight of the mould and soil

Figure 3.7 Weight of oven dry soil

Table 3.1 Bulk density of Black cotton soil

Wt. of mould + base plate W1(g)	Wt. of mould + base plate + compacted soil W2(g)	Wt. of compacted soil =(W2-W1) (g)	Bulk density =W/v (g/cc)
3677	5190.55	1513.55	1.51454
3677	5232.7	155.85	1.55687
3677	5309.85	1632.85	1.63493
3677	5362	1685	1.68517
3677	5454.5	1777.5	1.77773
3677	5540.4	1863.4	1.86369
3677	5545.7	1868.7	1.87312

Table 3.2 Water content and dry density of soil

Wt. of container (g)	Wt. of container + wet soil (g)	Wt. of container + dry soil (g)	Wt. of water (g)	Wt. of dry soil (g)	Water content (%)	Dry density (g/cc)
19.3	45.9	43	2.95	23.7	12.236	1.349
17.2	37.6	35	2.6	17.85	14.616	1.348
19.3	33.1	31.1	2	11.8	16.949	1.397
19	31.4	29.4	2	10.4	19.230	1.414
20.9	36.3	33.5	2.8	12.6	22.222	1.455
18.4	42.5	37.6	4.9	19.2	25.520	1.485
7.6	17.2	15.1	2.1	7.5	28.000	1.496
8.5	19.9	17.1	2.8	8.6	32.558	1.410

3.8 For Plain Black cotton soil

- After calculating the surface area of our mould, 12324.22gm of plain black cotton soil is filled in the mould.
- Black cotton soil is filled in the mould in 3 layers of 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mouldand after gravels plain black cotton soil is filled above it in 3 layers.
- After filling the mould, extreme rainfall of Andhra Pradesh is calculated i.e. found to be 0.69183L/hour which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3^{rd} day, 6^{th} day and 9^{th} day respectively in sample tubes.
- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.
- After COD and BOD we give our samples to perform tests on **heavy** metals to the particular labs to get our results.

3.9 For 2% of tanned leather

- After burning the tanned leather, we first take 2% of leather that is calculated to be 246.48gm i.e. (12324.22*0.02).
- After taking 246.48gm of opened burnt tanned leather, mix it in oven dried black cotton soil(12324.22gm) in very good manner so that all leather mixed with the soil.
- After mixing gradually, 26% of water i.e. found to be 3204.22ml (12324.22*.26) is mixed in the soil and tanned leather waste.
- We are using 26% of water because black cotton soil achieved its optimum moisture content at 26%, we conclude this from by Proctor test on black cotto

- After mixing 26% of water in the composition, mix the whole solution gradually and after mixing, filling the mould with 2% tanned leather with black cotton soil in three layers of thickness 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mouldand after gravels plain black cotton soil mixed with 2% leather waste is filled above it in 3 layers.
- After filling the moulds properly extreme rainfall of Andhra Pradesh is calculated i.e. found to be 0.69183L/hour which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3rd day, 6th day and 9th day respectively in sample tubes.
- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.
- After collecting the five to eight samples we go for the heavy metal testing to the particular labs to get our results.

3.10 For 6% of tanned leather

- After burning the tanned leather, we first take 6% of leather that is calculated to be **739.45gm** i.e. (12324.22*0.06).
- After taking 739.45gm of opened burnt tanned leather, mix it in oven dried black cotton soil(12324.22gm) in very good manner so that all leather mixed with the soil.
- After mixing gradually, 26% of water i.e. found to be **3204.22ml** (12324.22*0.26) is mixed in the soil and tanned leather waste.
- We are using 26% of water because black cotton soil achieved its optimum moisture content at 26%, we conclude this from by Proctor test on black cotton soil.
- After mixing 26% of water in the composition, mix the whole solution gradually and after mixing, filling the mould with 6% tanned leather with black cotton soil in three layers of thickness 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mouldand after gravels plain black cotton soil mixed with 6% leather waste is filled above it in 3 layers.

- After filling the moulds properly extreme rainfall of Andhra Pradesh is calculated i.e. found to be **0.69183L/hour** which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3rd day, 6th day and 9th day respectively in sample tubes.
- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.
- After collecting the five to eight days sample we go for the heavy metal testing to the particular labs to get our results.

3.11 For 10% of tanned leather

- After burning the tanned leather, we first take 10% of leather that is calculated to be 1232.42gm i.e. (12324.22*0.1).
- After taking 1232.42gm of opened burnt tanned leather, mix it in oven dried black cotton soil (12324.22gm) in very good manner so that all leather mixed with the soil.
- After mixing gradually, 26% of water i.e. found to be 3204.22ml (12324.22*0.26) is mixed in the soil and tanned leather waste.
- We are using 26% of water because black cotton soil achieved its optimum moisture content at 26%, we conclude this from by Proctor test on black cotton soil.

Figure3 .8 Plain black cotton soil

Figure3.9 Burnt leather

Figure 3.10 Mixing of black cotton soil with burnt**Figure 3.11**Evenly mixed burnt leather with soil

leather

Figure 3.12 After adding water in soil mixed with leather waste

- After mixing 26% of water in the composition, mix the whole solution gradually and after mixing, filling the mould with 10% tanned leather with black cotton soil in three layers of thickness 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mouldand after gravels plain black cotton soil mixed with 10% leather waste is filled above it in 3 layers.
- After filling the moulds properly extreme rainfall of Andhra Pradesh is calculated i.e. found to be **0.69183L/hour** which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3rd day, 6th day and 9th day respectively in sample tubes.
- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.

- After collecting the five to eight samples we go for the heavy metal testing to the particular labs to get our results.

3.12 Leather burnt at 400°Celcius

- After completing all the samples of open burnt tanned leather we moved our study to more depth i.e. now we study the quality of leachate at very high temperature i.e. at 400°C of different percentages of leather waste of 2%,6% and 10%.
- This time burning of tanned leather waste is done in muffle furnace at 400°celcius.
- The smoke released from the tanned leather waste is very poisonous in nature so precautions should be compulsory like gloves and mask.

3.13 For 2% leather burnt at 400 °C

- After burning the tanned leather in muffle furnace, we first take 2% of leather that is calculated to be 246.48gm i.e. (12324.22*0.02).
- After taking 246.48gm of tanned leather, mix it in oven dried black cotton soil(12324.22gm) in very good manner so that all leather mixed with the soil.
- After mixing gradually, 26% of water i.e. found to be 3204.22ml (12324.22*.26) is mixed in the soil and tanned leather waste.
- We are using 26% of water because black cotton soil achieved its optimum moisture content at 26%, we conclude this from by Proctor test on black cotton soil.
- After mixing 26% of water in the composition, mix the whole solution gradually and after mixing, filling the mould with 2% tanned leather with black cotton soil in three layers of thickness 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mould and after gravels plain black cotton soil mixed with 2% leather waste is filled above it in 3 layers.
- After filling the moulds properly extreme rainfall of Andhra Pradesh is calculated i.e. found to be **0.69183L/hour** which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3^{rd} day, 6^{th} day and 9^{th} day respectively in sample tubes.

- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.
- After collecting the five to eight days sample we go for the heavy metal testing to the particular labs to get our results.

3.14 For 6%leather burnt at 400°C

- After burning the tanned leather in muffle furnace, we first take 6% of leather that is calculated to be 739.45gm i.e. (12324.22*0.06).
- After taking 739.45gm of muffle furnace tanned leather, mix it in oven dried black cotton soil (12324.22gm) in very good manner so that all leather mixed with the soil.
- After mixing gradually, 26% of water i.e. found to be 3204.22ml (12324.22*0.26) is mixed in the soil and tanned leather waste.
- We are using 26% of water because black cotton soil achieved its optimum moisture content at 26%, we conclude this from by Proctor test on black cotton soil.
- After mixing 26% of water in the composition, mix the whole solution gradually and after mixing, filling the mould with 6% tanned leather with black cotton soil in three layers of thickness 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mouldand after gravels plain black cotton soil mixed with 6% leather waste is filled above it in 3 layers.
- After filling the moulds properly extreme rainfall of Andhra Pradesh is calculated i.e. found to be **0.69183L/hour** which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3^{rd} day, 6^{th} day and 9^{th} day respectively in sample tubes.
- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.
- After collecting the five to eight days sample we go for the heavy metal testing to the particular labs to get our results.

3.15 For 10% leather burnt at 400°C

- After burning the tanned leather in muffle furnace, we first take 10% of leather that is calculated to be **1232.42gm** i.e. (12324.22*0.1).
- After taking 1232.42gm of muffle furnace tanned leather, mix it in oven dried black cotton soil(12324.22gm) in very good manner so that all leather mixed with the soil.
- After mixing gradually, 26% of water i.e. found to be **3204.22ml** (12324.22*0.26) is mixed in the soil and tanned leather waste.
- We are using 26% of water because black cotton soil achieved its optimum moisture content at 26%, we conclude this from by Proctor test on black cotton soil.
- After mixing 26% of water in the composition, mix the whole solution gradually and after mixing, filling the mould with 10% tanned leather with black cotton soil in three layers of thickness 5cm each.
- Before filling of soil in the mould, up to 5cm of height of the mould gravel is also filled in the mould and after gravels plain black cotton soil mixed with 10% leather waste is filled above it in 3 layers.
- After filling the moulds properly extreme rainfall of Andhra Pradesh is calculated i.e. found to be **0.69183L/hour** which is 256ml/min is rain over the mould for one hour continuously.
- After rainfall we collected samples of leachate at different days i.e. on 3^{rd} day, 6^{th} day and 9^{th} day respectively in sample tubes.
- After collecting leachate samples we performed COD and BOD tests on the leachate samples and studied the results.
- After collecting the five to eight days sample we go for the heavy metal testing to the particular labs to get our results.

3.16Preparation of the leachate model

3.16.1 Leachate model

A cylindrical pipe was constructed of the sewage pipe, for support we use iron bars and for the base of the model we use class room chair because of tiny holes in the chair it's easy to get leachate from it. We also had given the slop to the center of the model to get the leachate in the bucket we are using for the collection of the leachate.

3.16.2Mixture of BCS and leather

According to the studied earlier we had made 3 compositions for the each sample i.e. 2%, 6% and 10%. In BCS we mixed leather in 3 percentages for this firstly burnt the leather and then sieve it from the 4.75 micron sieve then we take the 2%, 6% and 10% of the leather to the soil and we had calculate above the weight of the soil which we required for the one model. We take soil for the 24 hour oven drying, and then mix the soil and leather uniformly until the one blackish color or a uniform color not comes. Then we mix the water according to the OMC, again we mix it uniformly so leather mixed in the soil properly after all this we fill it in the model.

Figure 3.13 Fine crushing of the soil to remove lumps

3.16.3 Layers of the Mix

To get leachate in the suitable time period we provide the three layers of the mix and one base layer of the aggregates, each layer is of thickness 5cm and tamped with the rammer of 25kg with 25 blows each layer, as shown in the figure: 3.14.

Figure 3.14 Filling of the mould with soil and leather mix

3.16.4 Rainfall

We calculated the rate of discharge and after calculating the discharge we created the same rate of flow in the laboratory. The discharge used was 15.45L /hr, as shown in the figure: 3.15.

Figure 3.15 Rainfall conducted in laboratory

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results

4.1.1 Concentrations of heavy metals in leachate produced by soil mixed with open burnt tanned leather for various fractions of leather waste mixed.

Table 4.1 Concentration of Chromium in leachate produced by soil mixed with open burnt tanned leather for various fractions of leather waste mixed.

Percentage of leather waste mixed	Concentration of Chromium (mg/L)
0	0.000
2	0.670
6	2.020
10	2.970

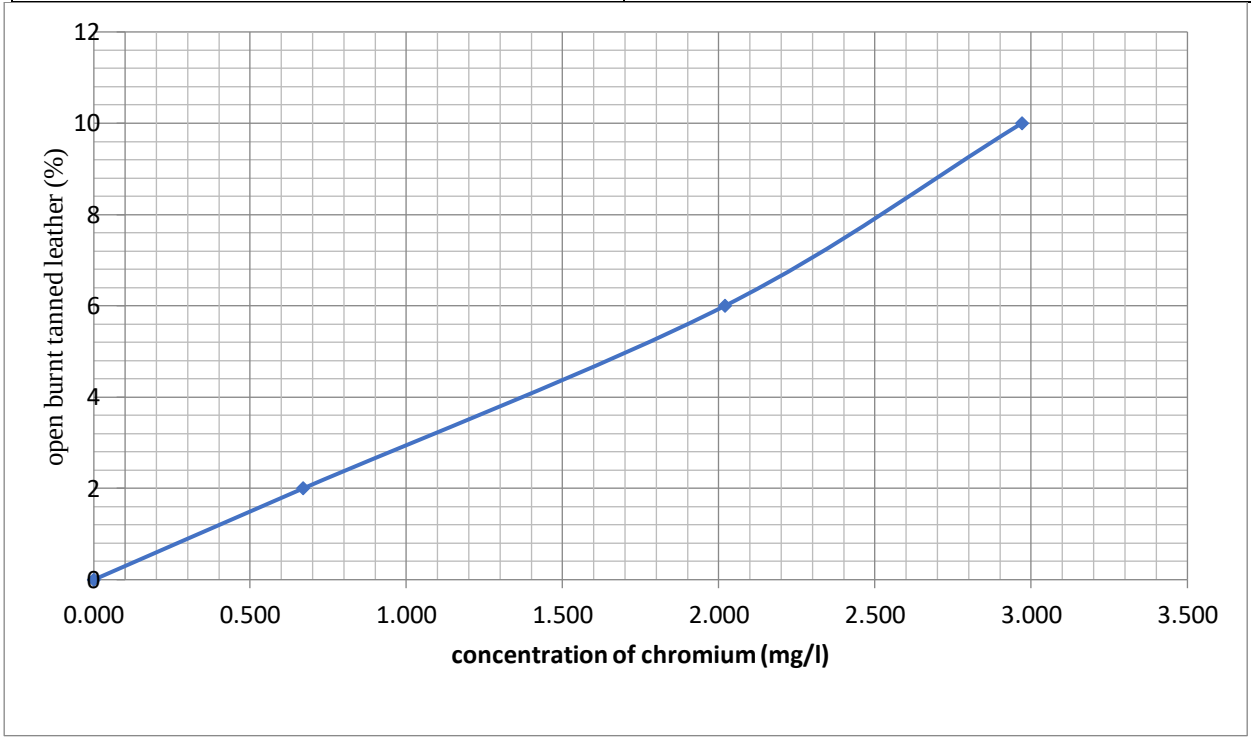

Figure 4.1 Concentration of Chromium for open burnt tanned leather for various fractions of leather waste mixed.

Table 4.2 Concentration of Lead for open burnt tanned leather for various fractions of leather waste mixed.

Percentage of leather waste mixed	Concentration of Lead (mg/L)
0	0.000
2	0.670
6	2.020
10	2.970

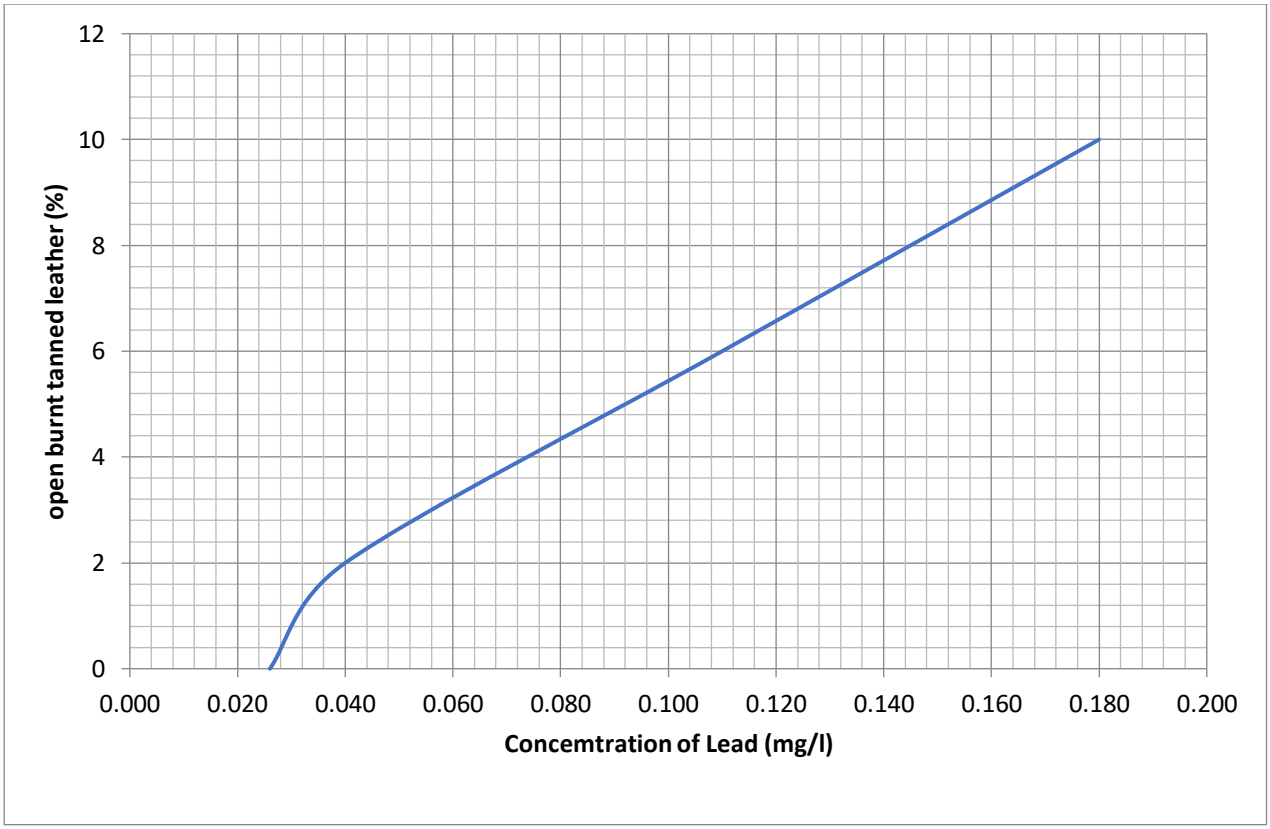

Figure 4.2 Concentration of Lead for open burnt tanned leather for various fractions of leather waste mixed.

Table 4.3 Concentration of Zinc for open burnt tanned leather for various fractions of leather waste mixed.

Percentage of leather waste mixed	Concentration of Zinc (mg/L)
0	0.012
2	0.020
6	0.060
10	0.110

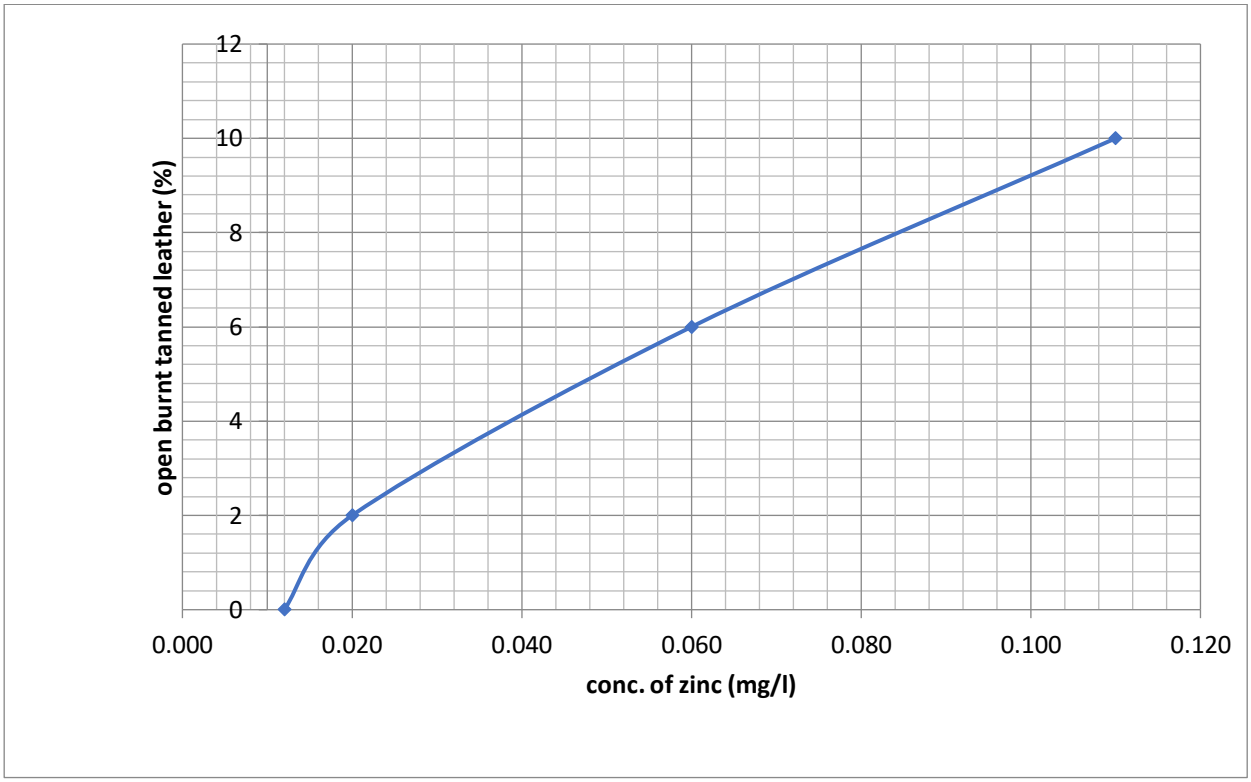

Figure 4.3 Concentration of Zinc for open burnt tanned leather for various fractions of leather waste mixed.

Table 4.4 Concentration of Nickel for open burnt tanned leather for various fractions of leather waste mixed.

Percentage of leather waste mixed	Concentration of metal (mg/L)
0	0.002
2	0.003
6	0.009
10	0.015

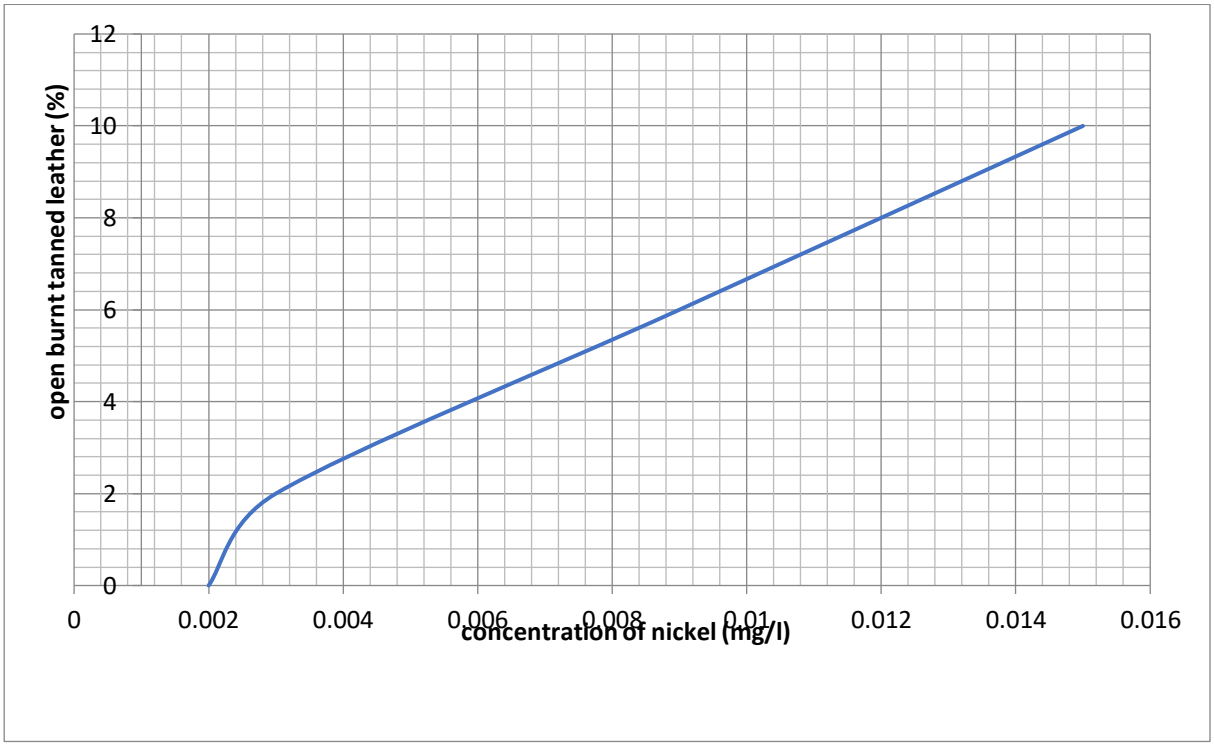

Figure 4.4 Concentration of Nickel for open burnt tanned leather for various fractions of leather waste mixed.

Table 4.5 Concentration of Copper for open burnt tanned leather for various fractions of leather waste mixed.

Percentage of leather waste mixed	Concentration of Copper (mg/L)
0	0.000
2	0.000
6	0.000
10	0.031

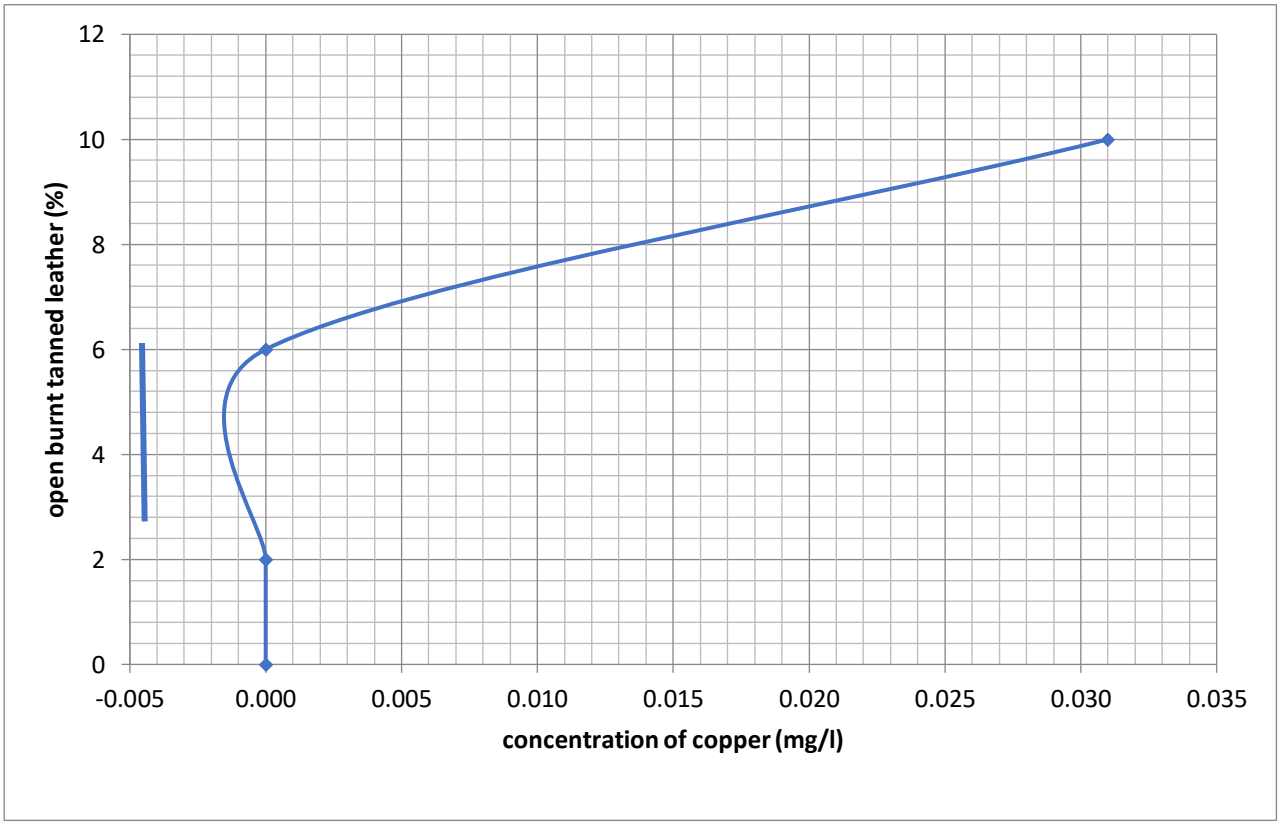

Figure 4.5 Concentration of Copper for open burnt tanned leather for various fractions of leather waste mixed.

Table 4.6 Concentration of Iron for open burnt tanned leather for various fractions of Leather waste mixed.

Percentage of leather waste mixed	Concentration of Iron (mg/L)
0	0.024
2	0.027
6	0.082
10	0.121

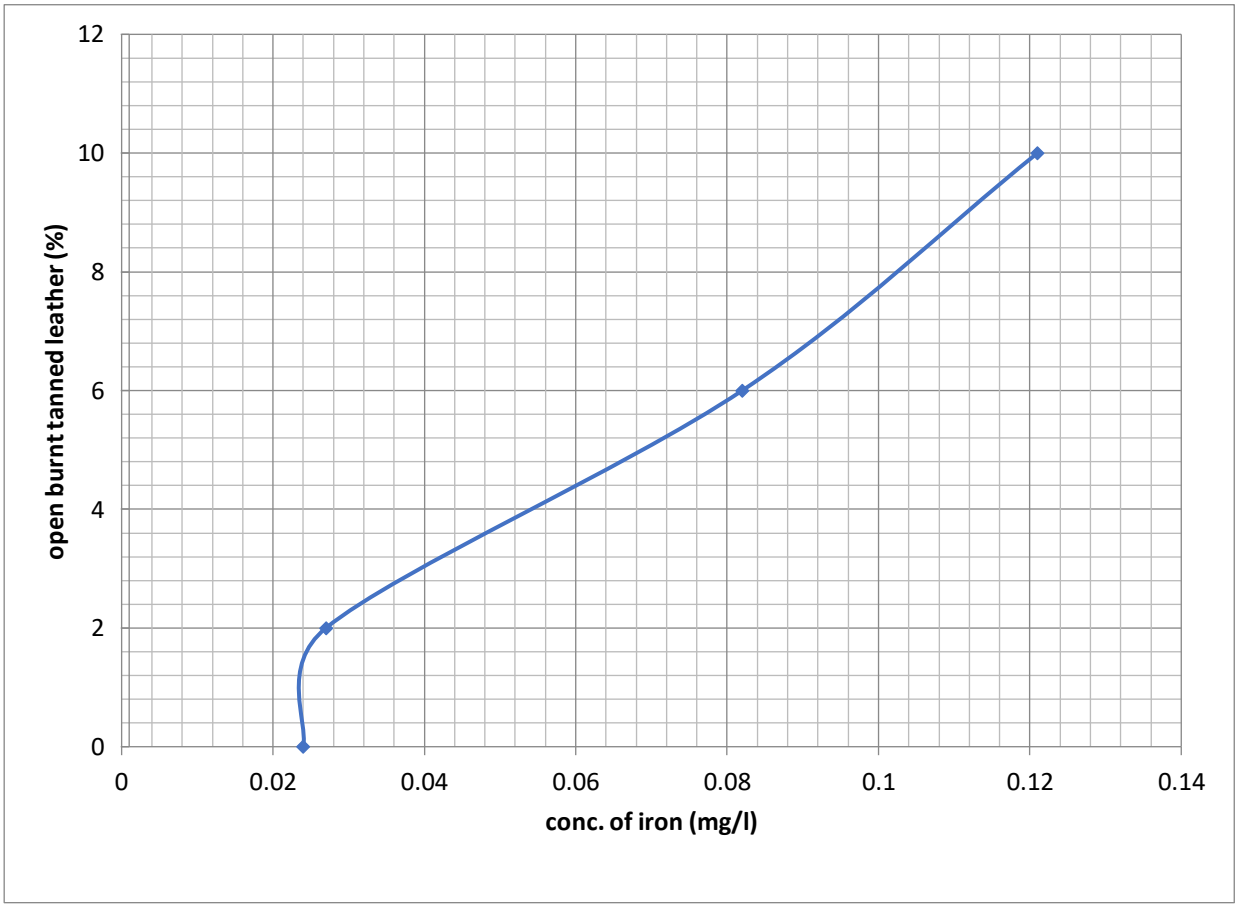

Figure 4.6 Concentration of Iron for open burnt tanned leather for various fractions of leather waste mixed.

4.1.2 Concentrations of heavy metals in leachate produced when soil was mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed

Table 4.7 Concentration of Chromium leachate produced by soil mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed.

Percentage of waste	Concentration of Chromium (mg/L)
0	0.000
2	0.610
6	1.980
10	2.240

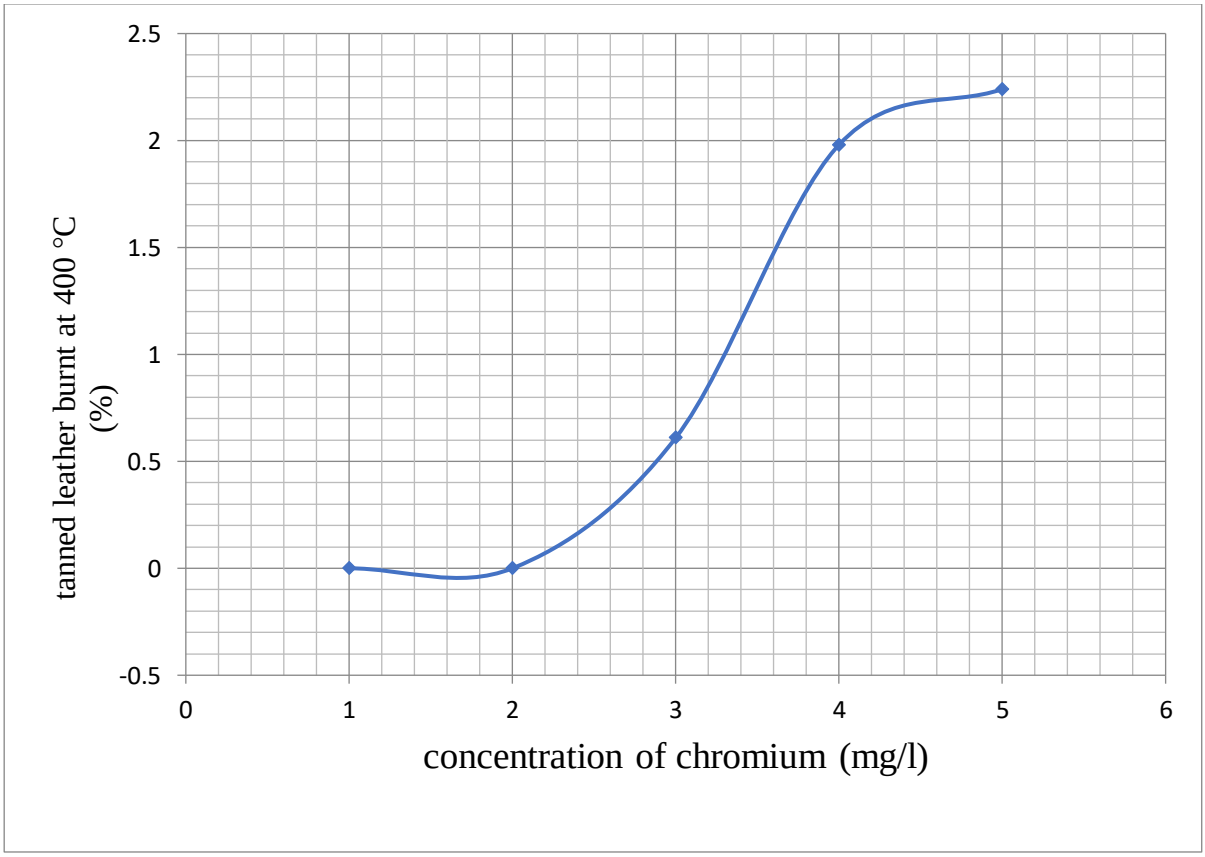

Figure 4.7Concentration of Chromium in leachate produced by soil mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed.

Table 4.8 Concentration of lead in leachate produced in soil mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed

Percentage of waste	Concentration of Lead (mg/L)
0	0.000
2	0.032
6	0.098
10	0.150

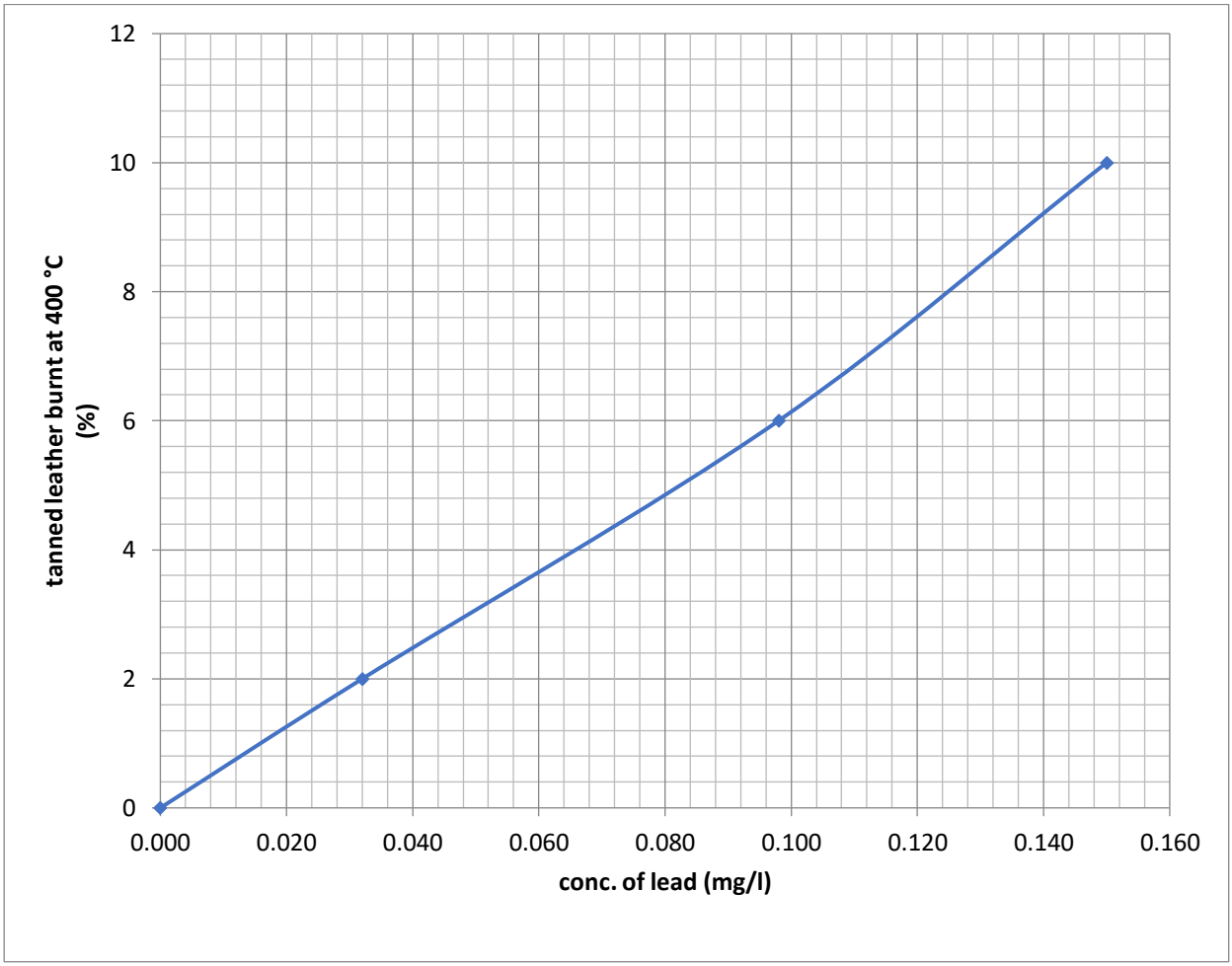

Figure 4.8 Concentration of lead in leachate produced by soil mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed.

Table 4.9 Concentration of zinc in leachate produced in soil mixed with tanned leather burnt at 400°C for various fractions of leather waste mixed.

Percentage of waste	Concentration of Zinc (mg/L)
0	0.012
2	0.022
6	0.054
10	0.100

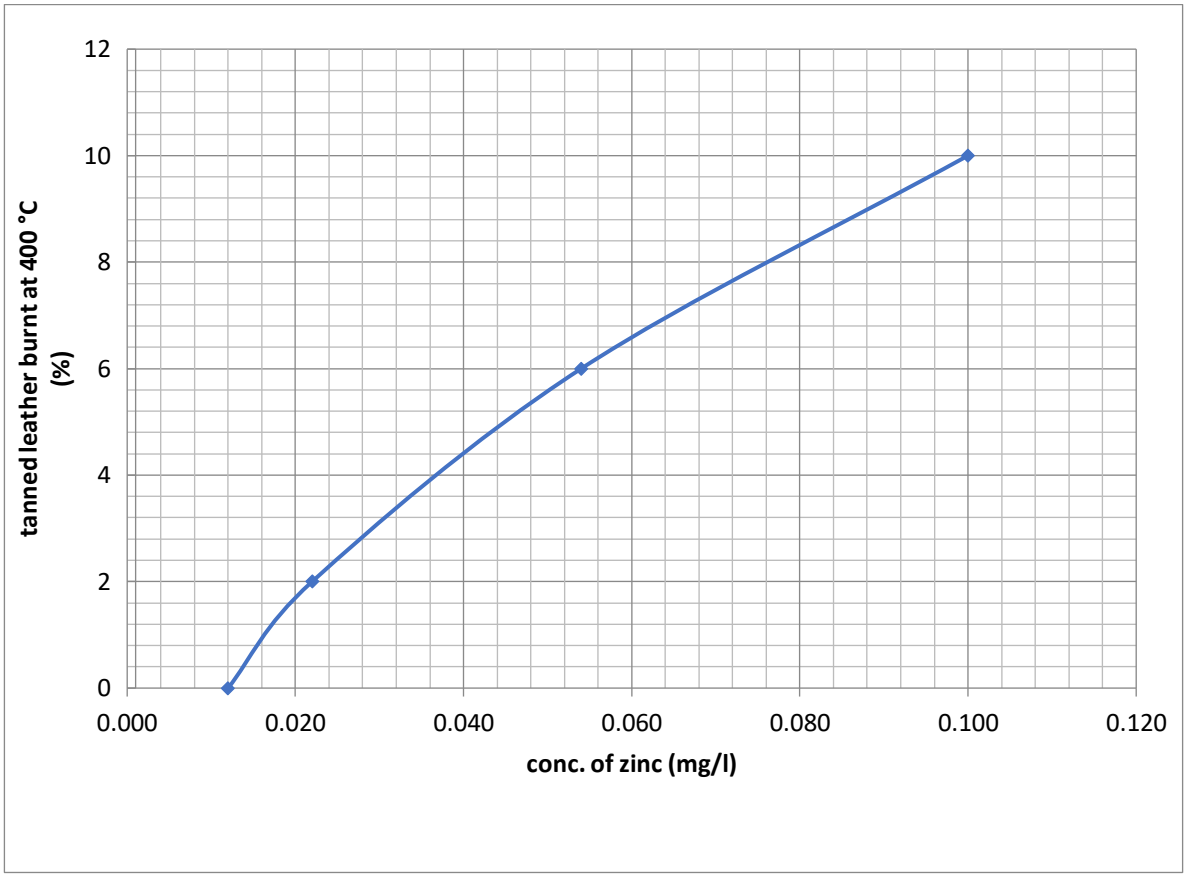

Figure 4.9 Concentration of zinc in leachate produced in soil mixed with tanned leather burnt at 400°C for various fractions of leather waste mixed.

Table 4.10 Concentration of nickel in leachate produced in soil mixed with tanned leather burnt at 400°C for various fractions of leather waste mixed.

Percentage of waste	Concentration of Nickel (mg/L)
0	0.0020
2	0.0020
6	0.0056
10	0.0044

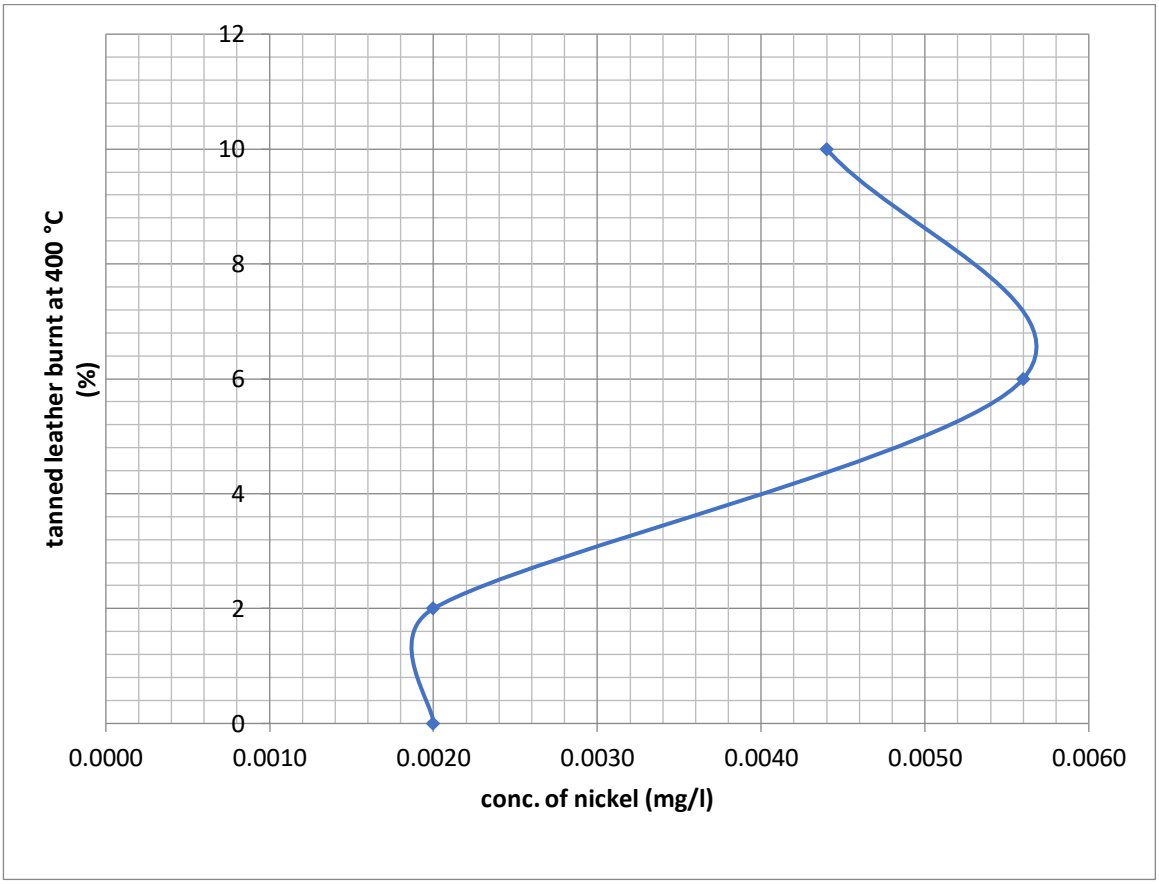

Figure 4.10 Concentration of nickel in leachate produced in soil mixed with tanned leather burnt at 400°C for various fractions of leather waste mixed.

Table 4.11 Concentration of Copper in leachate produced in soil mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed.

Percentage of waste	Concentration of Copper (mg/L)
0	0.000
2	0.000
6	0.000
10	0.028

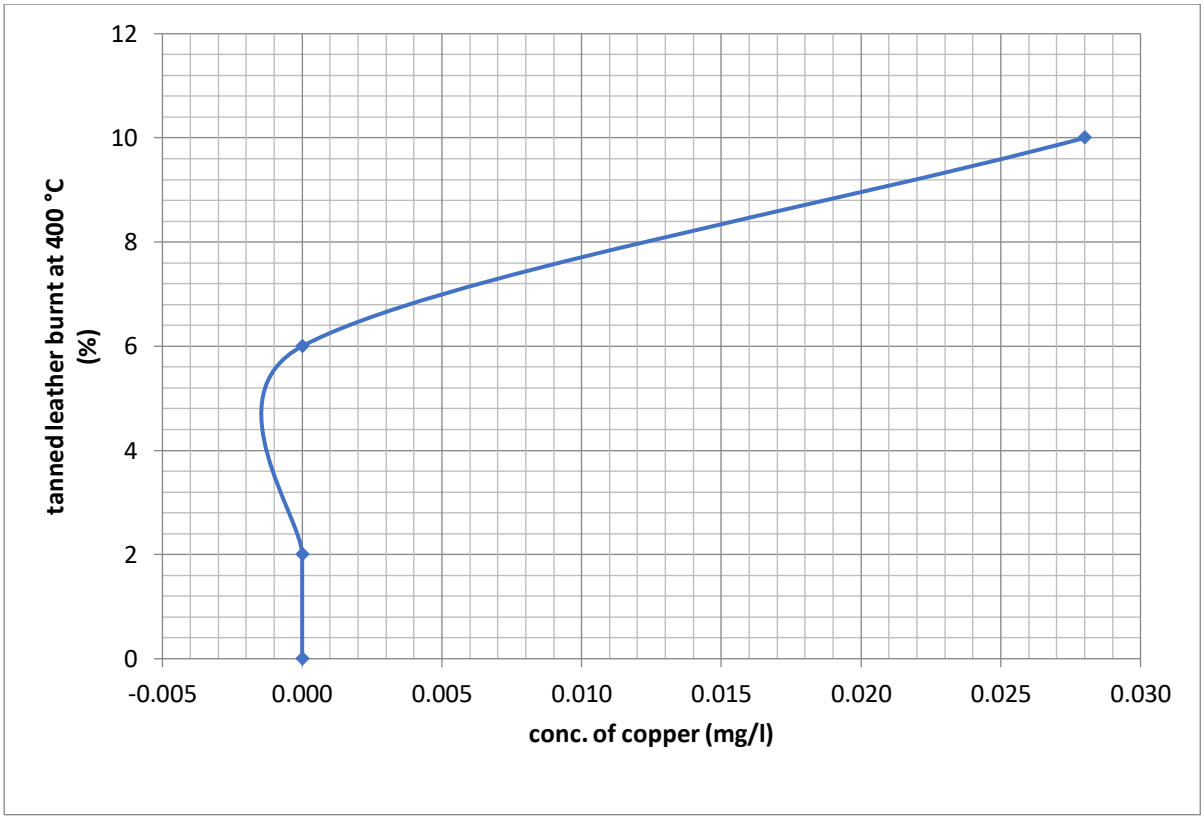

Figure 4.11 Concentration of Copper in leachate produced in soil mixed with tanned leather burnt at 400ºC for various fractions of leather waste mixed.

Table 4.12 Concentration of Iron in leachate produced in soil mixed with tanned leather burnt at 400^{o}C for various fractions of leather waste mixed.

Percentage of waste	Concentration of Iron (mg/L)
0	0.024
2	0.013
6	0.041
10	0.089

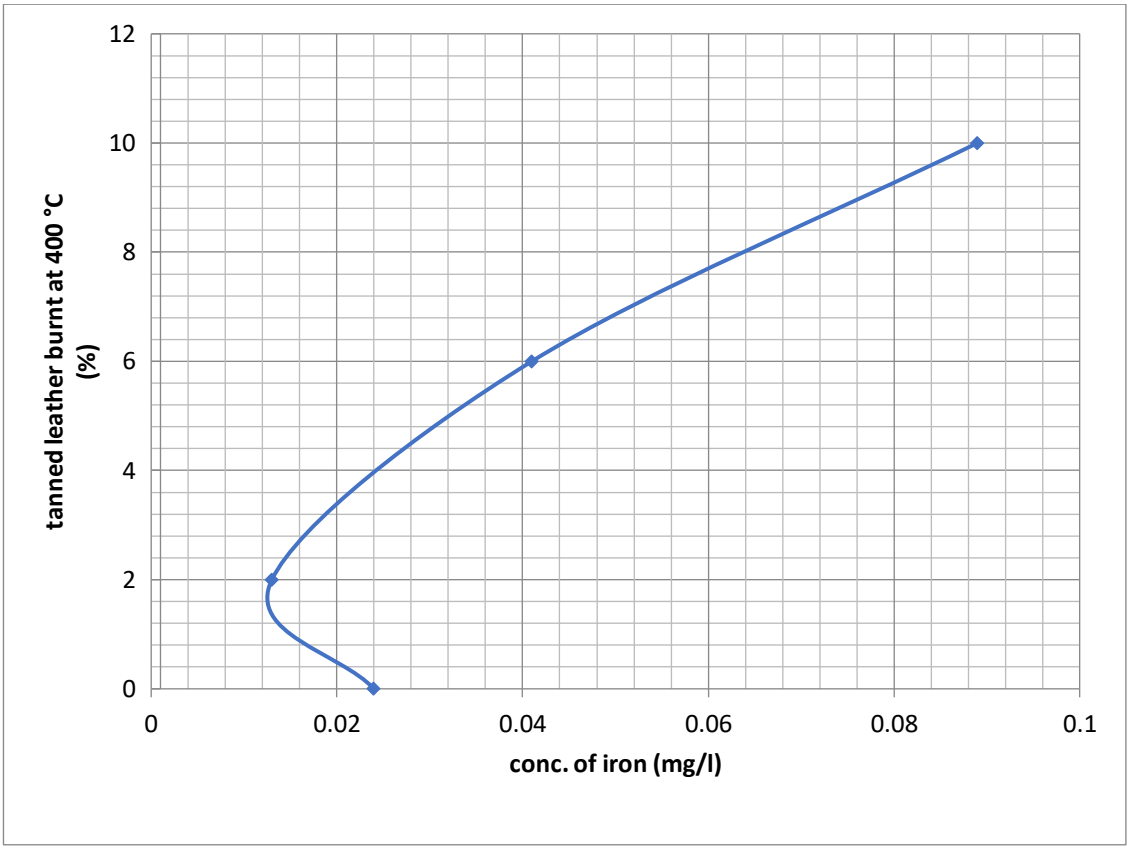

Table 4.12 Concentration of Iron in leachate produced in soil mixed with tanned leather burnt at 400^{o}C for various fractions of leather waste mixed.

CHAPTER 6

CONCLUSION

6.1. GENERAL

This chapter deals with the study of results obtained from experiments performed in the laboratory. This also shows that the optimum percentage of tanned leather (open burned or burn at 400 ºC) on the basis of experimental work done and further conclusions are made.

6.2. CONCLUSIONS

- The tests performed in the laboratory shows that concentration of the chromium ions is increasing as the percentage of the tanned leather increases.
- From the results it can be concluded that black cotton soil is effective absorbent of chromium and other heavy metal.
- Also there is very insignificant change in other heavy metals such as lead, zinc, iron and copper.
- As the temperature increases absorbing capacity of black cotton soil increases.
- Results also show that presence of chromium increases with increase in percentage of the tanned leather ash.
- It is also analyzed from the results that at high temperatures chromium reduce significant change.
- It is also concluded that absorbing capacity of black cotton soil increases at high temperature at all concentrations of tanned leather ash.
- Concentrations of other heavy metals are insignificant.
- Concentrations of heavy metals increases when mixed with tanned leather ash thermally treated.
- It is observed physically that soil loses its permeability

FUTURE SCOPE

- We can further study the properties of black cotton soil at higher temperatures.
- Also we can study the variable rainfall rates as per to the requirement.
- Further we can study the various oxide forms of chromium or other heavy metals as per our requirement.
- Further characteristics of black cotton soil can be studied at higher temperatures i.e. more than 400°C.

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