"LEACHATE STUDY OF THE PAVEMENT MODEL STABILISED WITH TANNED LEATHER WASTE ASH"

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

Mr. Niraj Singh Parihar

Assistant Professor

By

Arpit Rana (161053)

Shankar Kumar (161644)

Deepak Sharma (161665)

To

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173234

HIMACHAL PRADESH, INDIA

June – 2020

STUDENT'S DECLARATION

We hereby declare that the work presented in the Project report entitled **"Leachate Study Of The Pavement Model Stabilised With Tanned Leather Waste Ash"** submitted in 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 our 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.

Arpit Rana (161053)

Shankar Kumar(161644)

Deepak Sharma(161665)

Department of Civil Engineering
Jaypee University of Information Technology,
Waknaghat, Solan (H.P.), India

Date- 30 May, 2020

CERTIFICATE

This is to certify that the work which is being presented in the project report titled **"Leachate Study Of The Pavement Model Stabilised With Tanned Leather Waste Ash"** submitted in 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 work carried out by **Arpit Rana (161053), Shankar Kumar (161644) & Deepak Sharma (161665)** under the supervision of **Mr. Niraj Singh Parihar,** Assistant Professor**,** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

Date: 30 May, 2020

15/7/2020
HOD
CE DEPT

Niraj Singh Parihar.

Signature of HOD	Signature of Supervisor	External Examiner
Dr. Ashok Kumar Gupta	Mr. Niraj Singh Parihar	
Professor and Head	Assistant Professor	
Department of Civil Engineering	Department of Civil Engineering	
JUIT,Waknaghat	JUIT, Waknaghat	

ACKNOWLEDGEMENT

This project report gives a description of the study work done on the project topic **"Leachate Study Of The Pavement Model Stabilised With Tanned Leather Waste Ash"**for the partial fulfillment of the requirements for the degree of Bachelor of Technology in Civil Engineering, under the supervision of "**Mr. Niraj Singh Parihar"**.

We gratefully acknowledge the Management and Administration of Jaypee University of Information Technology, Waknaghat for providing us the opportunity and environment to initiate and complete our project.

We are very grateful to our Project Guide Mr. Niraj Singh Parihar and Head of Civil Engineering Department Dr. Ashok Kumar Gupta for their help and able guidance regarding the project. We are also very grateful to the support and assistance provided by the team of talented and dedicated technical staff comprising Mr. Jaswinder Singh, Mr. Itesh Kumar Singh, Mr. Amar Kumar, Mr. Rajesh Sahu and Mr. Pradeep Kumar of department of Civil engineering.

ARPIT RANA(161053)

SHANKAR KUMAR(161644)

DEEPAK SHARMA(161665)

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF GRAPHS

LIST OF PIE CHARTS

LIST OF ABBREVIATIONS

BCS……………………………………………………………………..……Black Cotton Soil

OMC………………………………………………………………….Optimum Moisture Content

CBR………………………………………………………………........California Bearing Ratio

ABSTRACT

Some soils possess very low bearing capacity and it was observed from previous researches that burnt leather waste is capable of stabilizing the soils and enhance it's properties like strength, bearing capacity etc. Leather waste is very light weight and occupies a lot of volume, so it is a problem for storage. So, it would be better if it can be utilized for stabilizing soils for road pavements.

So, tanned leather waste is used and a model for pavement design which is similar to Guna, Madhya Pradesh was prepared. The soil used is also collected from Guna, the Black cotton soil. First, the leachate study is done by doing the rainfall over the model in accordance to Guna weather and leachate collected is sent for toxic metals determination. Leather waste is also burnt at different temperatures for checking the best possible temperature in which toxic waste coming out is less and soil is also stabilized.

Stabilisation is checked by California Bearing Ratio test as it is most used test for checking soil bearing capacity in pavement design.

Keywords: leachate, Black Cotton soil, tanned leather waste

Chapter 1

INTRODUCTION

1.1 GENERAL

Mainly most of the structures are built on soil so it takes all the loads coming from super structure and the sub structure. As a result soil is a major aspect to be considered. Expansive soil or black cotton soil having low bearing capacity is a threat to the stability of the structure here in our case the sub base layer of the pavement. Black cotton soil contains minerals like montmorillonite and illite. The main function of the sub base layer is to provide support and improve drainage of the pavement. Here in our research for improving the bearing capacity of sub base layer of a pavement in Guna, Madhya Pradesh consisting of black cotton soil tanned leather waste is mixed with the soil model. The tanned leather is added in different proportions of 2%, 4%, 6%, 8% and 10% to the soil. This is done to find the best proportion having high CBR value and ultimately increasing the bearing capacity of soil to the larger extent as compared to other proportions.

Also the leachate study of that particular proportion is studied by modeling the sub base layer of the pavement at lab using various factors like rainfall intensity and depth.

Rainfall data of the region i.e of Guna Madhya Pradesh is studied and the maximum rainfall is thus stimulated in the lab itself by means of various tools. Leachate generated is thus tested for heavy metals that are harmful to the environment. Chromium ions are present in tanned leather as a result they can reach the ground water table with the rainfall water seeping into the pavement. Thus the ground water will get polluted and will result in serious health problems like damage to the kidneys and liver of the living beings. It can also cause allergic reactions to the human beings. The presence of high chromium also affects the survival of fresh water fishes ultimately damaging there liver, kidneys and gills. Thus, affecting the eco-system as a whole. So, the study of concentration of chromium ions is very important aspect for the sustainable development. The development should take place without disturbing the environment.

1.2 LEACHATE

Leachate is a liquid that is generated by water or any other liquid passing through the material and extracting some of it's soluble and suspends soils or any other component from the material itself. It also refers to the liquid that has harmful substances present in it causing serious harm to the environment and the eco system. The presence of harmful substances in soil causes potential problem like contamination of soil as these substances are resistant to biological or chemical degradation and so remain in their original state for many years or even for centuries. This leachate can enter ground water table causing harmful health hazards and causing serious environmental issues.

1.3 OBJECTIVES OF THE PROJECT

The main aim of our project is to stabilize the soil for road pavements by using tanned leather waste and check the environmental effects after stabilizing :-

1. To check the presence of heavy metals mainly chromium in the leachate obtained from stabilized soil.

2. To check the effect of tanned leather ash on the bearing capacity of soil by using California Bearing Ratio test.

3. To check at which percentage of tanned leather ash, the CBR coming out is maximum.

4. To check at which temperature of burning of tanned leather waste, it is performing best for stabilization and have maximum CBR value.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Previous researches showed that Black cotton soil requires stabilisation before any engineering work to start, soil stabilisation can be done through lime, rice husk ash, bagasse ash etc. Lime and different admixtures can also be mixed together. Scaling of soil and pavement design for Guna area is also discussed.

2.2 REVIEWS

2.2.1 K.J Osinubi(2009). "Lime stabilization of black cotton soil using bagasse ash as admixture"

This research paper was about using lime and Bagasse ash for soil stabilization. Bagasse ash can be obtained by burning the fibrous residue from extraction of sugarcane juice.

Key points:-

- 8% lime and 4% baggash ash admixture works good for stabilizing Black CottonSoil.

2.2.2 Shailendra Singh, Hemant B. Vasaikar(2013). "Stabilization of black cotton soil using lime"

This research paper was about testing the effect of lime alone on the BCS. BCS needs some stabilization before any engineering work.

Key points:-

- 4% and 6% of lime shows remarkable change in CBR, Plastic limit, Liquid limit and OMC of soil.

2.2.3 HN Ramesh, Krishna Manoj, HV Mamatha(2010). "Compaction and strength behavior of lime coir fiber treated black cotton soil"

In this research paper the effect of lime and coir was studied on the BCS on different properties like plastic limit, liquid limit, OMC etc.

Key points:-

- Coir in this study is processed fiber of coconut husk with 4%lime.
- Black cotton soil with 4% lime reinforced by coir fiber shows some ductility before and after failure.

2.2.3 Pankaj R Modak, Prakash B Nangare, Sanjay D Nagrale(2012).“Stabilization of black cotton soil using admixtures”

This research paper was about using both lime and fly ash to stabilize BCS properties. BCS is highly clayey soil i.e.- Montmorillonite clay mineral is present in it.

Key Points:-

- The use of fly ash and lime shows great increase in CBR values.

2.2.5. Indian Geotechnical Conference(2010). “Effect of lime stabilization on properties of black cotton soil”

This research paper was about knowing how actually lime is able to

stabilize the Black Cotton Soil.

Key points:-

- The lime reacts with soil and transforms the soil into a strong cementitious matrix.

2.2.6. Dilip Shrivastava, A K Singhai, R K Yadav(2014). “Effect of lime and rice husk ash in Engineering properties of black cotton soil”.

This research paper was about using rice husk ash and lime together to stabilize the BCS. Rice husk is already a big problem for waste management industry.

Key points:-

- Lime mixed with different proportions of rice husk in soil shows a significant change in soil properties.

2.2.7. Chethan Marol, Anand Neeralakeri(2016). “Experimental Study on Soil Stabilization using Admixtures”

This research paper was about using lime and fly ash together to bring changes on the different properties of soil like plastic limit, OMC, dry density etc.

Key points:-

- Lime with different concentrations of fly ash changed optimum moisture content, dry density etc. of soil considerably.

2.2.8 Nadeem khan, Rakesh Gupta, MukeshPandey(2016).“A study of Detailed Project Report for Upgradation of Nh-3 from Two to Four Lane”

This research paper was specifically about the road pavements in

Guna, Madhya Pradesh.

Key points-

- Initial cost of construction of rigid pavement is 21% more than flexible pavement. But after including maintenance cost for 20 years cost of flexible pavement increases by 6%.
- Subbase thickness of Guna is 0.38m.

2.2.9 Terry Lucke, Simon Beecham(2011). “An investigation into long-term infiltration rates for permeable pavements on sloping sub-catchments”

This research paper was about the design of road pavements in slopes.

Key points-

- Results showed that there is a clear relationship between pavement slope and the infiltration capacity through the pavement surface.

2.2.10 A. Askarinejad, J. Laue, A. Zweidler, M. Iten, E. Bleiker, H. Buschor, S.M. Springman (2012) “Physical modelling of rainfall induced landslides under controlled climatic conditions”

This research paper was about the scaling laws and principles that can be used in designing models of road pavements.

Key Points-

- Scaling factors varies accordingly to factors.

2.3 SUMMARY OF LITERATURE REVIEW-

1. Soil can be stabilised by using rice husk ash, fly ash, lime etc.

2. Soil stabilisation is done to increase the properties of soil like strength and bearing capacity.

3. CBR test is mostly using to check bearing capacity of soil when pavements are designed.

4. Scaling of soil can't be done directly, various laws have to be followed first.

5. The percentage used for stabilising soil should have proper gap in between.

CHAPTER 3

MATERIALS AND OTHER REQUIREMENTS

3.1 BLACK COTTON SOIL

Black cotton soil exhibits high amount of swelling and shrinkage when exposed to rapid changes in moisture content thus causing stability problems. The soil is clayey and impermeable in nature. It is made up of volcanic rocks. Also because of their tendency to hold water, it is appropriate for the cultivation of cotton in India hence therefore called as black cotton soil.

In India Deccan plateau has majority of black cotton soil present covering very big part of it. Deccan plateau consists mainly of Maharashtra and Karnataka including some parts of Gujarat and Madhya Pradesh. The black cotton soil for the project was collected from Guna, Madhya Pradesh.

Figure 1Black cotton soil

3.2 LEATHER

The steps involved in the making of leather are as follows:

- Curing- Animal skin is prevented from decaying by use of salts and additives.
- Soaking- In it skin is soaked in water for few days to remove dirt particles.
- Liming- In it skin is now soaked in alkali solution to remove extra fats.
- Fleshing- In it extra fats are now removed by a machine.
- De liming- pH is now maintained by removing the effect of alkali.
- Bating- Leather obtained from De liming is cleaned.
- Tanning- Chromium is now added to make the leather more stable. This step turns the leather into tanned leather.
- Shaving- For having a uniform shape and thickness, obtained leather is shaved.
- Neutralization- If there are any extra chemicals left then these are removed.
- Final drying- Moisture content is reduced.
- Finishing- Final changes like adding color, adding protective layer etc. are done.

The tanned leather for the project was obtained from Leather Industry Complex, Kapurthala, Jalandhar, Punjab.

3.2.1 Open burnt tanned leather waste

Tanned leather waste is open burnt and ash left is collected in a container. This leather ash is used as an additive and mixed with black cotton soil by weight at different percentages of 2%, 4%, 6%, 8% and 10%. The ash was sieved through a 425 micron sieve to remove any impurity.


Figure 2 Open burnt tanned leather waste


Figure 3 Open burning of tanned leather waste

3.2.2 Incinerator burnt tanned leather ash

Tanned leather waste is then burnt in incinerator at 400°**C,** 500°**C** and 600°**C** respectively. The ash is then collected in a container and is mixed with the black cotton soil at proportion showing maximum CBR value.

Figure 4 Incinerator burning

Figure 5 Incinerator burning at 800^{o}C

3.3 PREPARATION OF LEACHATE MODELS

For collection of leachate three cylindrical models were prepared of 35cm diameter and 50cm height supported by iron bars. The total height from ground being 92cm. Iron pipe used for carrying sewage was selected for cylindrical portion. At the base of the cylinder a steel sheet with tiny pores was attached so that only the leachate can easily pass and get collected in the container placed below the model.

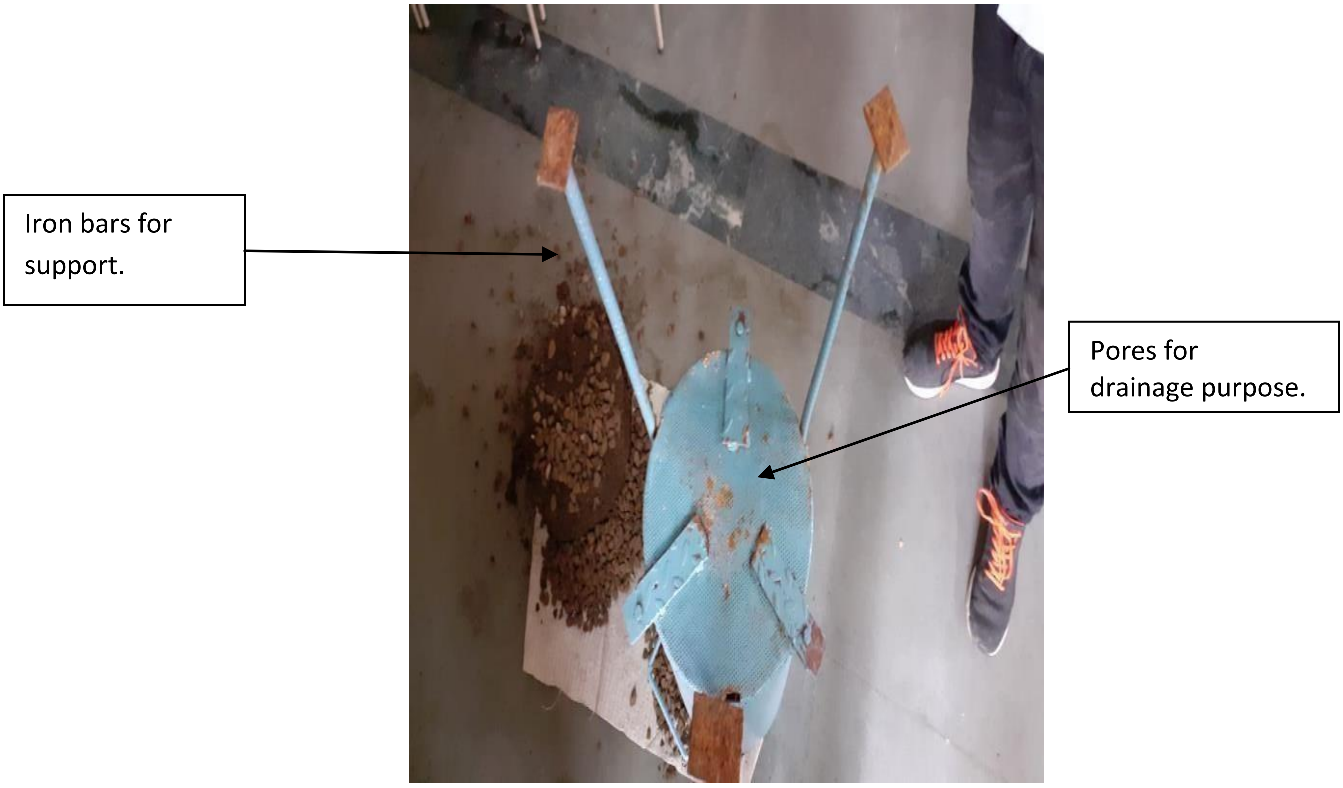


Figure 5 Leachate model drainage view

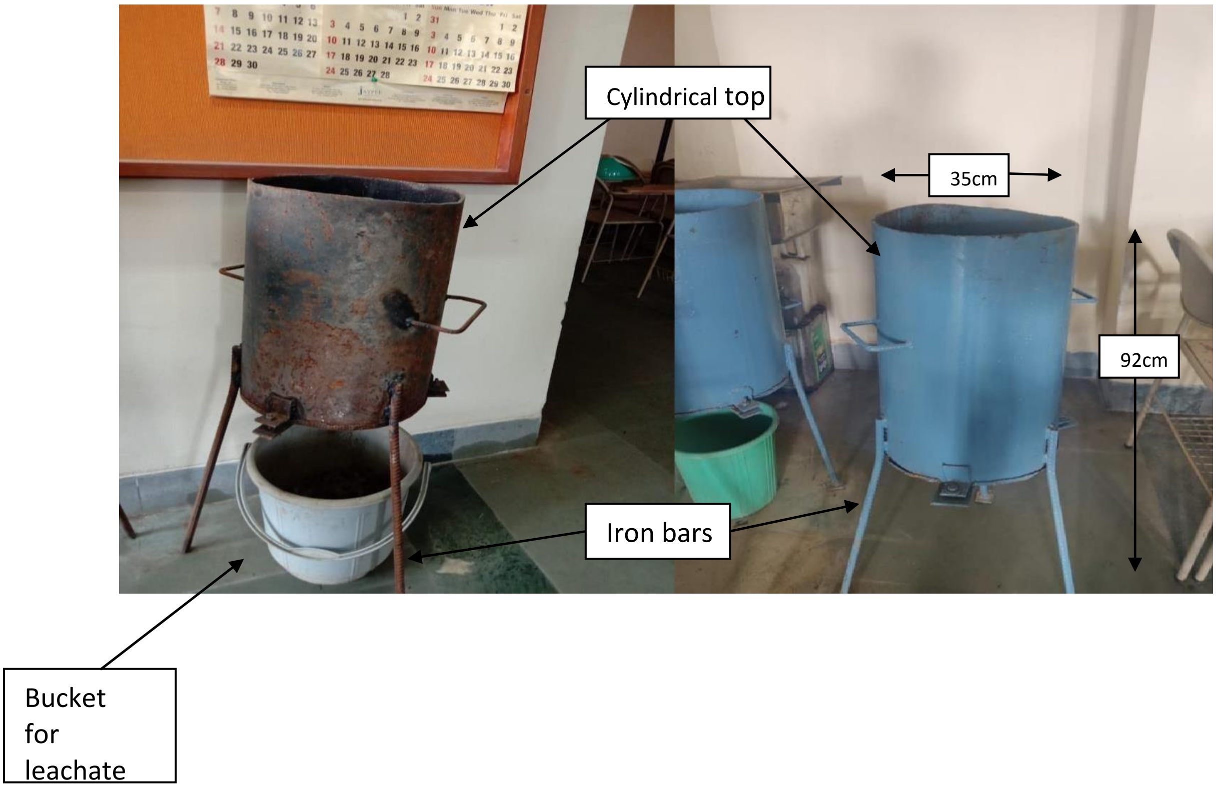


Figure 6 Leachate model side view

3.4 RAINFALL DATA

Extreme Rainfall for Guna is 1160.8 mm from the data given below. This data is taken from the official websiteof Indian Meterological Department (IMD) for Guna, MadhyaPradesh.

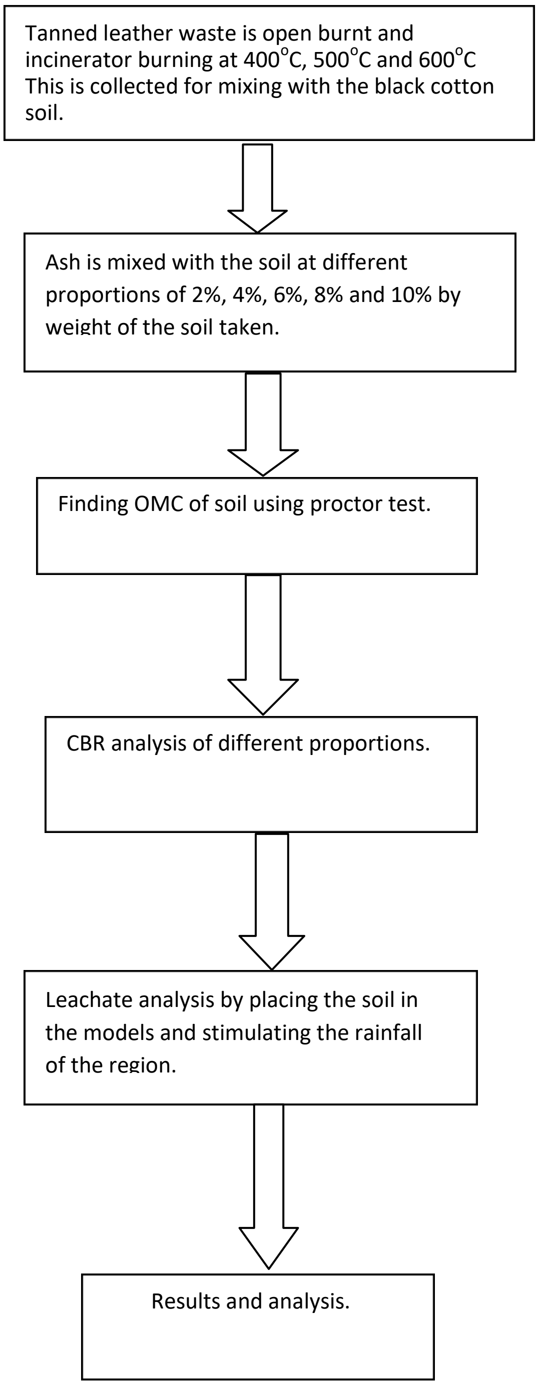
Table 1 Rainfall Data 2014-2019

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
2014	26.2	43.2	9.0	3.2	1.4	28.2	283.8	386.0	102.9	14.1	0.0	29.4
2015	45.2	26.5	38.9	10.5	1.7	143.2	611.6	310.5	12.8	0.8	0.0	0.0
2016	9.3	0.0	1.6	0.0	6.5	80.2	600.8	555.5	39.1	26.2	0.0	0.0
2017	6.0	7.7	9.7	0.0	5.0	126.4	372.1	125.8	154.2	1.0	0.0	0.0
2018	0.0	0.3	0.6	1.0	0.3	115.1	379.9	215.5	197.4	0.0	0.0	0.0
2019	3.5	9.6	1.3	34.6	0.2	31	521.1	1160.8	822.7	72.6	12.7	6.4

CHAPTER 4

METHODOLOGY

4.1 WORKPLAN



4.2 CALCULATIONS

4.2.1 Scaling Factors -

From the above rainfall data, it is clear that highest rainfall is recorded in 2019. So, as we are preparing for worst case scenario.
By the rules of scaling, our scaling factor comes out to be 20. It is denoted by N.
N=20
Rainfall (h)=1160.8mm=116cm(roughly)
Diameter of our mould (d)= 35 cm
Volume of mould in reference to rainfall= 111.6 litres ($\pi(d/2)^2h$)
Scaled Volume= h/N=111.6/20=5.5L
Scaled Rainfall duration= Total hours in month/N^2= 24X31/20^2=1.8 hours
As, it is not practical to flow 5.5L of water in 1.8 hours. So, sprinkler with very fine holes was used and water velocity was also set as minimum as possible.

CALCULATING OMC PROCTOR'S APPARATUS –

Empty Weight of mould = 3693 g
Weight of mould with soil and moisture = 5407 g
Weight of soil only = 1714 g
Radius of mould = 5.2 cm
Height of mould = 11.5 cm
Volume = $\pi r^2 h$ = 976.41 cm^3

DRYDENSITY-

Bulk density, γt = Soil Weight / Mould Volume = 1714 g / 976.41 cm^3
Dry density, $\gamma d = \gamma t/ (1+w)$ = (1714 / 976.41) / (1+ 0.234) = 1.422 gm/cm^3

4.3 OMC OF SOIL USING PROCTOR TEST

Soil is compacted at OMC (Optimum Moisture Content) to remove the extra voids and achieve maximum compaction. At OMC soil shows maximum dry density. OMC can be easily obtained by Proctor Test by making a curve between Moisture Content and Dry Density. Point of Moisture Content at Max dry density is OMC for the soil.

Procedure:

- Pass the given soil from 4.75mm sieve.
- Clean the proctor mould and apply grease in it.
- Weigh the mould with base plate.
- Oven Dry the soil for one day, since our soil is clay bring the moisture content of it to roughly 8%.
- Take 3kg of soil and place it in the mould in 3 layers by compacting each layer with rammer for 25 times.
- Soil should have filled the entire mould. Trim the excess soil in case it is there.
- Take some part of soil from the mould and determine it's moisture content.
- Again add 3% moisture content and repeat the steps.
- Make a graph and see the point of moisture content where dry density started to decrease.
- The point of maximum dry density is OMC of soil.

Figure 7 Proctor mould for OMC determination

4.4 ORGANIC CONTENT DETERMINATION

We used the weight reduction method to check the organic content of our ash. We checked for raw sample, open burnt sample, 400^{o}C burnt sample, 500^{o}C burnt Sample and then finally on 600^{o}C burnt sample.

1. Weight empty weight of vessel. Mark it as W1.
2. Add ash sample in it.
3. Put Vessel with ash sample in oven at 105^{o}C for 24 hours.
4. Weigh the sample with vessel and mark it asW2.
5. Put the W2 sample in muffle furnance at 600^{o}C for 20 minutes.
6. Mark it as W3.
7. Check the weight reduction by following formulae-

   (Weight of ash at 105^{o}C- Weight of ash at 600^{o}C /Weight of ash at 105^{o}C)X100 Or it can be rewritten as- ((W2-W1)-(W3-W1)/(W2-W1))X100

Figure 8 Muffle Furnance

4.5 CBR ANALYSIS

The Californian Bearing Ratio (CBR) test is used to check the bearing capacity of soil. It is most commonly used test in checking the bearing capacity of road pavements. It is generally performed in two ways, one way is soaked CBR in which sample is soaked in water and other is unsoaked CBR in which sample is not soaked in water. It is performed in two ways to check seasonal variations.

Procedure-

- Pass the soil from 20 mm I.S. sieve.
- It should also be retained on 4.75 mm I.S. sieve.
- Take 5 kg of soil and mix it in OMC.
- Put the collar and the base plate in the mould.
- Insert the spacer disc over base plate.
- Place filter paper on top of spacer disc.
- Add soil in the mould, make sure to attach the collar.
- Now, give 56 blows with 2.6kg rammer to the soil in 3layers.
- Remove collar and trim extra soil.
- Turn mould upside down and remove base plate and spacer disc.
- Put a filter paper on the top of compacted soil layer.
- For unsoaked CBR, just add a surcharge weight of 2.5kg and directly test the sample in CBR machine.
- For soaked CBR, add a dish with holes first over the filter paper. Then add surcharge weight of 2.5kg and submerge this complete mould in water for 4 days. After 4 days test the sample in CBR machine.
- Check the CBR reading at 2.5 and 5 mm penetration.
- If 5mm penetration is more, repeat the experiment and if still it is more then mark it as CBR value.

Figure 9 Compacting the soil and CBR test machine

4.6 LEACHATE ANALYSIS

4.6.1 For Plain Black cotton soil:

- Fill 12 kg of Black Cotton Soil in the mould after calculating surface area of mould.
- Fill it upto height of 15cm.
- Add a gravel layer for proper drainage and then fill the soil in mould.
- Do rainfall in accordance to scaled extreme rainfall of Guna as showed in section 4.2 of methodology.
- Collect leachate for 1st, 3rd and 6th day.
- Send the collected leachate for lab tests.

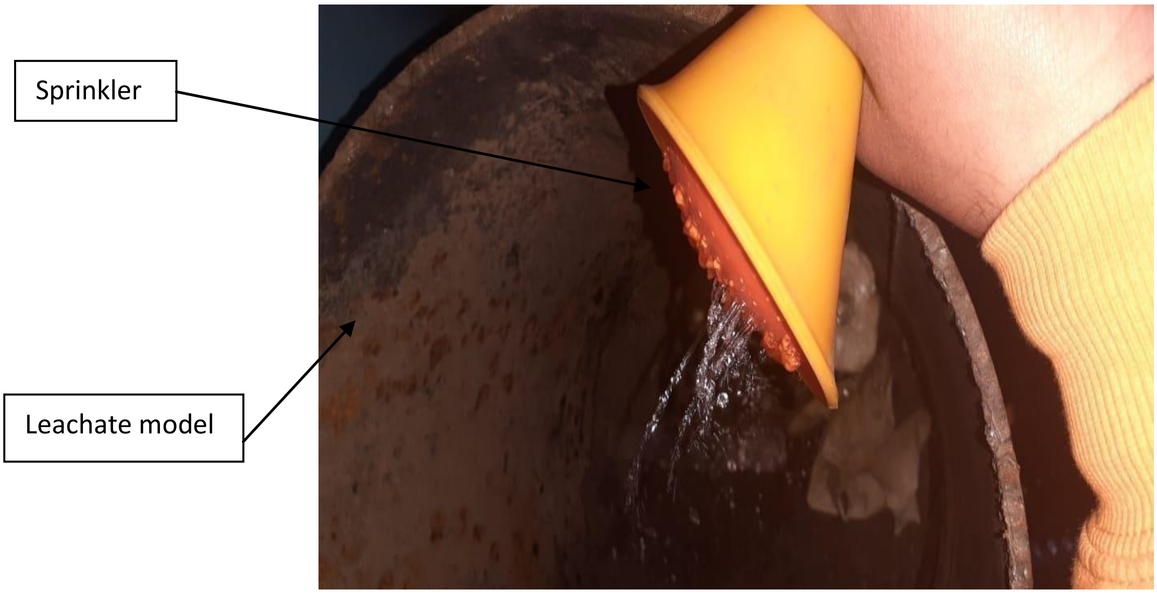


Figure 10 Sprinkler Used

4.6.2 For 2% of tanned leather:

- Take 2% of leather waste by weight of soil to be filled in top layer of soil in the mould.
- Mix it thoroughly with soil at OMC for 2% leather waste and soil (OMC values are given in Table2).
- Fill 12 kg of Black Cotton Soil and 2% leather waste in the mould after calculating surface area of mould.
- Fill it upto height of 15cm.
- Add a gravel layer for proper drainage and then fill the soil in mould.
- Do rainfall in accordance to scaled extreme rainfall of Guna as showed in section 4.2.
- Collect leachate for 1^{st}, 3^{rd} and 6^{th} day. Send the collected leachate for lab tests.

4.6.3 For 6% of tanned leather:

- Take 6% of leather waste by weight of soil to be filled in top layer of soil in the mould.
- Mix it thoroughly with soil at OMC for 6% leather waste and soil (OMC values are given in Table2).
- Fill 12 kg of Black Cotton Soil and 6% leather waste in the mould after calculating surface area of mould. Fill it upto height of 15cm.
- Add a gravel layer for proper drainage and then fill the soil in mould. Do rainfall in accordance to scaled extreme rainfall of Guna as showed in section 4.2.
- Collect leachate for 1st, 3rd and 6th day. Send the collected leachate for lab tests.

4.6.4 For 10% of tanned leather:

- Take 10% of leather waste by weight of soil to be filled in top layer of soil in the mould.
- Mix it thoroughly with soil at OMC for 10% leather waste and soil(OMC values are given in Table2).
- Fill 12 kg of Black Cotton Soil and 10% leather waste in the mould after calculating surface area of mould.
- Fill it upto height of 15cm.
- Add a gravel layer for proper drainage and then fill the soil in mould.
- Do rainfall in accordance to scaled extreme rainfall of Guna as showed in section4.2. Collect leachate for 1st, 3rd and 6thday. Send the collected leachate for lab tests.

CHAPTER 5

RESULTS

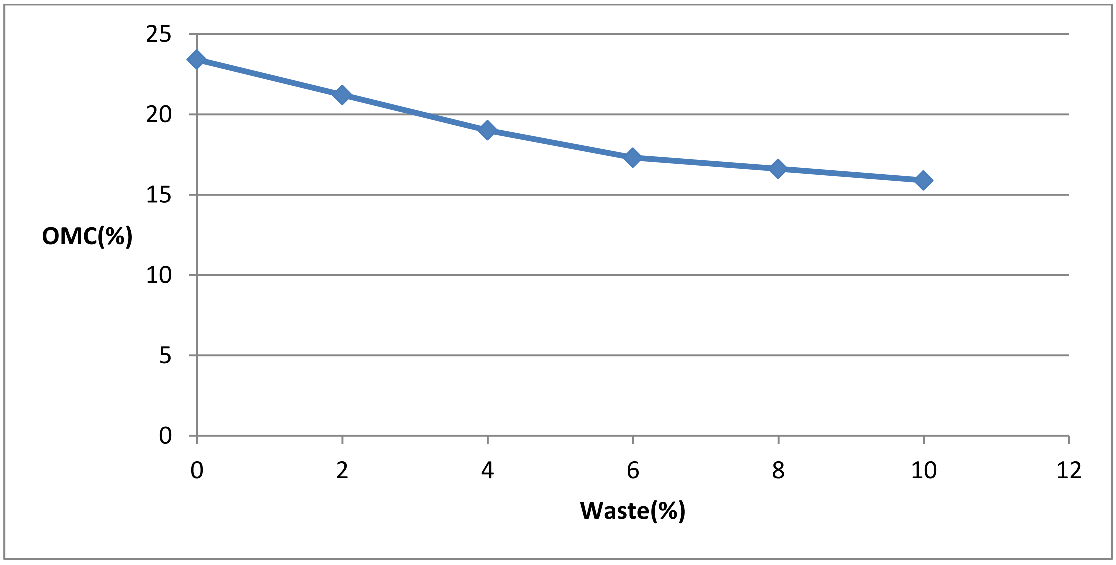
This chapter discusses the results obtained from various experiments performed.

5.1 OPTIMUM MOISTURE CONTENT FOR LEATHER ASH-

All results are shared in tables and graphs.

Table 2 OMC of Black cotton soil with different percentages of leather wastes.

Waste Percentage(%)	OMC(%)
0	23.4
2	21.2
4	19
6	17.3
8	16.6
10	15.88



Graph 1 OMC – waste proportion graph for different waste proportions.

5.2 PENETRATION AND LOAD VALUE IN CBR (UNSOAKED)

Table 3 CBR test Penetration-Load for black cotton soil.

Penetration(mm)	Load(Kg)
0	0
1	98
1.5	115
2	135
2.5	145
3	155
4	188
4.5	196
5	210

Table 4 CBR test Penetration-Load for soil + 2% leather waste.

Penetration(mm)	Load(Kg)
0	0
0.5	53.6
1	109.91
1.5	151.6
2	189.5
2.5	227.4
3	253.9
4	310.7
5	344.8

Table 5 CBR test Penetration-Load for soil + 4% leather waste.

Penetration(mm)	Load(Kg)
0	0
0.5	60.6
1	121.3
1.5	176.7
2	204.6
2.5	234.9
3	250.2
4	284.2
5	322.1

Table 6 CBR test Penetration-Load for soil +6% leather waste.

Penetration(mm)	Load(Kg)
0	0
0.5	64.4
1	129.9
1.5	155.6
2	205.4
2.5	249.4
3	266.5
4	292.7
5	314.9

Table 7 CBR test Penetration-Load for soil + 8% leather waste.

Penetration(mm)	Load(Kg)
0	0
0.5	70
1	135.2
1.5	164.8
2	210.3
2.5	258.6
3	285.4
4	299.1
5	320.2

Table 8 CBR test Penetration-Load for soil + 10% leather waste

Penetration(mm)	Load(Kg)
0	0
0.5	64.4
1	131
1.5	163.1
2	212.3
2.5	255.8
3	276.7
4	310.3
5	317.6

By using relation-

CBR value at 2.5= (Corrected Load value/1370)X100

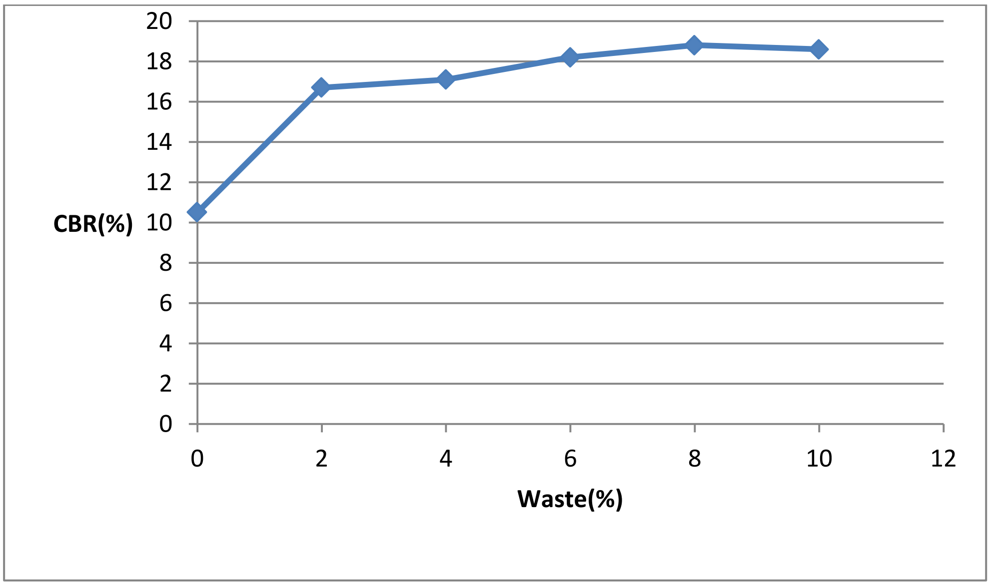
CBR value at 5= (Corrected Load value/2055)X100

(Choose the bigger out of two and in most cases it would be at 2.5)

5.2 WASTE PERCENTAGE COMPARISON WITH CBR VALUE (UNSOAKED)

Table 9 CBR values for soil mixed with different proportions of leather waste.

Waste Percentage(%)	CBR(%)
0	10.51
2	16.70
4	17.10
6	18.20
8	18.80
10	18.60



Graph 2 CBR test results comparison with leather waste percentage

5.3 PENETRATION AND LOAD VALUE IN CBR (SOAKED)

Table 10 CBR test Penetration-Load for soil + 2% leather waste.

Penetration(mm)	Load(kg)
0	0
0.5	13
1	30
1.5	72
2	109
2.5	140
3	163
4	191
5	212

Table 11 CBR test Penetration-Load for soil + 4% leather waste.

Penetration(mm)	Load(kg)
0	0
0.5	41
1	81
1.5	119
2	140
2.5	160
3	174
4	198
5	220

Table 12 CBR test Penetration-Load for soil + 6% leather waste.

Penetration(mm)	Load(kg)
0	0
0.5	45
1	89
1.5	131
2	154
2.5	176
3	191
4	218
5	242

Table 13 CBR test Penetration-Load for soil + 8% leather waste.

Penetration(mm)	Load(kg)
0	0
0.5	54
1	101
1.5	132
2	161
2.5	147
3	217
4	231
5	248

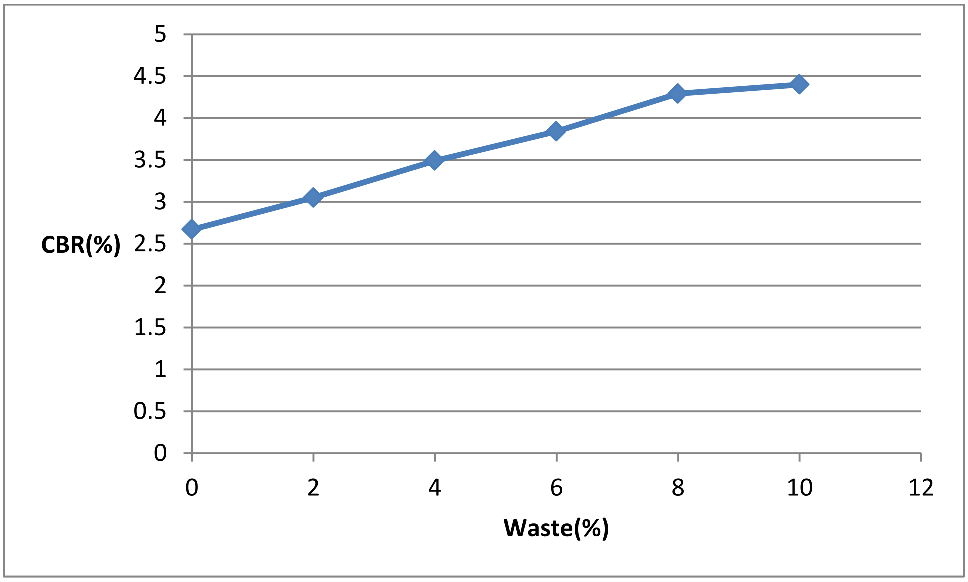
Table 14 CBR test Penetration-Load for soil + 10% leather waste.

Penetration(mm)	Load(kg)
0	0
0.5	54
1	103
1.5	129
2	162
2.5	202
3	215
4	237
5	247

5.4 WASTE PERCENTAGE COMPARISON WITH SOAKED CBR

Table 15 CBR values for soil mixed with different proportions of leather.

Waste Percentage(%)	CBR(%)
0	2.67
2	3.05
4	3.49
6	3.84
8	4.29
10	4.40



Graph 3 CBR test results comparison with leather waste percentage

5.5 INFERENCE OF CBR RESULTS

No remarkable change was observed as generally more than 5% value needed. So we checked for the sulphate content of the open burnt leather waste and 600°C incinerator burnt leather waste.

Table 16 Sulphate Content

Sample	Sulphate content (%)
600°C leather waste	1.96
Open burnt leather waste	3.33

Due to the presence of sulphate in leather waste there was ettringnite and thaumasite formation which was responsible for no remarkable changes in the soaked CBR results. Tests were performed by Shivalik Solid Waste Management lab, Nalagarh, Solan.

5.6 TEMPERATURE CHOOSEN FOR LEACHATE ANALYSIS

As, we are using Tanned leather waste. So, it is very important to check Chromium content and mainly Chromiun 6+ content. As, Chromium 6+ is very bad for environment. It is carcinogen in nature i.e.- it can cause cancer. So, our object is to used to stabilize the soil and also confirm that leachate produced do not carry chromium and chromium 6+. So, first of all we need to check the Chromium and Chromium6+ content in the leather ash we are using.Tests were performed by Shivalik Solid Waste Management lab, Nalagarh, Solan. Organic content test was performed by us in our environment lab of Civil Department in Jaypee University.

We have also found the organic content of raw leather sample, when it wasn't burnt.

Organic content of raw leather sample = 81.25%

Table 17 Properties of burnt leather ash at different temperatures

S.No.	Type of Ash	Organic Content	Total Chromium	Chromium 6+	Calcium
1	Open Burnt	46.66%	2002	131	15.7
2	400 Degree Burnt	29.88%	2002	81	16.5
3	500 Degree Burnt	29.75%	2006	66	16.1
4	600 Degree Burnt	28.57%	2013	36	15.4

So, from the above results as the 600 degree have the least amount of Chromium and Chromium6+. So, we proceeded with open burnt and 600 degree burnt samples. So, we proceeded with leachate analysis of open burnt and 600 degree samples.

5.7 OPEN BURNT LEATHER LEACHATE ANALYSIS.

Tests were performed by Shivalik Solid Waste Management lab, Nalagarh, Solan.

Table 18 Leachate analysis of 2% leather waste Open Burnt

Days	Chromium	Chromium6+
1	0-0.1 ppm	0-0.1 ppm
3	0-0.1 ppm	0-0.1 ppm
6	0-0.1 ppm	0-0.1 ppm

Table 19 Leachate analysis of 6% leather waste Open Burnt

Days	Chromium	Chromium6+
1	0-0.1 ppm	0-0.1 ppm
3	0-0.1 ppm	0-0.1 ppm
6	0-0.1 ppm	0-0.1 ppm

Table 20 Leachate analysis of 10% leather waste Open Burnt

Days	Chromium	Chromium6+
1	0-0.1 ppm	0-0.1 ppm
3	0-0.1 ppm	0-0.1 ppm
6	0-0.1 ppm	0-0.1 ppm

5.8 600 DEGREE BURNT LEATHER LEACHATE ANALYSIS

As, the result is coming out to be undetected only i.e.- lying between 0 to 0.1 ppm. So, we just proceeded with leachate analysis of 600 degree burnt leather to confirm that chromium is not leaching.

Table 21 Leachate analysis of 10% leather waste ash at 600^{o}C

Days	Chromium	Chromium6+
1	0-0.1 ppm	0-0.1 ppm
3	0-0.1 ppm	0-0.1 ppm
6	0-0.1 ppm	0-0.1 ppm

All lied in the **Undetected range** of their testing that means value is between **0 to 0.1 ppm**. Result obtained was same, chromium movement is automatically restricted due to high clay content in our soil. As, in the previous researches it is already proved that clays and bentonites are used to arrest the leach of chromium in landfills.

Chapter 6

CONCLUSION

- Tanned leather waste chromium's mobility in leachate can be restricted by using it over the soils which have high clay content.
- Tanned leather waste does not shows a great increase in soil's bearing capacity(CBR) alone for wet conditions, it does shows a marginal increase. Reason for it is suphate content present in tanned leather waste. So, soils of areas having normal or heavy rainfall throughout the season can't be stabilized with tanned leather waste.
- On the other hand, tanned leather waste has increased the soil's bearing capacity a lot in dry conditions. So, in dry areas having soils with lot of clay tanned leather waste is an excellent choice.
- Burning the tanned leather waste upto 600^{o}C showed reduction of most of Cr6+. So, it can be concluded that 600 degrees burnt leather waste is good for soil stabilization. For soils having enough clay, open burnt will also work fine as chromium mobility will get restricted.
- For Guna road pavement with lots of clay content but high rainfall, tanned leather waste alone can't be suggested for soil stabilization.

Chapter 7

FUTURE SCOPE

- In dry regions of the country tanned leather waste can be adopted as an additive in black cotton soil for more construction purposes.

- A compound to reduce the effect of sulphate content in wet conditions can be used to further improve soil bearing capacity when stabilized with tanned leather waste.

- More industrial wastes can be checked for stabilization.

References

Dr. Akshaya Kumar Sabat(2012); “ A Study on Some Geotechnical Properties of Lime Stabilized Expansive Soil – Quarry Dust Mixes”International Journal of Emerging trends in Engineering And Development, Volume 1 issue2, pp 2249-6149.

Askarinejad, Amin & Laue, Jan & Zweidler, A. & Iten, M. & Bleiker, Ernst & Buschor, H. & Springman, S.M.. (2012). Physical modelling of rainfall induced landslides under controlled climatic conditions. EuroFuge 2012. 1-10.

Shailendra Singh, Hemant B. Vasaikar(2013); “Stabilization of Black Cotton Soil using Lime” International Journal of Science and Research, Volume 6 issue14, pp 2319-7064.

Amit Tiwari, H.K Mahiyar(2014); “Experimental study on Stabilization of Black Cotton Soil by fly ash, Coconut Coir Fiber and Crushed Glass” International Journal of Emerging Technology and Advanced Engineering, Volume 4 issue11, pp 2250-2459.

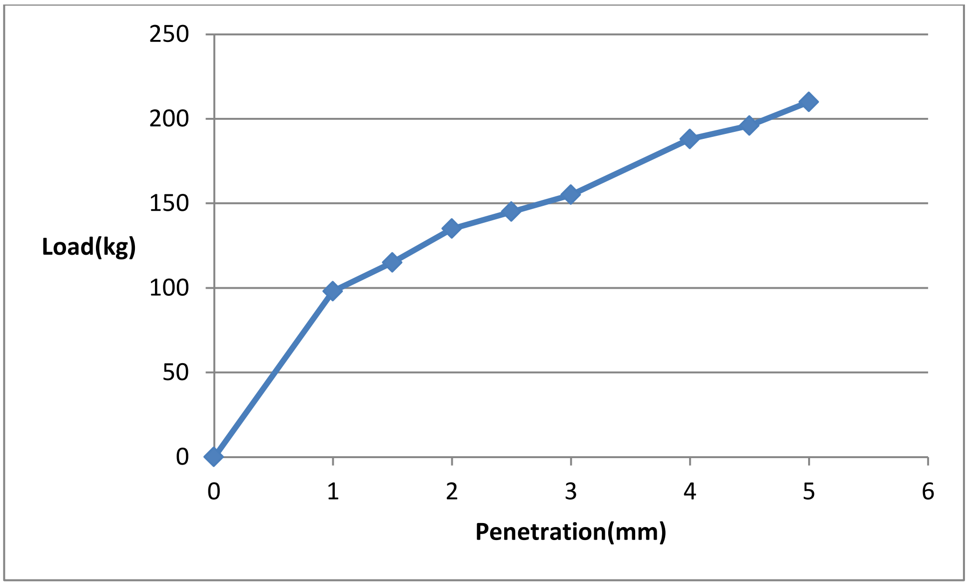
Kumari Pratima, Sharma Prafull and Singh J.P(2015); “Swelling behavior of expansive soil mixed with lime and fly ash as admixture” International Journal of Innovative Research in Science Engineering and Technology, Volume 4 issue6, pp 4364-4372.

R.K Yadav,(2016); “Effect of lime on index properties of black cotton soil”International Journal of Engineering and Technology, Volume 3 issue11, pp 2395-0072.

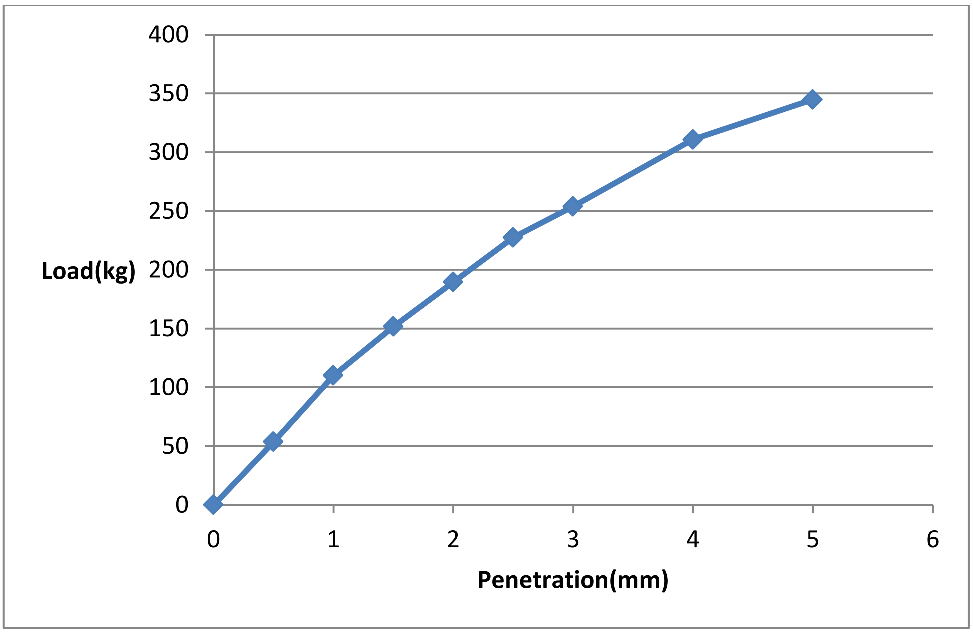
R.K Etim, A.O Eberemu, K.J Osinubi(2017); “Stabilization of Black Cotton Soil with Lime and Iron ore tailings admixture” Journal of Transportation Geotechnics, Volume 5 issue9, pp 2214-3912.

Appendix A

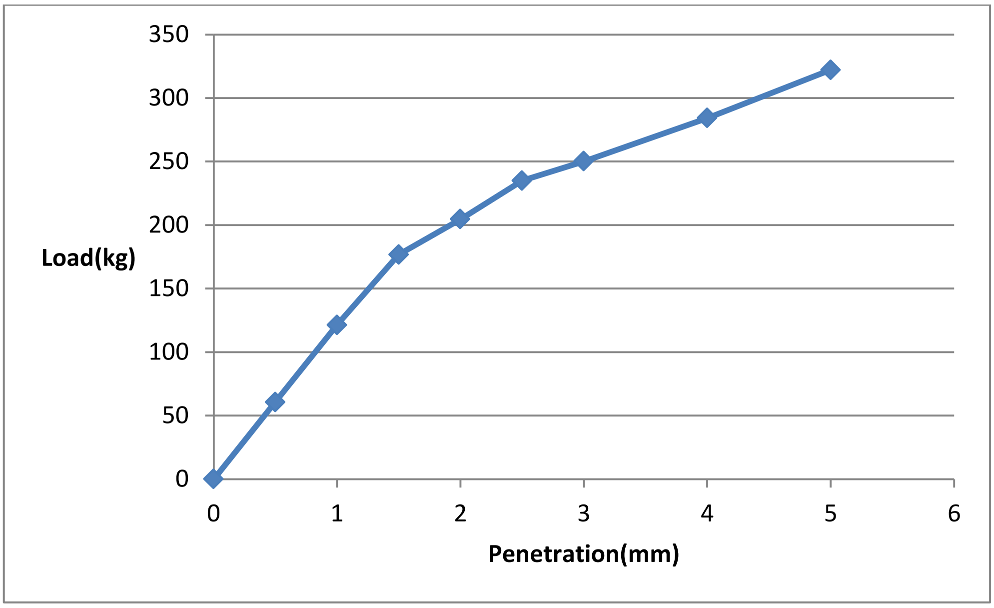
CBR Graphs



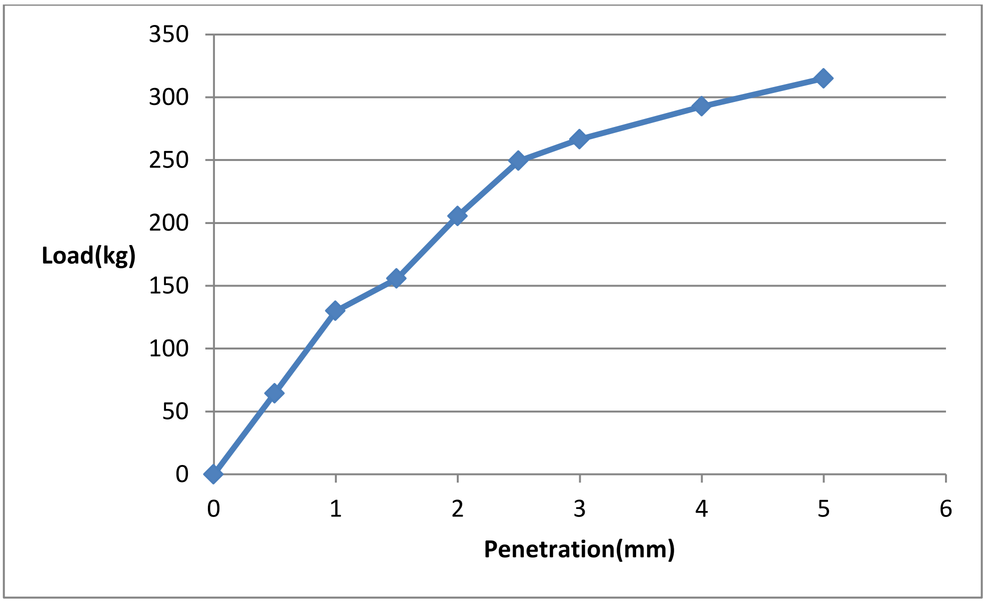
Graph 4 Penetration vs Load for BCS (Unsoaked)



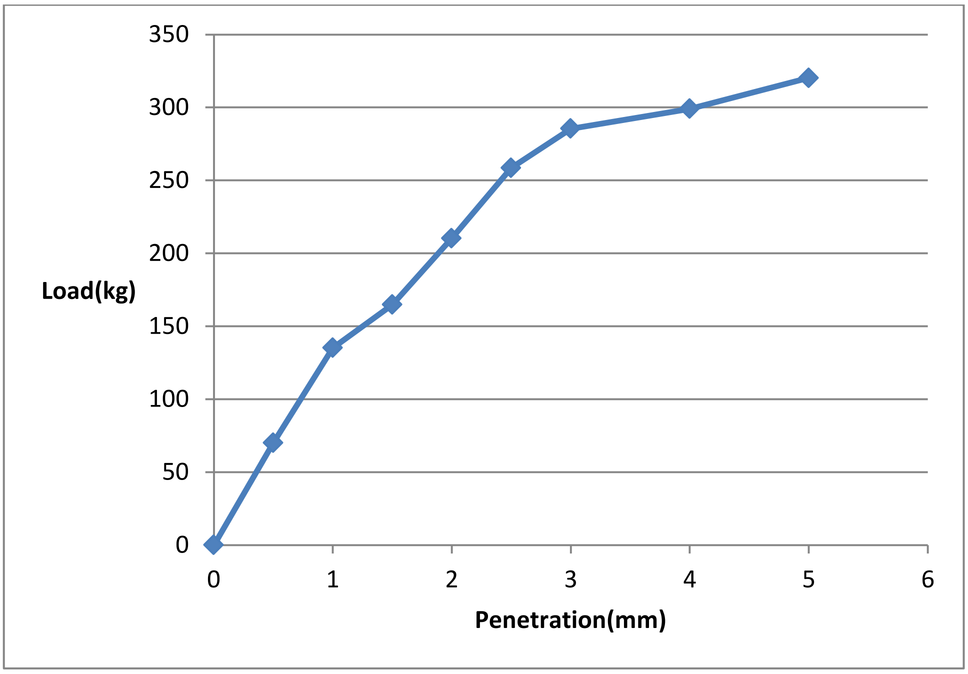
Graph 5Penetration vs Load for BCS + 2% Leather Waste (unsoaked)



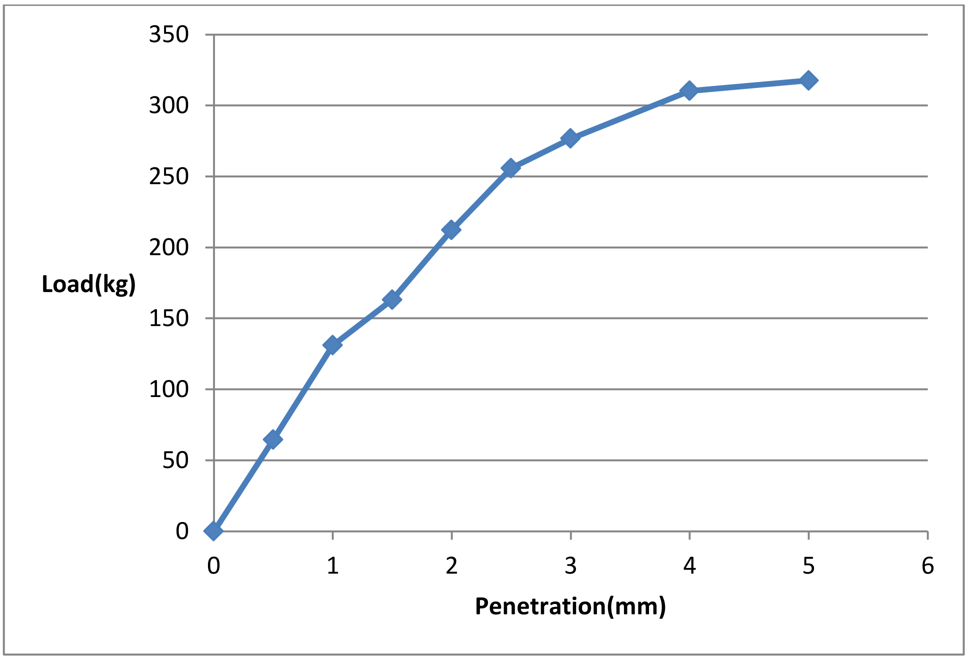
Graph 6 Penetration vs Load for BCS + 4% Leather Waste (unsoaked)



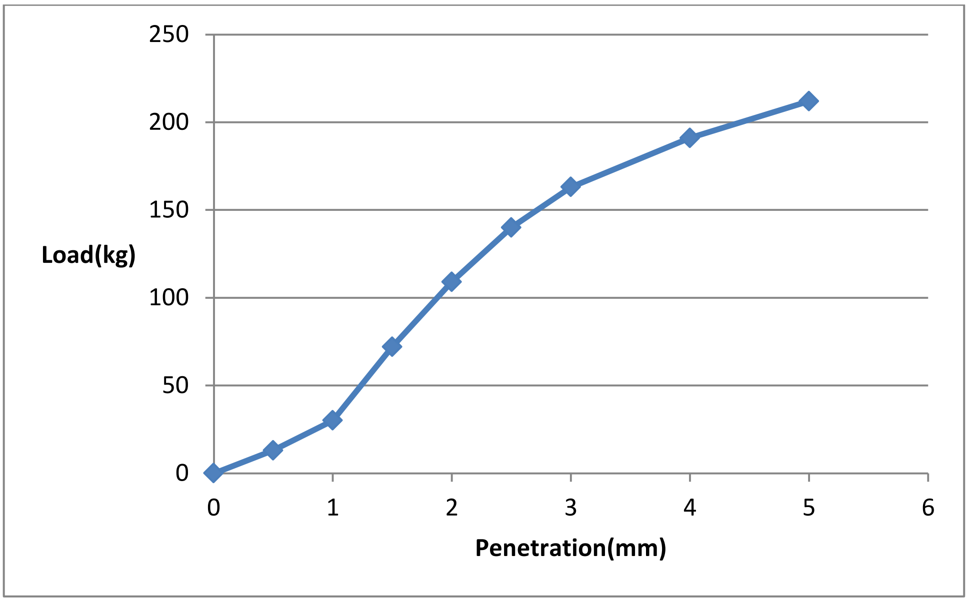
Graph 7 Penetration vs Load for BCS + 6% Leather Waste (unsoaked)



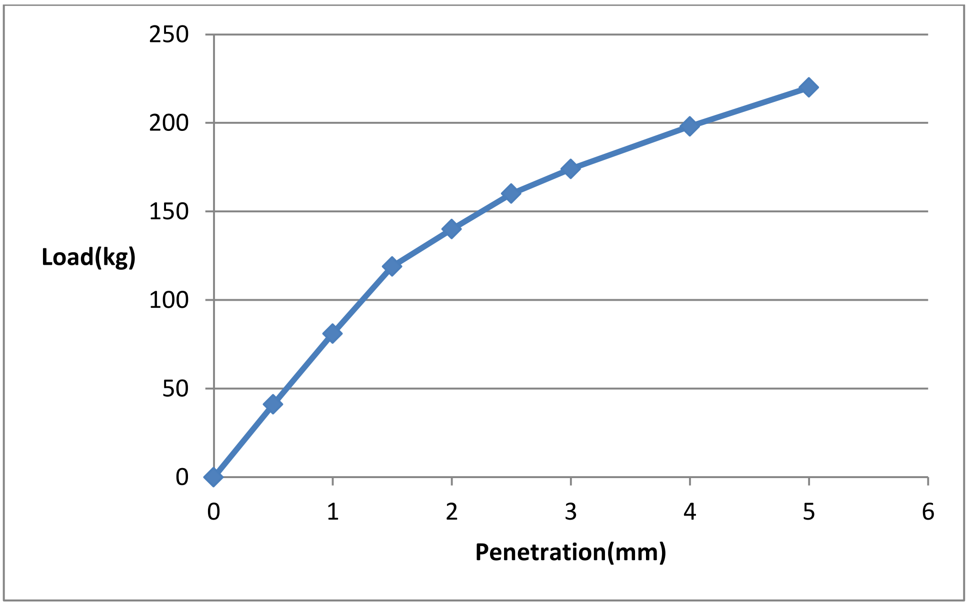
Graph 8 Penetration vs Load for BCS + 8% Leather Waste (unsoaked)



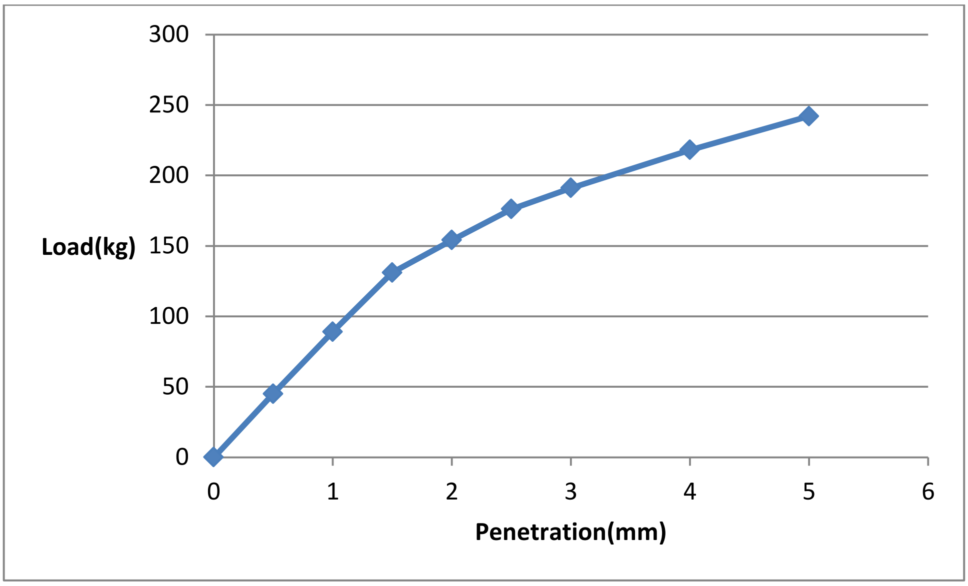
Graph 9 Penetration vs Load for BCS + 10% Leather Waste (unsoaked)



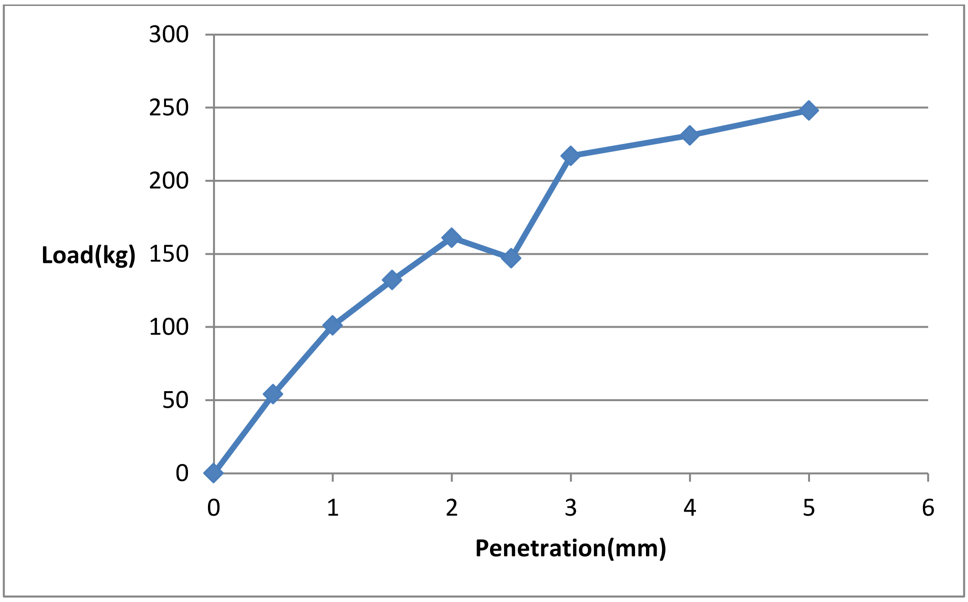
Graph 10 Penetration vs Load for BCS + 2% Leather Waste (soaked)



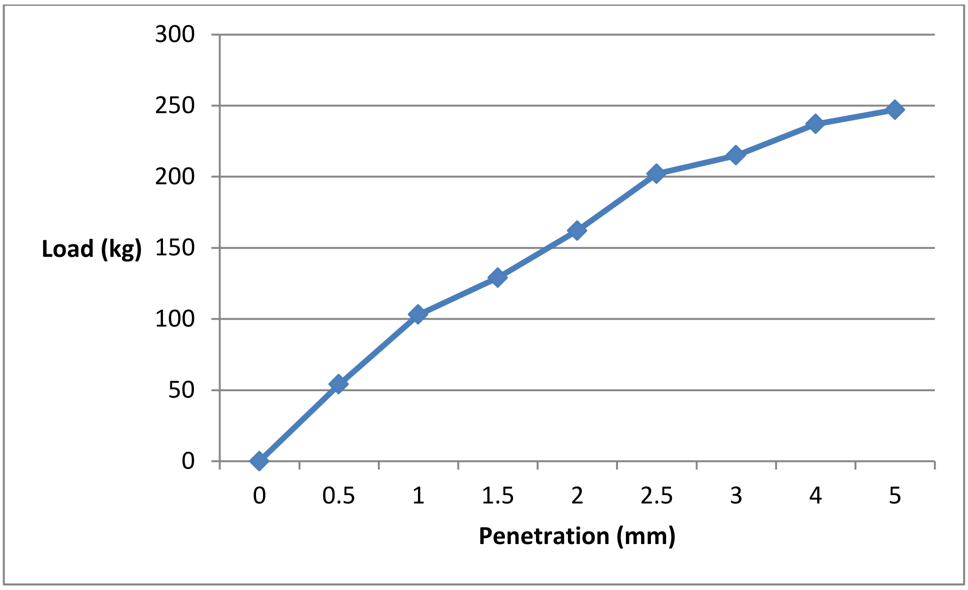
Graph 11 Penetration vs Load for BCS + 4% Leather Waste (soaked)



Graph 12 Penetration vs Load for BCS + 6% Leather Waste (soaked)



Graph 13 Penetration vs Load for BCS + 8% Leather Waste (soaked)



Graph 14 Penetration vs Load for BCS + 10% Leather Waste (soaked)

Appendix B

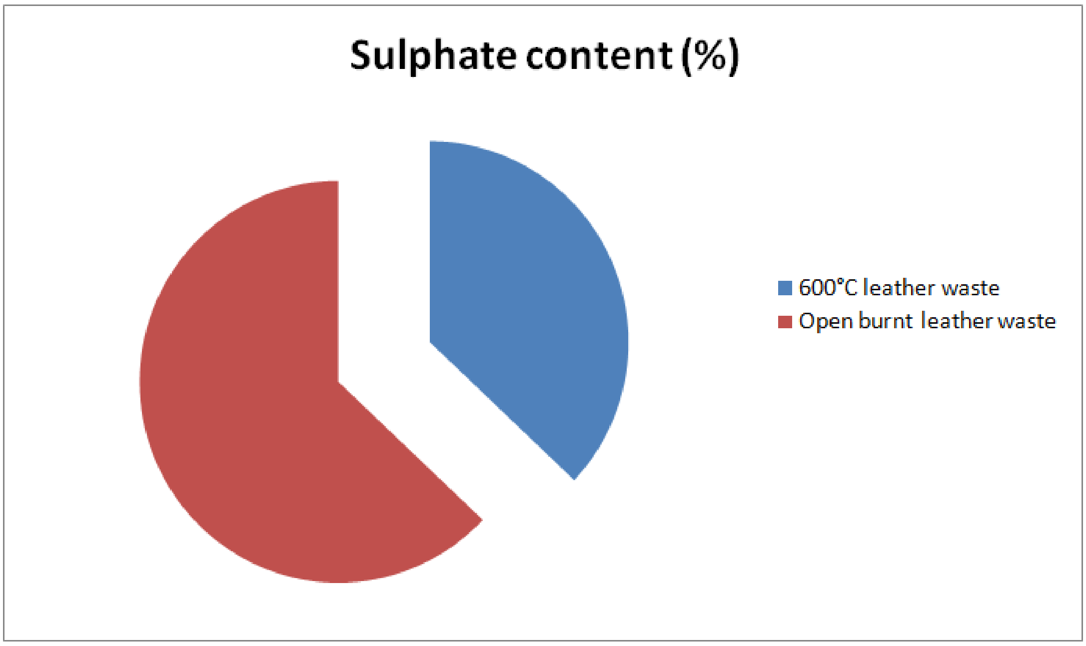
Organic Content Data

Table 22 Organic Content Determination

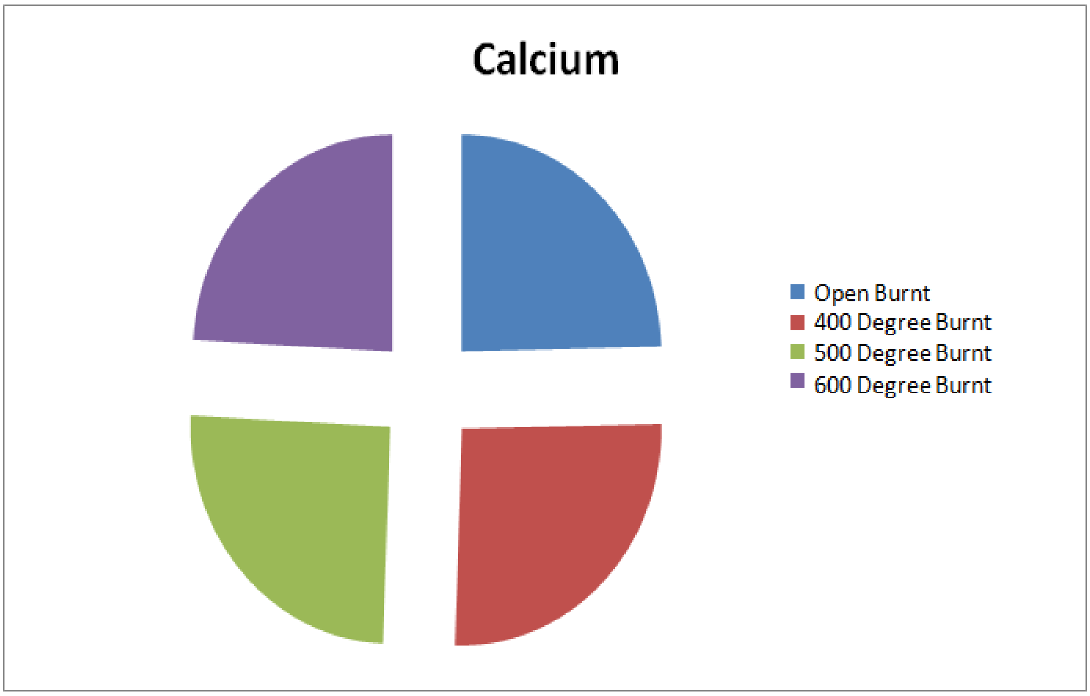
Type of Sample	Empty Weight (W1)	Empty weight + weight of ash at 105^oC(W2)	Empty weight + weight of ash at 600^oC(W3)
Raw	18.3	21.5	18.9
Open Burnt	20.7	27.9	24.54
400 burnt	20.7	29.4	26.80
500 burnt	18.8	22.9	21.68
600 burnt	19.2	22.7	21.70

Appendix C

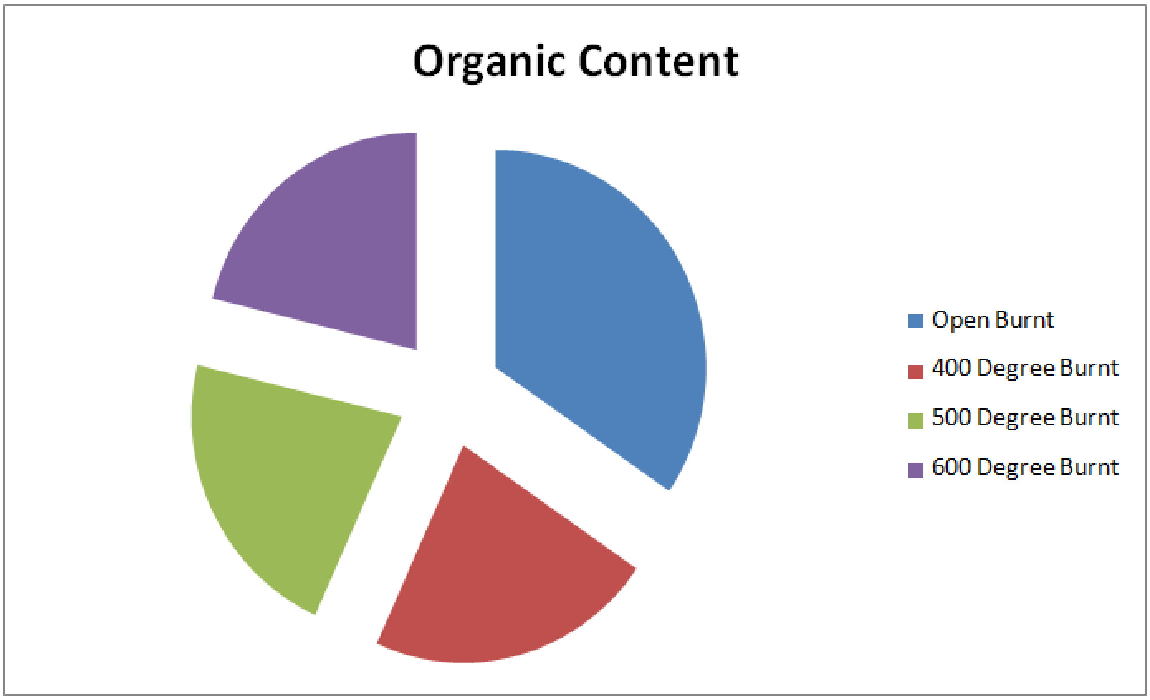
Pie Chart Comparison of different Leather Waste



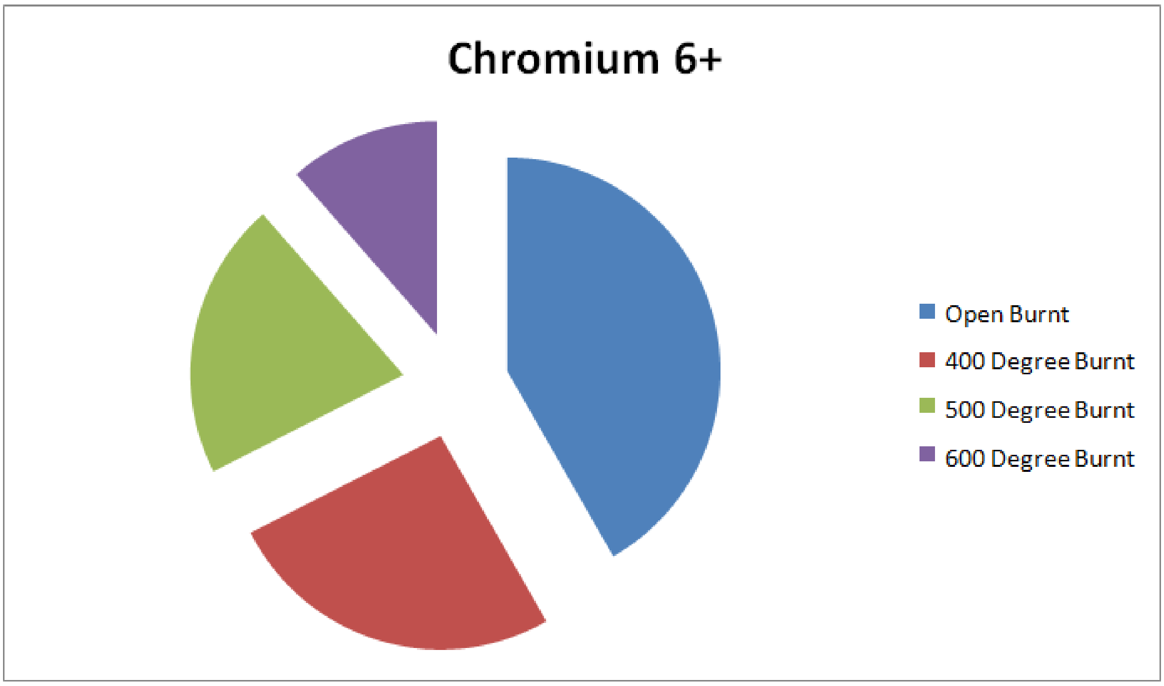
Pie Chart 1 Sulphate Content Comparison



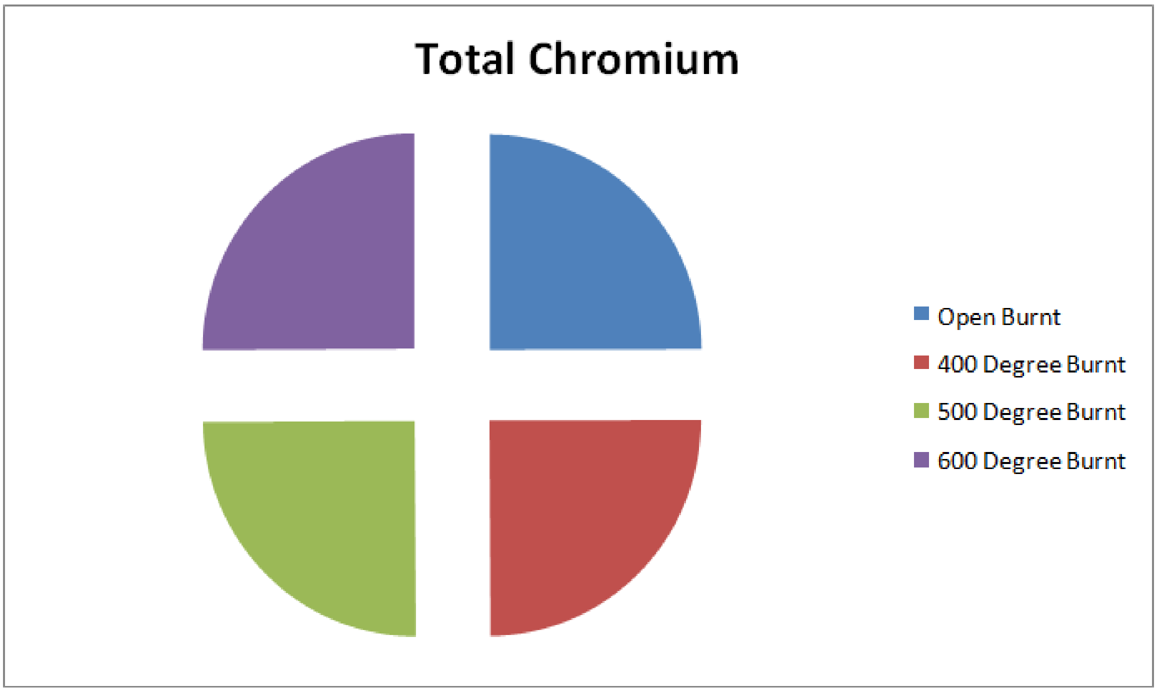
Pie Chart 2 Calcium Content Comparison



Pie Chart 3 Organic Content Comparison



Pie Chart 4 Chroium 6+ Comparison



Pie Chart 5 Total Chromium Comparison

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

PLAGIARISM VERIFICATION REPORT

Date: 30/05/2020

Type of Document (Tick): PhD Thesis | M.Tech Dissertation/ Report | B.Tech Project Report ✓ | Paper

Name: Arpit Rana, Shankar Kumar and Deepak Sharma Department: Civil Enrolment No 161053, 161644, 161665

Contact No. +917018787633 E-mail. arpitrana9000@gmail.com.

Name of the Supervisor: Mr. Niraj Singh Parihar

Title of the Thesis/Dissertation/Project Report/Paper (In Capital letters): LEACHATE STUDY OF THE PAVEMENT MODEL STABILISED WITH TANNED LEATHER WASTE ASH

UNDERTAKING

I undertake that I am aware of the plagiarism related norms/ regulations, if I found guilty of any plagiarism and copyright violations in the above thesis/report even after award of degree, the University reserves the rights to withdraw/revoke my degree/report. Kindly allow me to avail Plagiarism verification report for the document mentioned above.

Complete Thesis/Report Pages Detail:

- Total No. of Pages = 60
- Total No. of Preliminary pages = 4
- Total No. of pages accommodate bibliography/references = 11

Arpit Rana
Shankar Kumar
Deepak

(Signature of Student)

FOR DEPARTMENT USE

We have checked the thesis/report as per norms and found **Similarity Index** at two (2) (%). Therefore, we are forwarding the complete thesis/report for final plagiarism check. The plagiarism verification report may be handed over to the candidate.

30/05/2020 Niraj Singh Parihar
(Signature of Guide/Supervisor)

15/7/2020
HOD
CE DEPT
Signature of HOD

FOR LRC USE

The above document was scanned for plagiarism check. The outcome of the same is reported below:

Copy Received on	Excluded	Similarity Index (%)	Generated Plagiarism Report Details (Title, Abstract & Chapters)	
	• All Preliminary Pages • Bibliography/Images/Quotes • 14 Words String		Word Counts	
Report Generated on			Character Counts	
		Submission ID	Total Pages Scanned	
			File Size	

Checked by
Name & Signature

Librarian

Please send your complete thesis/report in (PDF) with Title Page, Abstract and Chapters in (Word File) through the supervisor at plagcheck.juit@gmail.com