USE OF WASTE TYRE AS SUBGRADE IN FLEXIBLE PAVEMENT

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Abstract - *Today we know that tyres, especially the tyres which are fitted to motor vehicles, are manufactured from synthetic rubber. The number of vehicles is increasing tremendously so that the discarded rubber tyres are also increasing. The disposal of the scrap tyres is the major issues associated with the management of waste tyres. In this project work, we are going to make use of waste tyres with subgrade layer of the flexible pavement. Soil used in the study is collected from nearby locations. In this study we are used scrapped crumb tyres from the light motor vehicle which is passing IS 2.36mm sieve. Crumb tyre is to be mixed with soil in various proportions and tested for compressive strength and California bearing ratio. The waste tyre pieces mixed with soil in various proportions and tested for California bearing ratio to determine its optimum content.*

Key Words: California bearing ratio, Compressive strength, Optimum content, Crumb tyre, Flexible pavement, Synthetic rubber, Scrap tyre.

1.INTRODUCTION

Use of tyre shreds for civil engineering application has several advantages. Recently an increasing attraction has been paid to find applications for such materials in civil engineering. The manufacturing process for tyres combines raw materials into a special form that yields unique properties such as flexibility, strength, resiliency, and high frictional resistance. If tyres are reused as a construction material instead of being burned (burning is currently the leading method of reuse accounting for 17% of scrap tires), the unique properties of tyres can once again be exploited in a beneficial manner [9]. The benefits of using crumb tyres are particularly enhanced if they can be used to replace virgin construction materials made from non-renewable resources[11]. In recent years, civil engineering applications of crumb tyre, scrapped from light motor vehicle tyres passing 2.36mm sieve, have increased[10]. These uses include lightweight fill, insulation beneath roads, and lightweight backfill for retaining walls. The effects on water quality have been found to be negligible, although three thick tire shred fills have experienced serious heating reactions[9]. Tire shreds have also been used as an alternative to the soil as drainage media in landfill leachate collection systems. The shear strength properties of tyre chips were studied for mixtures of crumb tyre and soils. This paper aims at studying the suitability of crumb tyres for its use in pavement engineering, i.e. to stabilise the subgrade of the pavements. It discusses CBR value of soil-tyre mixture and the results are presented[9].

2. MATERIALS

The soil sample was collected near the soil mechanics laboratory of Amal Jyothi College of Engineering & Technology, Kanjirapally. The soil was found to be inorganic clay of medium plasticity. Crumb tyres are small pieces of scrap waste tyre from light motor vehicles. In this study, the scrapped tyre pieces passing IS 2.36mm sieve considered as crumb tyre rubber.

3. METHODOLOGY

Initially, the engineering properties of soil were performed.

On 10th October we collected tyre samples were collected from a mat factory near Changanassery and the samples are allowed to pass through 2.36 mm sieve. The sample which is passing through 2.36mm sieve is to be used for different tests.

On 17th October we did the proctor test for the soil sample. The soil sample collected from the college itself near G.T lab. A representative air dry soil sample of about 3kg is taken. Sufficient amount water is added to sample. In the mould, the soil placed in 3 equal layers with compaction of 25 blows in each layer. Mass of the mould with base plate is taken. The experiment is repeated for the suitable increment of water contents. The dry density of soil sample for each water content is obtained from the formulae.

Dry density, $\rho_d = \rho_b / (1 + w)$

ρ_b= Mass of compacted soil/ Volume of the mould

w= Water content

Compaction curve plotted between water content on the x-axis and dry density on the y-axis. The optimum moisture content is obtained for the given soil sample.

On 23rd October we carried out the CBR for zero percent replacement of tyre in subgrade soil. The soil samples of 4.5 kg are sieved through 20mm IS sieve. The calculated amount of water should be added to the soil sample and mixed uniformly. Then the spacer disk inserted into the mould and soil is placed in the mould in 3 equal layers with a compaction of 56 blows. The base plate and spacer disk is removed and is weighed. The mould is inverted and clamped the base plate to it. The penetration test for the sample is done and the load corresponding to the penetrations of .5, 1, 2, 2.5, 5, 7.5, 10 and 1.5 mm was taken. The load penetration graph was plotted. The load corresponding to 2.5 and 5mm penetration was taken and the CBR value is obtained for the highest value among this.

CBR= (P_T/P_S) x 100

P_T = Corrected unit test load corresponding to the chosen penetration from the load penetration curve.

P_S = Standard load for the same penetration.

4. RESULT AND DISCUSSION

4.1. Procter Test

Length of the mould, h = 127.3 mm

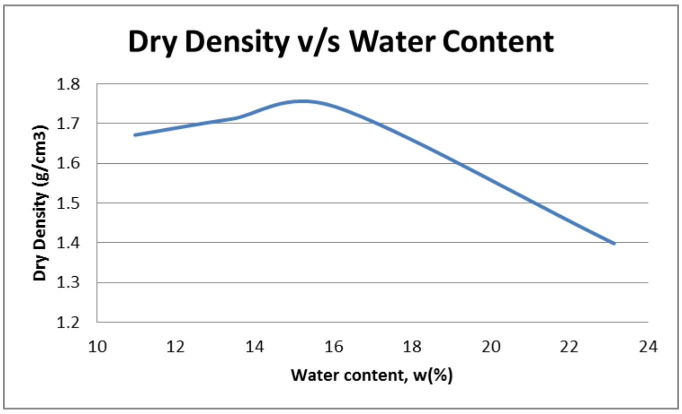
Diameter of the mould, d = 100 mm

Volume of the mould, V = πd^2h /4 = $\pi 10^2$ x 127.3 /4 = 1000cm^3.

Mass of the mould with base plate, M_1 = 5835 g

Observation No.	1	2	3	4
Determination of density				
Mass of mould + compacted soil, M_2 (g)	7690	7777	7858	7557
Mass of compacted soil, M = $M_2 - M_1$ (g)	1855	1942	2023	1722
Bulk density, ρ_b = M / V (g /cm^3)	1.855	1.942	2.023	1.722
Water content determination				
Mass of container, m_1 (g)	47.51	67.9	39.96	39.25
Mass of container + wet soil, m_2 (g)	59.55	77.7	54.8	66.18
Mass of container + dry soil, m_3 (g)	58.36	76.54	52.75	61.12
Water content, w = $(m_2- m_3) / (m_3-m_1)$ x 100 %	10.97	13.43	16.03	23.14
Dry Density, $\rho_d = \rho_b / (1+w)$ g/ cm^3	1.67	1.72	1.74	1.4

Fig 4.1: The graph between dry density and water content is plotted and is shown below



Optimum moisture content= 16%

4.2. CBR

4.2.1. Determination of quantity of water to be added:

Weight of sample, W=5kg

Natural moisture content, w= 5% =.05

Dry density, w_d= W / (1+w) = 4.7619

OMC of the sample = 16% =.16

Amount of water to be added= W_d x (OMC of the sample - w) =523.80ml

4.2.2. Penetration Test

Type of sample = Remoulded

Condition of specimen= Dynamic

Surcharge weight =5kg

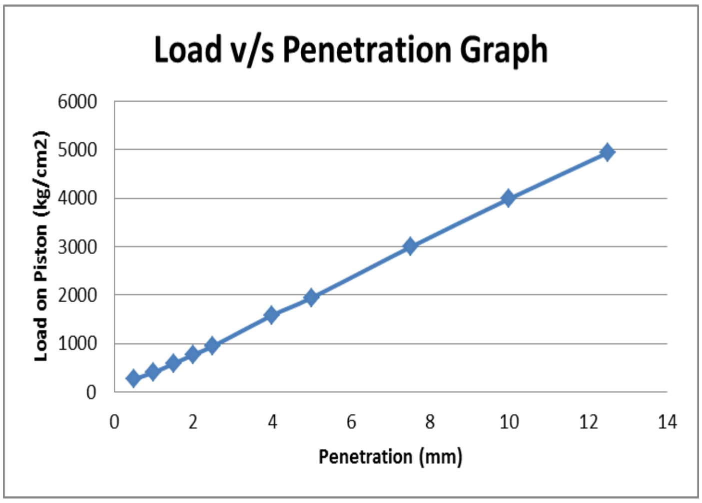
Dry unit weight = 4.7619

LC= .01

Multiplying Constant= 45.355

PENETRATION DIAL		LOAD DIAL	
Readings	Penetration (mm)	No of divisions on Proving ring	Load (N)
(a)	(b)= (a) x LC	(c)	(d)=(c) x multiplying constant
50	.5	6	272.13
100	1	9	408.195
150	1.5	13	589.615
200	2.	17	771.035
250	2.5	21	952.455
400	4	35	1587.425
500	5	43	1950.285
750	7.5	66	2993.43
1000	10	88	3991.24
1250	12.5	109	4943.695

Fig 4.2: The graph between load and penetration graph is shown below



CBR at 2.5mm penetration = (952.45 x100)/13700= 6.95 %

CBR at 5mm penetration = (1950.265 x 100)/20550 = 9.49%

CBR of sample = 9.49

5. CONCLUSION

Standard proctor test was carriedout to access the amount of compaction and the water content required in the field. Compaction curve is plotted between water content and dry density for various road construction purposes. The optimum moisture content for the given soil is 16%.

The CBR value at 2.5 and 5 mm penetration are 6.95% and 9.49% respectively. As per IS 2720 (part 16) the CBR value at 2.5 will be normally reported. Since CBR at 5 mm penetration is greater than 2.5 mm penetration due to the lack of time. Therefore the CBR value of subgrade soil is 9.49%.

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