ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

STUDY OF SWELLING AND STRENGTH CHARACTERISTICS OF BLACK COTTON SOIL MIXED WITH JAROFIX

Berin Joysha
P.G Student JBCMET, Arackappady,Perumbavoor
berinjoysha@gmail.com

Dipin Syam
Associate Professor, Department of Civil Engineering, JBCMET, Perumbavoor
dipinsyam@gmail.com

Abstract
Seasonal changes in moisture content result in volume change in black cotton soil. The Swelling and strength characteristics of soil may get changed due to the addition of chemicals. Major problem that zinc manufacturing industries face today is the disposal of jarosite waste. When it is mixed with 2 % lime and 10 % cement, the resulting stable material is called Jarofix. Laboratory results in combination with jarofix showed that in combination with jarofix showed alterations in Atterberg's limits, free swelling decreases to 0% beyond 50% of jarofix mix, Maximum dry density decreases with increase in percentage of Jarofix, The 10% Jarofix is having higher strength and there is an increase of 59.80% than that of soil. The results both in soaked and Unsoaked CBR show that the 10% of jarofix black cotton soil mix show higher strength. It's a factor that soaking would attribute additional strength to the black cotton jarofix mix.
Keywords: Jarosie, Jarofix, Unsoaked.

I. INTRODUCTION

As the sites for construction are being limited day by day the ground improvement technology becomes a rapidly developing field. For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behaviourSeasonal changes in moisture content result in volume change in expansive soils, which may damage structures founded on them. Evaluation of swelling characteristics of expansive soils, namely, swell potential is important for the design of foundations. Free swell index (FSI) indicates the potential expansiveness of a soil. FSI, being determined on the soil fraction <425 µm sieve like the other index properties of clays, is also an index property of an expansive soil. The increase in volume as percentage of initial volume is termed as free swell index. Jarosite is a waste material produced during extraction of zinc ore concentrate by hydrometallurgy operation. Major problem that zinc manufacturing industries face today is the disposal of jarosite waste. When it is mixed with 2 % lime and 10 % cement, the resulting stable material is called Jarofix. So the unstable and hazardous jarosite is stabilized to jarofix, which is a non hazardous waste from the factory.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

II. SCOPE AND OBJECTIVE

If the strength is improved it would attribute to:-

- The effective use of the land
- Jarofix can be used for stabilisation of Black cotton soil.
- The environmental problem caused due to disposal of jarofix can be minimized.
- The black cotton soil could be used for construction purpose.

III. MATERIALS USED

Soil sample used in this study is black cotton soil, which are most commonly observed soil type in Kerala premises of Palakkad. Black cotton soil sample is being taken from Erunthelpathi, Palakkad district, Kerala by manual excavation. Jarofix sample were obtained from the Binani Zinc Ltd, Eloor. Properties of black cotton soil and jarofix are shown in Table 1 and Table 2.

SL. NO.	Properties	Values
1.	Specific gravity	2.39 %
2	Liquid Limit	47.50 %
3	Plastic Limit	26.66 %
4	Shrinkage Limit	47.50 %
5	Optimum Moisture Content	20.20%
6	Maximum Dry Density	1.672 g/cc
7	Unconfined Compressive Strength	245.17 KN/m^2
8	Free swelling index	17.39^0
9	California Bearing Ratio	5.6%

TABLE 1
PROPERTIES OF BLACK COTTON SOIL

SL. NO.	Properties	Values
1.	Specific gravity	1.86 %
2	Liquid Limit	64 %
3	Plastic Limit	50 %
4	Shrinkage Limit	47.50 %
5	Optimum Moisture Content	64.36%
6	Maximum Dry Density	1.02 g/cc
7	Unconfined Compressive Strength	100.65 KN/m^2
8	Free swelling index	17.39^0

TABLE 2
INDEX PROPERTIES OF JAROFIX

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

a) PREPARATION OF TEST SAMPLE

Jarofix samples were added to the soil sample in 10, 20, 30, 40 and 50 percentages by weight of soil sample for swelling and compressibility characteristics test. And for strength characteristic jarofix samples were added to the soil sample in 10, 20,30,40,50 percentages by weight of soil sample and they are mixed at their optimum moisture content.

Figure 1 mixing of jarofix with black cotton soil

Sample a	Black Cotton Soil
Sample b	Jarofix
Sample 1	10% Jarofix +90% Soil
Sample 2	20% Jarofix+80% Soil
Sample 3	30% Jarofix+70%Soil
Sample 4	40% Jarofix+60%Soil
Sample 5	50% Jarofix+50%Soil

TABLE 3
mixing of jarofix with black cotton soil

IV. LABORATARY STUDIES

A. Determination of Grain Size Distribution

Grain size analysis is mainly carried out to determine the percentage of different particles in the black cotton soil and jarofix. Sieve analysis was done on the samples which passes through 4.75mm sieve and retained on 75 micron IS sieve. Tests were done according to the IS 2720 (Part 4) – 1985.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

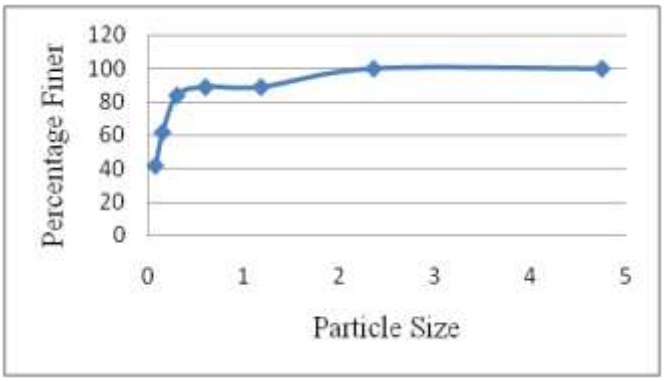

Figure 2 Particle size distribution curve of black cotton soil

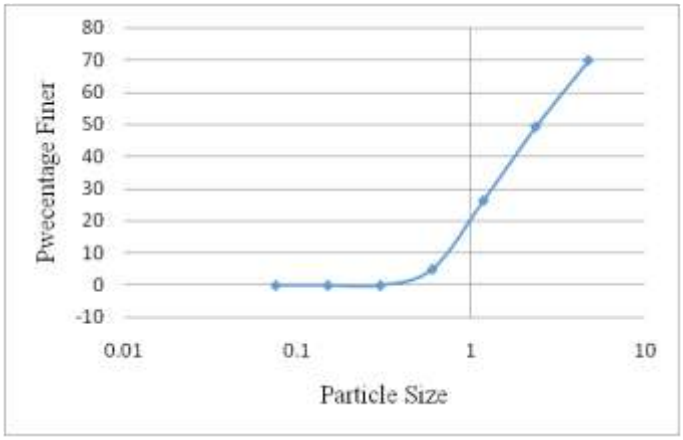

Figure 3 Particle size distribution curve of Jarofix

B. Determination of Atterberg's limits

Atterberg's limits for the black cotton soil were determined by using test procedures according to IS 2720 (Part -5) 1985. The liquid limit, plastic limit and plasticity index should found as per the standards.The corresponding variation in liquid limit ,plastic limit,shrinkage limit and plastic limits are shown in the figures below in different percentage of jarofix mix.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

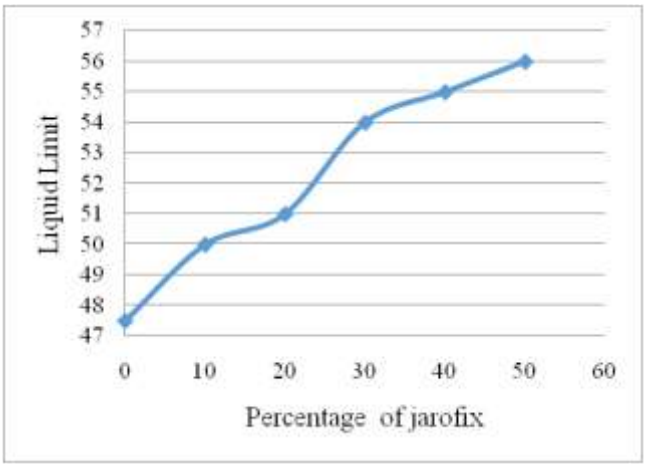

Figure 4 Variation in Liquid Limit

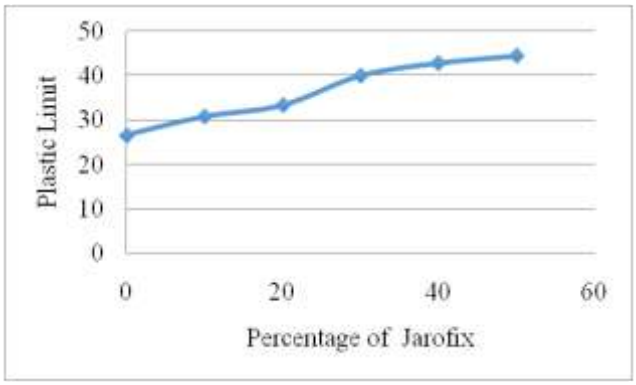

Figure 5 Variation of Plastic Limit

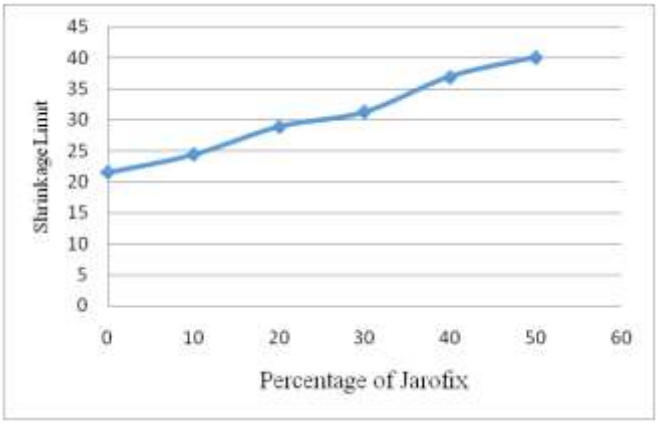

Figure 6 Variation in Shrinkage Limit

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

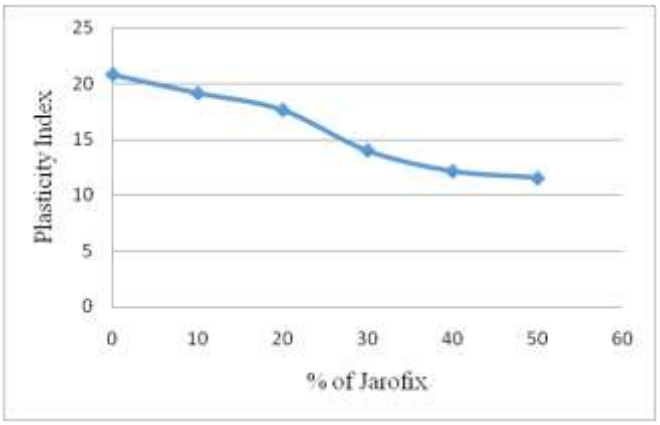

Figure 7 Variation in plasticity index

C. Free Swelling Index Test

Free swelling index test was carried out and swelling is determined according to IS 2720-41, 1977 The free swelling index of soil is found to decrease with increase in jarofix percentage. The table shows the variation of free swelling index with the addition of jarofix. Fig. 5.5 shows the variation in free swelling index with different percentage of jarofix.

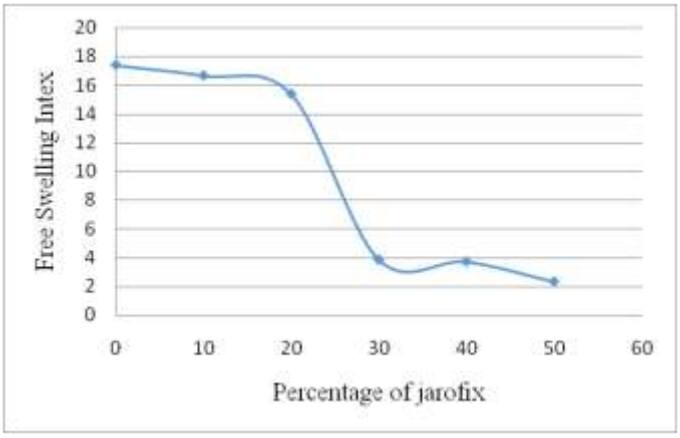

Figure 8 Variation in Free Swelling Index.

D. Unconfined Compression Test

Unconfined compression test was carried out with different percentages of jarofix on different days. It is found that as the number of day's increases there is increase in the unconfined compressive strength. The test was conducted with reference to IS 2720 Part10-1973. The unconfined compressive strength of black cotton soil replaced with jarofix at different percentage are shown.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

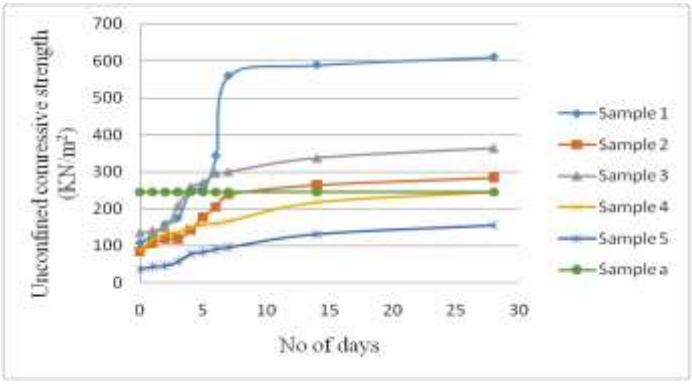

Figure 9 Variation in UCC for Different Percentages in Different Days

E. California Bearing Ratio Test

The California Bearing Ratio is determined by performing the CBR test as per IS: 2720 (part XVI) 1979. The Unsoaked and soaked CBR tests were carried out. CBR test were most important test because as per IRC 37 the pavement thickness depends upon CBR value of soil. The test was done on black cotton soil mixed with different proportions of jarofix mix .

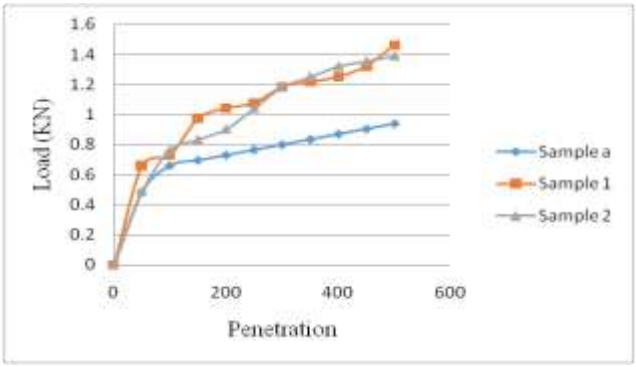

Figure 10 soaked CBR test results value

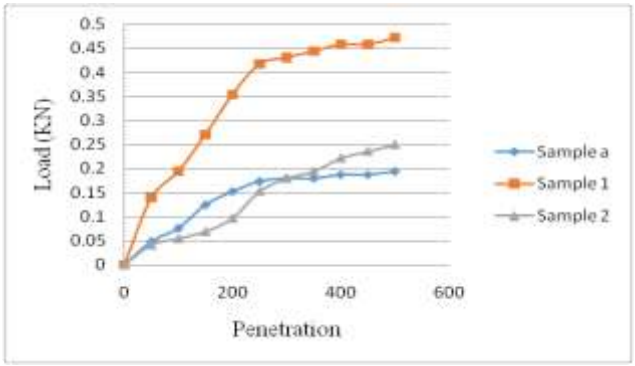

Figure 11 UnSoaked CBR test results value

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

V.CONCLUSION

1. Liquid limit increases with increase in percentage of Jarofix.
2. Plastic limit increases with increase in percentage of Jarofix.
3. Shrinkage limit increases with increase in percentage of Jarofix.
4. Plasticity index decreases with increase in percentage of jarofix.
5. Free swelling index decreases with increase in percentage of jarofix and it is reduced to 0% at 60% and 70% of jarofix.
6. Maximum dry density decreases with increase in percentage of Jarofix.
7. As the maximum dry density of the jarofix is less and when the black cotton soil combines with jarofix the dry density of black cotton soil reduces.
8. Optimum moisture content increases with increase in percentage of Jarofix .
9. For 10%, 20%, 30%, 40%, 50% of Jarofix, the unconfined compressive strength increases with number of days. The 28 day strength of 10%, 20%, 30% Jarofix is more than the 28 day strength of soil. The 40% Jarofix is having same strength as that of soil. The 10% Jarofix is having higher strength and there is an increase of 59.80% than that of soil.
10. For 10% of jarofix has higher value for CBR compared with 20% for 30%of jarofix mixed with black cotton soil the CBR value is lesser than the CBR value of Black cotton soil.
11. As the soaking is done for CBR it attains strength as the curing period is increased.
12. The strength improvement in the black cotton soil as the jarofix is added proves that the reason for the same is due to the hydration process which is involved in the black cotton soil mix.
    The change in property of soil by addition of jarofix may be due to fine and clayey nature of jarofix.
    The improvement in strength may be due to the presence of lime and cement in Jarofix.

ACKNOWLEDGEMENTS

I place on record and warmly acknowledge the continuous encouragement, tremendous support, expert and inspired guidance, timely suggestions and motivation offered by my guide **Dipin Syam.**, Associate Professor in Civil Engineering, Jai Bharath College of Management and Engineering Technology , Perumbavoor without which this work would not have been materialised.

I would like to express my deep sense of gratitude to **Prof. K.Soman**, Head of the Department, Department of Civil Engineering,Jai Bharath College of Management and Engineering Technology, Perumbavoor for all the necessary support extended by him in the fulfilment of this work.

Last but not the least, I express my obeisance and record my gratefulness before the **Almighty God** who has showered his blessings on me and strengthened me for preparing this work and who made this work flawless.

REFERENCES

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 5, August 2016

[1] AgusSetyoMuntohar(2012). "Utilization of uncontrolled burnt rice husk ash in soil improvement." DimensiTeknikSipil, Vol. 4, No. 2, 100 - 105

[2] A.K.Sinha, S.Mathur and V.K.Arora (2011). "Feasibility study of Jarofix waste material for road construction" Indian Geotechnical Conference Paper No.L-041

[3] A.K. Sinha, V G. Havanagi, V K Arora, (2012). "Design, Construction & Evaluation of Jarofix Embankment and Sub Grade Layers" International Journal of Environmental Engineering Research, Volume 1, Issue 3

[4] Dr.Akshaya Kumar Sabat(2012). "A study on some geotechnical properties of lime stabilized expansive soil – quarry dust." International Journal of Emerging trends in Engineering and Development Issue 2, Vol.1

[5] Ashis Kumar, Bera (2010). "Effect of Pond Ash Content on Engineering Properties of Fine Grained Soil" Indian Geotechnical Conference – 2010, GEOtrendz

[6] Bidula Bose (2012). "Geo-Engineering Properties of Expansive Soil Stabilized with Fly Ash." EGJE vol 17

[7] B. Michael, Ogundoju, J. Oluofowobi(2014). "Clay Soil Stabilization using Powdered Glass." Journal of Engineering Science and Technology Vol. 9, No. 5

[8] DivyaKrishnan.K, V.Janani, R.Annadurai, P.T.Ravichandran, (2014). "Effect of Fly Ash and PhosphoGypsum on Properties of Expansive Soils." International Journal of Scientific Engineering and Technology Volume No.3 Issue No.5, pp : 592-596

[9] Ogunribido T.H.T.(2013). "Potentials of Sugar Cane Straw Ash for Lateritic Soil Stabilization in Road Construction." International Journal of Science & Emerging TechnologiesVol-3 No 5

[10] Puneet Agarwal and Suneet Kaur (2014). "Effect of bioenzyme stabilization on unconfined compressive strength of expansive soil." International Journal of Research in Engineering and TechnologyVolume: 03 Issue: 05