

# EXPERIMENTAL STUDY ON SHEAR STRENGTH PARAMETERS OF SOIL-TAR

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**Abstract** - Laying of pavement in certain places is costlier because the pavement needs much more earthwork to lay them. In some sites, the subsurface conditions are not capable of holding load from the pavement. So we need to do some soil stabilization work or we need to dump the soil which capable of holding the load from the pavement. When such soil is far away from the site then its transport makes the construction of pavement very costlier and it also makes delay in construction. The main aim of this project is to give a clear idea about the various strength parameters of soil and tar mixture. For further investigation literature study was made on the soil and tar mixture. This paper consists of basic test on soil & tar, shear strength parameter on the combination of soil and tar with partial replacement of soil by 3%, 5%, 7%, and 9% in the form of a ductile material. The conclusion leads to obtaining an idea of the material used and it also helps to know the benefits of ductile properties of tar and soil.

**Key Words:** Soil-Tar, SBWT, Ductile state of tar, partial replacement of soil, Shear Strength Parameters.

## I. INTRODUCTION

### 1.1. General

Flexible pavements are very essential for the transportation of public and good to travel between two places. construction of flexible pavement is always having a problem of acquisition of land, equipment, and material such as good quality of course aggregate, tar, and sub grade materials take on loan in of those materials are not always accessible around the site trucks and lorries have to make a long journey to get the material on-site. this process makes the project a more expansive one by making the materials available on-site for the use of the construction of pavement will reduce the cost of entire project. the main aim of this project is to give an idea to increase the shear strength parameter of the red clay, California Bearing Ratio by introducing a ductile state of tar. laboratory tests are getting started with basic tests on red clay and tar in its natural state, then observation for obtaining the shear strength parameter of soil tar mixture with various ratio and its leads to get the proper proportions required to meet the good quality of the mixture.

## II. OBJECTIVES

The main objective of the work is to determine the shear strength parameters of soil-tar mixture with varying percent of tar on the soil.

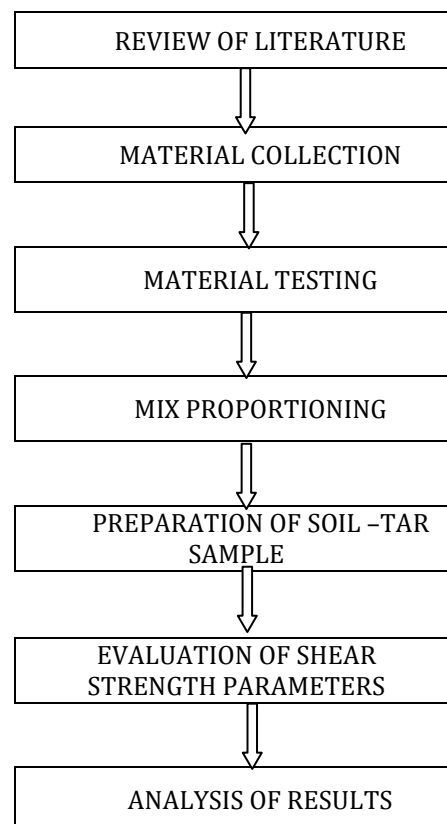
The current paper utilizes the locally available soil blended with Tar.

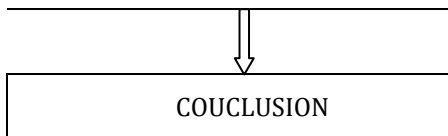
The broad Ares includes:

- Producing a foundation material or base course for laying of pavement.
- Study on Effect of shear strength parameters on SBWT

## III. METHODOLOGY

Following preparation process was observed for preparing Soil - Tar samples.





### 3.1 Mix Proposition

Mixing hardened tar into the soil makes the soil a stiffer one but the amount of tar required for that process is very large and it will not get bond with soil so it acts as two different materials to avoid this problem, the tar added to the soil in a ductile state, As per the observation made on the study it is observed the softening point of the tar will be 46°C with this reference tar is heated about 46°C and mixed with soil properly, the percentage of tar added in the soil get increased as 3%,5%,7%, and 9%.

Table 1 Mix Proportion

Mix	Natural soil	3% of Tar	5% of Tar	7% of Tar	9% of Tar
Weight of soil (g)	5000	4850	4750	4650	4550
Weight of Tar (g)	0	150	250	350	450

## IV. EXPERIMENTAL INVESTIGATONS

Laboratory tests are aimed to get the basic knowledge of index properties and engineering properties of the soil and tar. For red clay oven-dry method is used for the determination of natural water content, pycnometer apparatus is utilized for getting the specific gravity of the soil, sieve analysis is done to know about the grain size distribution of the soil, and determination of shrinkage limit (SL), plastic limit (PL), and liquid limit (LL). The shrinkage limit support getting an idea of the point where the soil is 100% saturated. the above-mentioned tests were helped to get the index properties of soil and for the determination engineering properties of soil modified Proctor test apparatus is used to determine the relationship between dry density and the water content of the soil and the California Bearing Ratio test is done.

### 4.1 Properties of Soil

The results obtained from the various test performed on the soil, tar, and soil-tar mixture of different proportion are as follows

Table 2 Index Properties of soil

S. No	Properties of soil	Test Performed	Symbol	Result
1.	Natural Moisture Content	Oven Dry Method	w	11%
2.	Specific Weight	Pycnometer Test	Sw	2.45
3.	Atterberg Limits LL,PL,SL	Atterberg Limits	LL	76%
			PL	43%
			SL	16%
4.	Optimum Water Content, Maximum Dry Density	Modified Proctor Test	Ow	11%
			Dd	2.243 Kg/cm <sup>3</sup>

Figure 1: Shows the particle size analysis of the soil

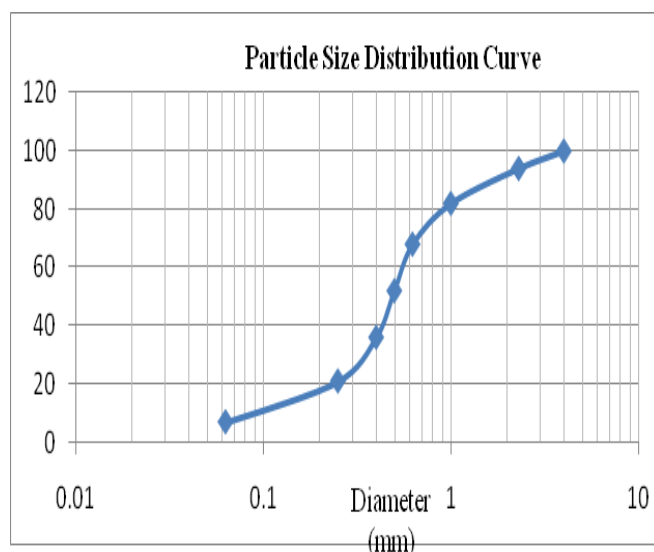


Fig. 1 Particle Size Analysis of the Soil

From the observation made by sieve analysis and its particle distribution curve gave a conclusion that Soil is Well Graded Soil Proctor compaction test is carried out for soil sample and the result and graph obtained from the test is follows.

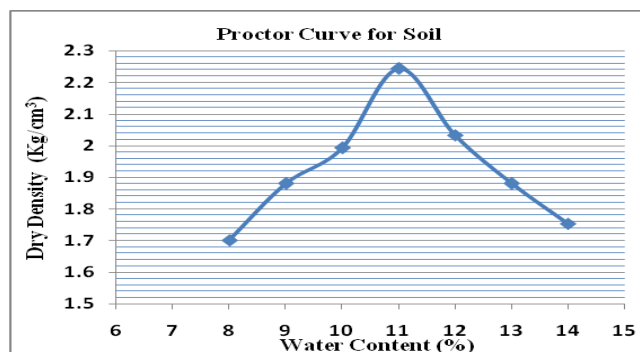


Fig. 2 Proctor Compaction Test

From the proctor compaction test results it is observed that the maximum Dry density and Optimum moisture content will be 2.243 Kg/cm<sup>3</sup> and 11%

The proctor compaction test is performed with varying Number of stokes on the same soil and the below figure shows the result observed from tests.

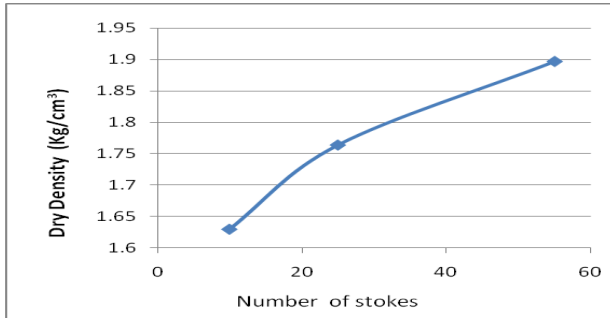


Fig. 3 Modified Proctor Compaction Test

The above proctor compaction results shows that increase in number of stokes on the sample will increase the dry density of soil similarly California Bearing Ratio test is done and results were represented below in the form of graph

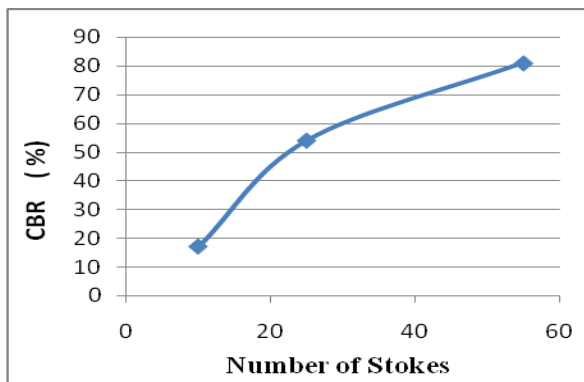


Fig. 4 California Bearing Ratio Test

#### 4.1 Properties of Tar

Table 2: Index Properties of Tar

S. No	Properties of soil	Test Performed	Result
1.	Specific Gravity	Pycnometer Test	1.04
2.	Penetration at 25° C	Penetration test	80/100
3.	Softening Point at 27° C	Ring Ball Test	46 °C
4.	Ductility at 27° C	Standard Ductility Test	96mm

#### TEST RESULTS ON SAMPLE OF SOIL BLENDED WITH TAR (SBWT) AT DIFFERENT RATIO

The proctor compaction test is performed and Dry density obtained from the SBWT sample with different ratio is listed below

Table 3: Modified Proctor Compaction Test on SBWT

S. No	Number of Stokes	Percentage of Tar Added				
		0	3%	5%	7%	9%
1.	10	1.871	1.8	1.842	1.821	1.791
2.	25	1.99	1.967	1.976	1.89	1.864
3.	55	2.754	2.16	2.3	2	1.942

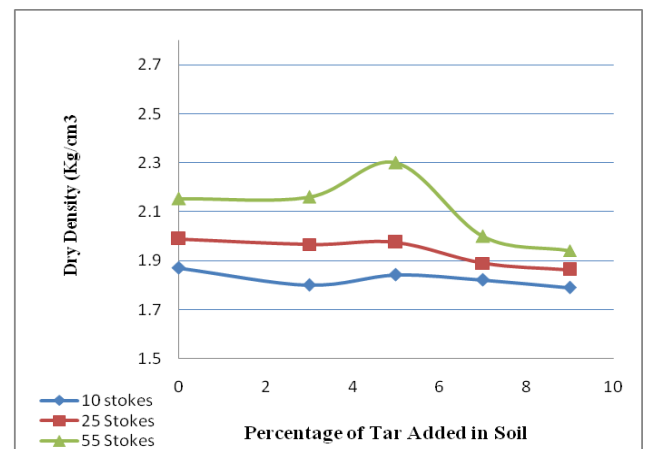


Fig. 5 Modified Proctor Compaction Test on SBWT

By analyzing the proctor compaction test Results it is observed that adding 5% of tar in the soil will increase the dry density of soil and further increment of tar in the soil will decrease the dry density.

California Bearing Ratio test is done on the sample of SBWT at different ratio of tar added and the results are given in the table

Table 4: California Bearing Ratio Test on SBWT

S. No	Number of Stokes	Percentage of Tar Added				
		0	3%	5%	7%	9%
1	10	15	18	27	12	9
2	25	42	58	71	51	39
3	55	81	91	122	88	64

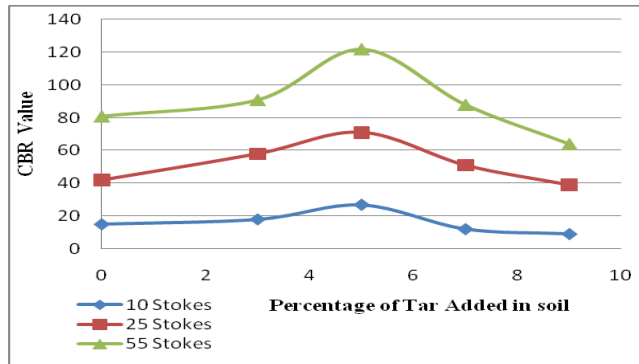


Fig. 6 California Bearing Ratio Test on SBWT

From the above tests and analysis of results, it is clear that the soil dry density and CBR values can be improved by adding tar in the form of a ductile state and it will be used for pavement works under the condition of

- (i) The soil having 0% to 1% of tar can be used as a foundation material for the pavement having T1, T2 and T3 traffic because it has the CBR value less than 30
- (ii) The soil having 1% to 3% of tar can be used as a foundation material for the pavement having T3, and T4 traffic because it has the CBR value lies between 30 to 60
- (iii) The soil having 3% to 3.5% of tar can be used as a Base layer of for the pavement having T5 traffic because it has the CBR value lies between 60 to 80
- (iv) The soil having 3.5% to 5% of tar can be used as a Base layer of for the pavement having T5 traffic because it has the CBR value greater than 80

## CONCLUSION

In this work, we have given some tests on how to improve the shear strength parameters of the soil by adding a certain percentage of tar in the ductile state. From the results, we conclude that the optimal percentage of tar to be mixed with soil in the range of 0 to 5%.

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