International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

Characteristics Study of Site Soil for an Efficient Cricket Pitch

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Abstract - *The characteristic of soil for pitches varies considerably from country to country and generally pitches in Indian subcontinents are regarded to be slow and dusty in contrast to pitches in other countries. This study involves research on the behaviour of soil for cricket pitches in Kerala according to BCCI guidelines expressed in terms of percentages. The main purpose is to make use of locally available soils in order to improve its strength thereby developing a fast and bouncy pitch. For this purpose different percentage of Bentonite clay is added to the available soil inorder to yield hardness to the pitch. The clayey property of Bentoniteclay makes the soil stiffer. Using proper clay content and appropriate techniques and proper maintenance a perfect pitch can be developed here in Kerala.All the steps and available conditions during making process like soil selection , laboratory tests like compaction ,CBR test , specific gravity, sieve analysis etc schedules to attain maximum compaction, CBR values andproperties of soils do have proved scientific reasons and have the direct correlation with outcome and performances of pitch .This project tried to address the problem by investigating the possibility of improving the characteristics of soils for an efficient rebounding pitch.*

***Key Words*: Shear Strength, Compaction, California Bearing Ratio.**

1. INTRODUCTION

Cricket is one of the most popular sports in the world. Weather, playing surface, ground conditions and many other variables play a part. Especially important among these is the playing surface known as Cricket Pitch. Here a model pitch is generated to observe charateristics of soil. Process of improving strength , durability of soils for an efficient pitch. A relation is generated between Compaction and Vertical Bounce test. A ball is allowed to fall under gravity on model pitch from a height of about 2m inorder to measure the bouncing height made by the ball. The bouncing height is measured by Enguage Digitilizer recommended by BCCI.

Different percentages of bentonite clay is added to the available soils to improve its physical characteristics. The liquid consistency state plays an important role in pitch preparation. Transformation between solid and plastic consistency is used in pitch preparation. The model pitch is wetted to make it plastic so it gets smoothened and then allowed to dry so it move to solid consistency where it becomes hard as well as bouncy character get improved. According to BCCI rule the plastic limit of soil varies from 13.8 -28% and L.L between 22.5% to 49.6%.

2. LITERATURE REVIEW

John Shannon (2010) made a basic guide on pitch preparation for cricket on soils inorder to make a fast and bouncy pitch. He mentioned guidelines for developing pitches on soils and also renovation of old pitches for better performances. He also suggested that the process of compaction and closely mown truf could develop perfect pitches on ground.

Simon Parsons (2012) studied the effect on aeration of clay soils in cricket pitches . In this study effect of aeration processess on soils was analysed so he came to a conclusion that the areation process can change physical properties and biological health of soil based sports surfaces. Thus he proposed guidelines for conducting aeration treatment on soil pitches, thereby providing best solutions to overcome ground problems.

Nawagamuwa U. P et al (2014)made a study on the improvement of local soils inorder to make fastand bouncy cricket pitches. In this study he mainly focussed on the possibilities of improving characteristic of soils for producing fast and bouncy pitches by focussing on different soil properties .he concluded that from the tests conducted ,the results showed that the plasticity characteristic of soil improved by the introduction of Bentonite clay on the
local soils.

S.B Singh (2014) made a study on Cricket pitches- science behind the art of pitch making. In this study he mainly focused on different methods to develop a perfect bouncy pitch by conducting different experiments at different percentages. And he came to a conclusion that on soils with some desirable amount of clay content are considered as a perfect pitch soil.

D.M.James et al (2015) made a study on predicting the playing character of cricket pitches. In this study , he determined the soil properties and a correlations were drawn between pitch performance and soil compaction . He concluded by finding different properties of the soil and the amount of percentage of clay content required for an efficient bouncy pitch was also determined.

S.J .Haake (2015) made a study on the playing performance of countries cricket pitches. In this study he determined the different soil properties by conducting different experiments and conditions required for producing a fast and bouncy pitch. He concluded by finding different Soil properties and the amount of bentonite clay required to produce a fast and bouncy pitch was identified.

Hashir Usman et al (2016)made a study on improvement of geotechnical properties of cricket pitches. In this study,he determined the properties of soil for developing bouncy pitches by conducting experiments. He came to conclusion that the Results obtained from different tests showed that the soil along with proper clay content and techniques have improved property as well as developed a bouncy pitch and also concluded that the Black soil also proved to be effective for pitch making.

3. MATERIALS

3.1 Bentonite

Bentonite is a form of clay which comprises of montmorillonite. Bentonite used in this study mainly comprises of sodium ions as their major constituent. The material was collected from English India Private Ltd, Veli. A clayey material which enhances the properties of soil by its addition in varying percentages proves an efficient way in increasing the strength parameters of the soil. The bentonite property is mainly exploited to produce green molding sand. In this application, bentonite with a suitable moisture content covers quartz sand grains and acts as a connective tissue to the entire mass. Under this homogenous coating, even at maximum compression, water will remain in a highly "rigid" state, binding the sand grains and lending maximum resistance to the sand mould. Bentonite vitrification temperature is higher than other clays. Therefore, when used as an additive, it makes green sand more durable, and, in particular, more resistant to heat stress.

Figure 1 Bentonite Clay

Table .1 Properties of Bentonite Clay

Properties	RESULT
Liquid Limit %	336
Plastic Limit %	47
Shrinkage Limit %	12.4
Plasticity Index %	289
Soil Classification	CH
Percentage of Clay %	82
Specific Gravity	2.59
Differential free swell index %	120
ucc strength kN/m^2	112.7
Coefficient of permeability m/s	$3.2*10^{-10}$
Optimum Moisture %	40
Maximum Dry Density kN/m^3	1.19

3.2 RED SOIL

Red soil is a type of soil that develops in a warm, temperate, moist climate under deciduous or mixed forest, having thin organic and organic-mineral layers overlying a yellowish-brown leached layer resting on an illuvium red layer. Red soils are generally derived from crystalline rock. They are usually poor growing soils, low in nutrients and humus and difficult to be cultivated because of its low water holding capacity. The soil sample was thoroughly oven dried, weighted and stored in sacks at room temperature.

Figure 2 Red Soil (Source : Wikipedia)

Table 2 Properties of Red Soil

Properties	RESULT
Liquid Limit %	35
Plastic Limit %	24.47
Shrinkage Limit %	16
Soil Classification	CI
Clay %	57
Silt %	24
Sand %	19
Specific Gravity	2.62
ucc strength kN/m^2	33.23
Optimum Moisture %	17
Maximum Dry Density kN/m^3	1.7

4. METHODOLOGY

Laboratory tests were conducted to determine the engineering properties and strength characteristics of soil samples with and without addition of bentonite. The

main materials characterized in the present study are red soil, bentonite. A brief introduction about these materials and methodology are explained in this chapter. The soil considered for this study were tested first for engineering properties and the samples were tested for determination of strength parameter that is Compaction. Tests were conducted on varying percentages of bentonite to both the samples – 0%, 5%, 10%, 15%, 20%, and 25% by weight respectively and optimum is found out.

4. RESULTS AND DISCUSSIONS

4.1 Liquid Limit

The experiments was conducted for red soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the red soil . The variation of liquid limit for red soil with varying percentages of bentonite is shown below.

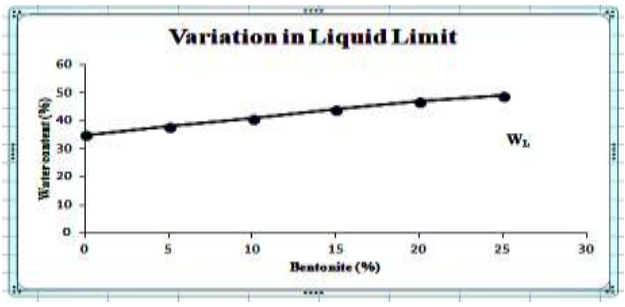

Chart -1: . Variation in liquid limit for red soil with varying percentages of bentonite.

There is increase in the liquid limit value with increase in percentage of bentonite clay content. The liquid limit increased up to 25% (Nawagamuwa U. P et al (2014) .The values obtained is with in the limits and is considered suitable for remaining experiments.

4.2 Plastic Limit

The experiments was conducted for red soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the red soil . The variation of plastic limit for red soil with varying percentages of bentonite is shown below.

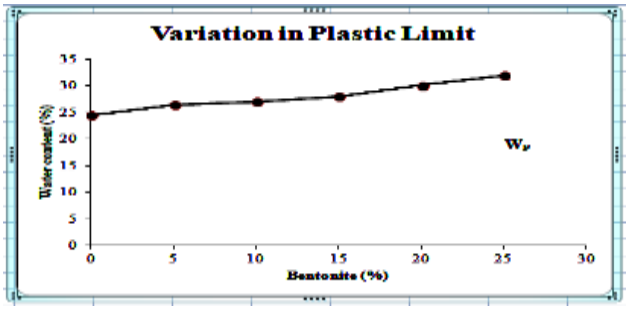

Chart -2: Variation in plastic limit for red soil with varying percentages of bentonite.

Red soil showed an increase in plastic limit with increase in percentage of bentonite clay content .The values obtained is with in the limits and is considered suitable for remaining experiments (Nawagamuwa U. P et al (2014)).

4.3 Plasticity index

The experiments was conducted for red soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the red soil . The variation of plasticity index for red soil with varying percentages of bentonite is shown below.

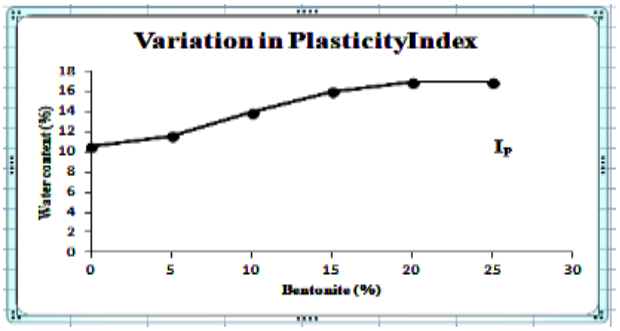

Chart -3: . Variation in plasticity index for red soil with varying percentages of bentonite

Red soil showed an increase in the plasticity index with increase in percentage of bentonite clay content.

4.4 Compaction characteristics

The experiments was conducted for red soil with varying percentages of bentonite from 0%, 5%, 10%, 15%, 20%, 25% of bentonite along with the red soil . The variation of compaction for red soil with varying percentages of bentonite is shown below.

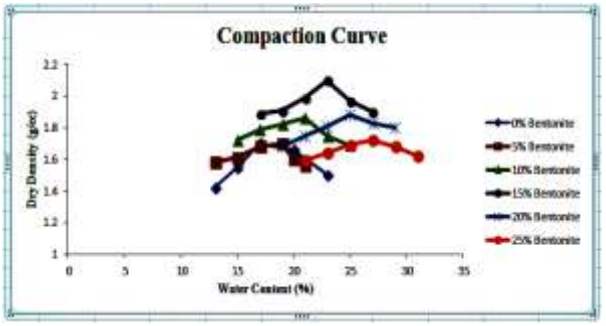

Chart -4: Compaction curve for red soil with varying percentages of bentonite.

The compaction value of Red soil also increased with increase in percentage of bentonite clay content .as per the journal of Hashir usman et al (2016). The maximum value obtained for compaction was for 15% of clay content with OMC 23% and MDD 2.1%.

4.5 Image processing of vertical bounce test

The experiment was conducted by allowing the cricket ball to fall freely from a height of about 2m into the model pitch. By image processing the rebound height of ball is noted and it is found that upto 15 % of bentonite content

bounce value increased and then it decreased. The variation of bounce height for red soil with varying percentages of bentonite is shown below.

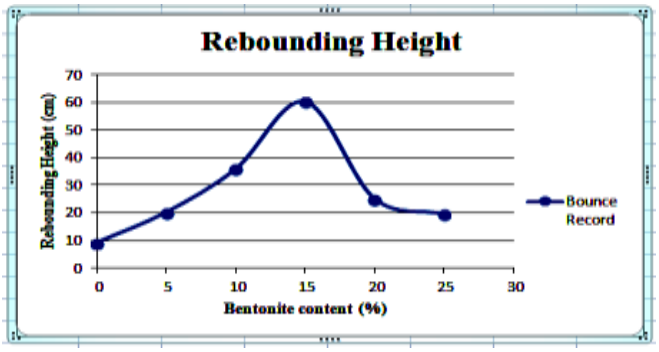

Chart -5: Variation of vertical bounce with varying percentages of bentonite clay.

The red soil showed an increase in height upto 15% of bentonite content and then it decreased. The optimum value of bounce is found at 15% clay content.

5. CONCLUSIONS

The Red soil were used in this study. Sodium Bentonite was added to the red soil in varying percentages. A series of laboratory test were conducted and the following conclusions were obtained from the study.

- The initial properties of Bentonite clay, Red soil were found.
- Liquid Limit, Plastic Limit, Plasticity index were found with varying percentages of bentonite in Red soil .
- The Compaction curve was found with increase in percentage of bentonite in Red soil.
- For the optimum percentage of bentonite , the vertical bounce increased to 5.5 times than that of original state. The optimum value for bounce was observed at 15% of clay content for red soil.
- The Liquid limit value was determined for red soil with varying percentages of bentonite clay from 0% - 25%. The result showed an increasein value of liquid limit with increase in percentage of bentonite. clay.The value obtained for each percentage was within the limits that is between 22.5% to 49.6%. Which indicates that the soil can be utilised for the making of pitches .
- The plastic limit value was determined for red soil with varying percentages of bentonite clay from 0% - 25%. The result showed an increasein value of plastic limit with increase in percentage of bentonite clay.
- The value obtained for each percentage was within the limits that is between 13.8 -34%. It indicates the binding effect of bentonite on soil. The compaction values were also determined for red soil with varying percentages of bentonite clay from 0 % - 25%. The maximum dry density (MDD) and OMC was obtained at 15% of bentonite clay content on red.

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