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A Study on Strength Characteristics of Clay and Shredded Tyres Mixture

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***Abstract*-- As the uses of automobiles are increasing day by day, the amount of waste tyres are also increasing. It is approximately estimated as 60% to 70% of waste tyres are disposed in improper way in various areas. As a result there is a great damage to ecosystem like air pollution and aesthetic pollution. To reduce this environmental impact, we can utilize this tyre waste in different civil engineering applications. Enhancing the soil properties has received great attention in recent times. In the present study shredded tyres from waste are chosen to stabilize clay soil with 4 different sizes 5mm, 10mm, 30mm and 50mm and with 3 different percentages 10%, 25% and 50% by weight of soil. The study is focused mainly on the strength behaviour of clay and shredded tyres. The samples are subjected to compaction test and California bearing ratio test. The tests clearly showed that 25% of 5mm of tyre improved the CBR values to 8.91% when compared to clay alone**

***Keywords*—Stabilisation, Clay, shredded tyres, California bearing ratio test and compaction test.**

I. Introduction

Clay soil is often weak soil and has no enough stability in heavy loading hence it is necessary to stabilize the soil. The main objective of the stabilization is to increase the strength or stability of the soil. As scrap tyres are being produced and accumulated in large volumes causing an increasing threat to the environment, we can utilize these waste tyres in stabilizing the weak soils. The aim of the study is to use the waste tyres for the stabilization of clay in order to reduce the environmental impact and to study the appropriateness of shredded rubber tyres for its use in pavement engineering.

II. Materials Used

The soil used in this study is natural clay collected near Chethukadavu in Calicut city, Kerala (India). The classification of soil as per IS specifications is CI (as per IS 1498-1970) which is inorganic clay of medium plasticity. Shredded tyres used were obtained commercially in sizes 5mm, 10mm, 30mm and 50mm. These shredded tyres were mixed with dry clay in percentages of 10, 25 and 50 by weight.

III. Compaction Characteristics

Standard proctor test is conducted on clay and clay-shredded tyres mixtures to determine its compaction characteristics, namely optimum moisture content (OMC) and maximum dry density (MDD). The compaction behavior of the clay alone and with 10%, 25% and 50% of shredded tyres of different sizes are investigated. The OMC and MDD values obtained are shown in the tables 3.1 to 3.4.

Table 3.1
5mm size of shredded tyres at different percentages

Percentage of shredded tyres	Moisture content (%)	Dry density(g/cc)
Clay alone	19.10	1.66
10	19.10	1.53
25	19.13	1.30
50	19.33	1.14

Table 3.2
10mm size of shredded tyres at different percentages

Percentage of shredded tyres	Moisture content (%)	Dry density(g/cc)
Clay alone	19.10	1.66
10	19.19	1.54
25	19.13	1.29
50	19.33	1.07

Table 3.3
30mm size of shredded tyres at different percentages

Percentage of shredded tyres	Moisture content (%)	Dry density(g/cc)
Clay alone	19.10	1.66
10	19.27	1.54
25	19.40	1.36
50	19.54	1.11

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TABLE 3.4
50MM SIZE OF SHREDDED TYRES AT DIFFERENT PERCENTAGES

Percentage of shredded tyres	Moisture content (%)	Dry density(g/cc)
Clay alone	19.10	1.66
10	19.49	1.49
25	19.50	1.35
50	19.65	1.19

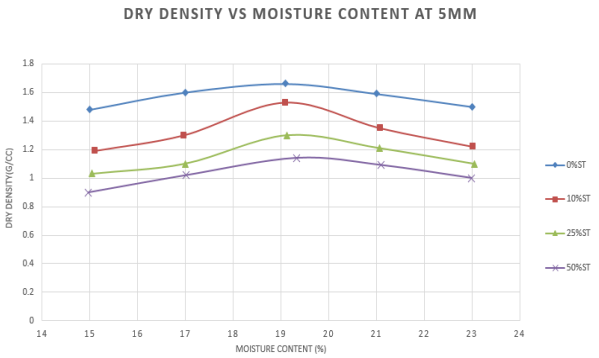

Fig 3.1: Compaction Behaviour of Clay and Clay –Shredded Tyres Mixture of Size 5mm

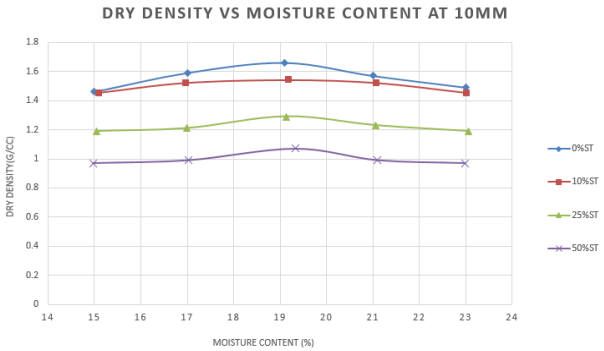

Fig 3.2: Compaction Behaviour of Clay and Clay –Shredded Tyres Mixture of Size 10mm

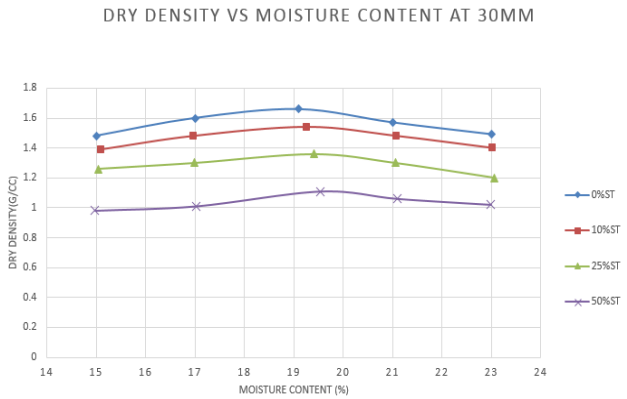

Fig 3.3: Compaction Behaviour of Clay and Clay –Shredded Tyres Mixture of Size 30mm

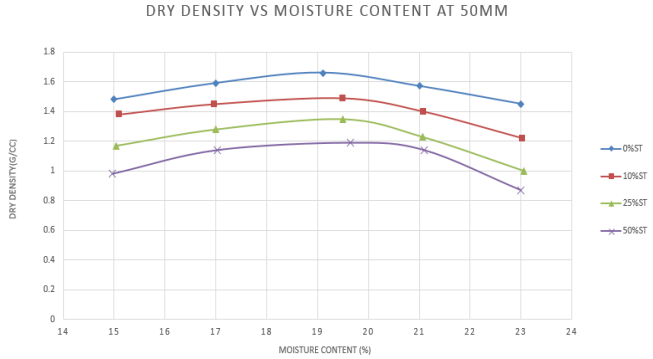

Fig 3.4: Compaction Behaviour of Clay and Clay –Shredded Tyres Mixture of Size 50mm

The compaction behaviour of the clay alone and with 10%, 25% and 50% of shredded tyres of different sizes were investigated in terms of dry density versus moisture content as shown in Fig 3.1 to 3.4. The figures shows that the maximum dry density decreased and optimum moisture content remained roughly the same as the amount of shredded tyres increased. A decrease in the dry density was expected due to the lighter weight of shredded tyres compared to the soil.

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The decrease in the dry density found by calculations is mainly due to that effect which shows that the presence of shredded tyres did not have a detrimental effect on the compaction of the clay. On physical examination of the compacted samples, "good bonding" was observed between the shredded tyres and the clay which improved as the moisture content increased. Cracking was observed with the lower moisture content mixtures and it was minimized when the samples were compacted at moisture contents at least 2% above optimum.

IV. CBR Value Of Clay-Shredded Tyre Mixture

CBR tests were conducted on clay and clay-shredded tyre mixtures to determine the CBR value to evaluate the suitability of the mixture. Shredded tyres are varied for 10%, 25% and 50%. Optimum shredded-tyre content is calculated for 5mm, 10mm, 30mm and 50mm size of shredded tyres. The CBR value for clay alone is very low compared with the CBR values for clay-tyre mixture. In all the samples it was observed that the bearing ratio increased up to 25% of the shredded tyres by weight future addition of shredded tyres caused decrease in the bearing ratio. This is because of over reinforcement. It has been observed that as the size of shredded tyres is increasing the strength is decreasing in other words it is said strength is inversely proportional to the size of shredded tyres. The CBR value is high when the size of shredded tyre is small. From the study it can be said that the increasing in bearing ratio depends on the size of the shredded tyre and percentage of mix. Variation of CBR with respect to percentage and sizes of tyres are shown in the Fig 4.1 and 4.2

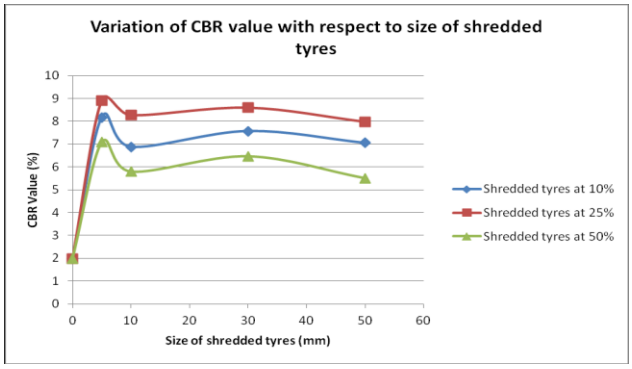

Fig 4.1 Variation of CBR Values of shredded tyres with respect to size of shredded tyres.

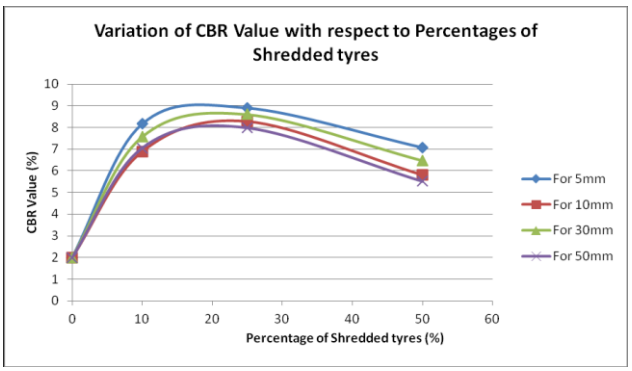

Fig 4.2 Variation of CBR Values of shredded tyres with respect to percentage of shredded tyres.

V. Conclusions

Based on the experiments carried out on Clay and Clay-shredded tyre mixture, the following conclusions are drawn:

1. Maximum percentage of increase in CBR value was observed at 25% of 5mm which gives a value 8.91%, 25% of 10mm which gives the value 8.27%, 25% of 30mm which gives the value 8.60% and 25% of 50mm which gives the value of 7.98%.
2. It was observed that the bearing ratio increased upto 25% of shredded tyres by weight. Further addition decreased the bearing ratio implying the over-reinforcement.
3. It was observed that the bearing ratio depends upon the size of shredded tyres and percentage of shredded tyre mixture. Bearing ratio is high when the size of shredded tyre is small.

The range of results produced shows the high dependency of behavior of the clay shredded tyre mixtures on the moisture content and the shredded tyre content. Hence, each situation will need to be considered separately to arrive at a clay-shredded tyre mixture suitable for the site and problem conditions.

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