

# A STUDY ON EFFECT OF TYRE WASTE ON CBR VALUE OF FINE GRAINED SOIL

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## Abstract

More and more construction of buildings and other civil engineering structures have to be carried out on weak or soft soil due to increasing of population and the reduction of available land. According to an observation it is observed that every year 13.5 billion of tones of tyre waste disposing on the landfill sites. It is a well-known fact that complete combustion (Incineration) of tyre-waste is not possible. For Soil of poor strength and high swelling & shrinkage, a great diversity of ground improvement techniques are found out and those techniques are successful also. So rather focusing on stabilization this work focused to increase CBR value of soil. So here it is proposed to use tyre waste as an improvement agent for soil's strength (mechanical). Complicated nature, its stability and poor mechanical strength these three are main characteristic of the black cotton soil. Sample of Black cotton soil is taken from Varnama village, near Por Ta. and Dist. Vadodara for the study. Vadodara district is fond of yellow soil but after Vadodara and up to Surat, the land is full of black cotton soil. Here tyre of cycle to bus and tractor to earthmoving equipment and of any size is used. Tyre in any form such a powder, chips and shredded form can be used.

**Keywords:** Fine grained soil, Tyre waste, CBR value

## INTRODUCTION

A greatest revolution in waste management, environmental science and social views toward pollution took place in twentieth Century. Government awakening, scientific discovery and debates on social priorities beginning with unhindered pollution and ending with attempts at total to control. Waste tyres which is majority produced by transport industry need to be recycled otherwise can be a major disposal problem since their incineration produces a lot of harmful gases.

There is an urgent need to formulate a method because huge quantity of tyres being either thrown or dumped in landfills for its useful utilization. The construction industry on the other hand is facing an uphill task of finding good sites for construction with the ever-increasing demand of residential as well as commercial spaces. The possibility of utilization of the tyres wastes in stabilization of soft soils or expansive soils is an option which is being studied under the present project.

## INDIAN SCENARIO

Large volume of scrap tyres accumulation causing an increasing threat to the environment. To eliminate the negative effect of these depositions and in terms of sustainable development there is great interest in the recycling of these non-hazardous solid wastes. These are or can be used as a light weight material either in the form of powder, chips, shredded and as a whole and its applications in geotechnical engineering proven to be effective in protecting the environment and conserving natural resources. It is estimated that 13.5 million tonnes of scrap tyres are disposed of every year worldwide. These numbers include all sorts of tyres from car tyres to trucks and huge tractor tyres and earth moving tyres.

Infrastructure with adequacy is a prime need of the overall growth in all sectors of a nation. Thus, emphasis is given to improve and augment the road and highway network over the entyre country. Presence of expansive soil, i.e. black cotton soil in the central part of India have problems of foundation whose swelling properties pose threat to the techno-economic design, construction and maintenance of the pavements whether flexible or rigid. Cyclic expansion and shrinkage of expansive soil depending

on moisture variation causes distress like pot holes, creeks, settlement, heaving of road surface etc. which turns into unstable, poor performing pavements ultimately great economical loss to the country. Excavation and replacement of expansive soil is costly, time consuming and almost impossible task. Other methods of expansive sub-grade improvement include deep compaction, chemical stabilization and preloading.

### BLACK COTTON SOIL AND ITS PROBLEM

Expansive soil possesses low strength in wet condition, cyclic shrinkage and swelling with moisture variations resulting into differential settlement and angular distortions. Flexible or rigid pavements over such soil not only include high construction costs but also exhibit poor performance, thereby causing inefficient traffic movement as well as repetitive repair costs. Pavements built over such soil sub-grade suffer from the problems of pavement unevenness, longitudinal cracking of pavement along wheel tracks, excessive settlement of the edge region over the central portion and also shear failure of the sub grade with time.

Extreme hardness when dry along with high swelling potential during the process of wetting are the main characteristics of Black cotton soil. It deposits in India are a boon to farmers but problematic to civil engineers. Large-scale damage is experienced by structures due to heaving accompanied by loss of strength of these soils during rainy seasons and summer.

Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Tamilnadu and Madhya Pradesh are the states fond of black cotton soil and almost contribute about one third of the entire nation. Construction of dams, canals, cross drainage works, roads and buildings include heavy cost due to presence of it. Thousands of kilometers of roads pass through its deposits required an economical procedure for its improvement.

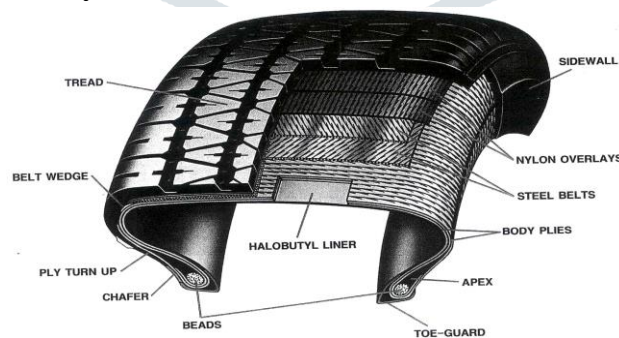
### USE OF TYRE WASTE

Applications of civil engineering typically use large tyre chunks produced by coarsely shredding waste tyres at a processing facility or stockpile site. These shreds are used in numerous highway construction applications such as in a lightweight fill in highway embankments constructed over unstable soils, abutment backfill to decrease lateral pressure on walls, in a vibration dampening layer under rail tracks and in thermal insulation under roadways to limit frost penetration. It also serves as leachate drainage layers, gas transmission channels and daily cover in modern landfills. They have also been used as an alternative septic system drain field aggregate and as a basement foundation backfill providing enhanced drainage and thermal insulation.

Tyre-derived fuel (TDF), as its name suggests, refers to tyres as a supplemental energy resource. Whole tyre combust in cement kilns as an alternative to save fossil fuels such as coal, oil or natural gas. Some power plants use shredded tyres as a similar replacement in full compliance with all applicable environmental regulations.

If the tyres are not completely worn out than retreading, reuse and exporting of tyres is possible when removed from a car. Retreading can extend the life of the main tyre carcass.

#### Tyre Waste and Shredded Products Sizes



*Fig. 1: Detailing of Tyre*

Tyre structure itemizing is demonstrated to fig1. On turn utilized tyres under suitable products, tyres are transformed under shredded results alternately tyre Waste. These are those manifestations of crude material designers will make attempting for. An extensive variety from claiming shredded tyre items may be presently made will help existing showcase necessities. Despite Practically At whatever variety starting with these measures Might hypothetically be made, usage for existing results in the commercial center might improve those accessibility and cosset for material.

### OBJECTIVE OF WORK

The aim of the present research work is to use tyre waste for construction and geotechnical applications such as cement replacement and to improve engineering properties of expansive soil. Additives such as lime and cement for mixing can also be explored if the results are positive.

The aim of the present study is to use tyre waste for improvement of expansive soils for its use as a sub base layer or for construction activity over it

- ❖ Improvement in engineering properties of expansive soils by mixing with various proportion of tyre waste for sub base by reducing the swelling characteristics.
- ❖ Improvement of strength properties of the soil by addition of tyre waste as a friction material.

### DATA COLLECTION AND ANALYSIS

The expansive chosen for the research was black cotton soil brought from Karjan. First physical and engineering properties of black cotton soil were investigated.

Parameters adopted for study are:

- Consistency limits by percentage
- Maximum Dry Density & Optimum Moisture Content; MDD-gm/cm<sup>3</sup>; OMC-%
- Specific Gravity
- Free Swell by percentage
- California Bearing Ratio(CBR)

### MATERIAL DESCRIPTION

Tyre waste which was used in the study is shown in fig 2 and detailing if its size is shown in table1 below:



*Fig. 2: Tyre Waste used for stud*

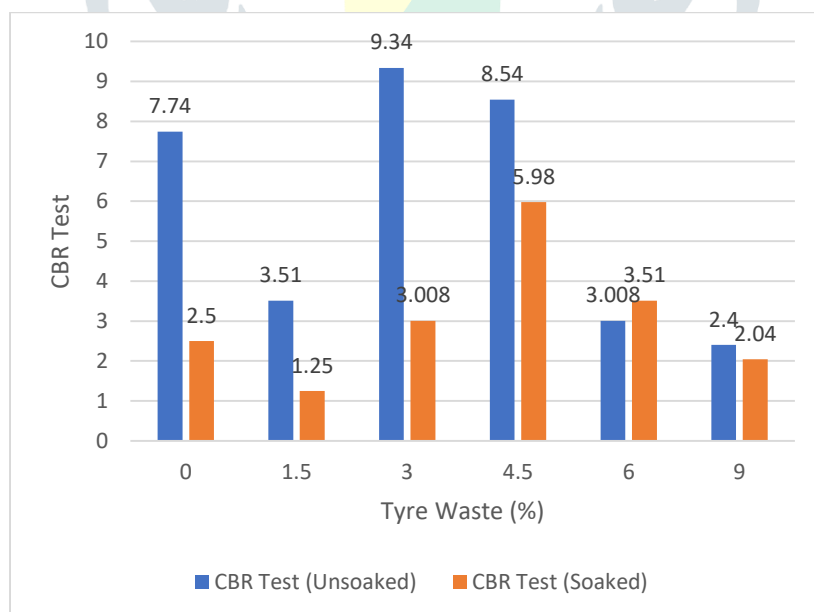
*Table 1: Size Description of Tyre waste*

LENGTH(cm)	WIDTH(mm)
1.5	3
2	5
1.7	4

The values determined for properties of black cotton soil used for study by several tests are shown in table2.

*Table 2: Properties of soil used for study*

SN	PROPERTY	VALUE
1	Specific gravity	2.93
2	Liquid limit (%)	49.27
3	Plastic limit (%)	27.27
4	Plasticity index	22
5	Swelling test (%)	41.1
6	Shrinkage test (%)	25.15
7	Optimum moisture content (%) of virgin soil	28.9
8	Maximum dry density (gm/cc) Of virgin soil	1.6
9	CBR Value of virgin soil	7.74
10	Optimum moisture content (%) of soil mixed with BC soil	28.12
11	Maximum dry density (gm/cc) of soil mixed with BC soil	1.42
12	CBR value of tyre waste mixed with black cotton soil	9.34



*Fig. 3: Comparison of CBR value for different percentage of tyre waste mixed with soil under soaked and unsoaked condition*

Starting with as specified in fig. 3 it might make watched that CBR esteem for unsoaked state will be helter skelter contrast with doused condition What's more it will be useful will blend 3% tyre waste for dirt with bring most astounding mechanical quality to soil Yet toward same duration of the time it Additionally fundamental to Think as of mechanical quality Previously, drenched condition Similarly as outcome to drenched condition will be supportive should Audit possibilities in condition in submergence from claiming soil On water, inspired water level and so on. So, it may be best to utilize 4. 5% tyre waste should get enough quality over doused and also unsoaked condition.

## CONCLUSION

Mix of 3% to 4.5% shows greater increase in the CBR value of the soil. If we consider mix of 4.5% for soaked condition it can give increase in CBR value by 10.34% and for unsoaked condition it give rise in CBR value by 139.2% compared to CBR value of soil without having mix of tyre waste. So it will be very helpful to use mix of 4.5% tyre waste with soil where conditions are prior to having soil submergence in water.

## APPLICATION

Indian Air Force (IAF) has stepped forward to utilize parkway extends as "Runways" in a crisis for contender flying machines. Such extends would be created in Rajasthan, Gujarat and Punjab on need premise considering these states share their limits with Pakistan. The soil strata in Gujarat for the most part comprises of Black Cotton Soil which has low soundness. Utilizing this system, BC soil can be balanced out and this can help in upgradation of interstates for arrivals and departures.

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