STRENGTH IMPROVEMENT OF EXPANSIVE SOIL BY USING TYRE POWDER

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ABSTRACT

Expansive soils often exhibit undesirable engineering properties such as low strength, swelling and shrinkage characteristics etc., to improve these properties a common method followed is stabilization. Stabilization is the process of improving the engineering properties of the soil and thus making it more stable. It is required when the soil available for construction is not suitable for the intended purpose. Stabilization includes compaction, pre consolidation, drainage and many other such the objective of the present study is to increase the strength of expansive soil by using economical material like TYRE POWDER. In the present study we have done Wet Sieve Analysis, Liquid Limit and Plastic Limit tests for the classification of soil and then we added tyre powder 4%, 6%, 8%, 9%, and 10% determined the properties of soil such as Moisture content, Dry Density of Soil. The addition of lime to the expansive soil determines the impact on different properties of the soil. This way the change of state can be made at our will by mixing the suitable quantity of tyre powder in the soil

1. INTRODUCTION

The **stabilization** of different types of problematic **soils** such as **expansive soil**, soft **soil**, contaminated **soils** etc. by using various chemical stabilizers such as lime and cement is well known techniques in the field of geotechnical engineering and ground improvement and has been practiced since last several years the research reports some solid waste materials The stabilization method depends on the type of soil and its properties. The selection of type and determination of the percentage of additive to be used is dependent upon the soil classification and the degree of improvement in soil quality desired. Generally, smaller amounts of additives are required when it is simply desired to modify soil properties such as gradation, workability, and plasticity. When it is desired to improve the strength and durability significantly, larger quantities of additives are used.

Soil stabilization a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose. Improvements include increasing the weight bearing capabilities and performance of in-situ sub soil's, sands, and other waste materials in order to strengthen road surfaces. The prime objective of soil stabilization is to improve the California bearing ratio of in-situ soils by 4 to 6 times.

In this work, the possibility of using tyre powder was an additive to improve the strength of soft soil was investigated.

2. LITERATURE REVIEW

This chapter discusses the research work carried out on expansive soils by using tyre powder in various proportions. This chapter gives a strength behavior of expansive soil after addition of tyre powder

A.SATHWIK and ARTI SUDAM Disposal of scrap tyres is environmental dilemma as the utilization of automobiles is in the increasing trends which therefore cause damage to the eco-system. As the tyres are manufactured with synthetic rubber, disposal of these wastes have become difficult. It is approximately estimated as 60 to 70% of waste tyres are disposed in improper way in various areas. To avoid this damage we can utilize the

tyre wastes with technical development in different fields like using them in construction project However, they can improve the characteristics of soil which is one of the essential materials used for construction. A program of Standard Proctor tests, Unconfined Compression tests and California Bearing Ratio tests were carried out on the specimens of cohesive soil-tyre mixtures, by varying tyre powder content like 4%, 8%, 12% and 16% by weight of the soil. This paper discusses the shear strength characteristics of cohesive soil after adding various percentages of tyre powder. The aim of the study is also to analyze the seepage velocity of the soil by adding different proportions of tyre powder Ghatge Sandeep Hambirao,Dr.P.G.Rakaraddi

Solid waste management is one of the major environmental concerns worldwide. In India, the scrap tyres are being generated and accumulated in large volumes causing an increasing threat to the environment. In order 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. The potential of using rubber from worn tyres in many civil engineering works has been studied for more than 30 years. Applications where tyres can be used have proven to be effective in protecting the environment and conserving natural resources. In recent times with the increase in the demand for infrastructure and feasible foundation design in not applicable due to poor bearing capacity of ground soil stabilization has started to take a new shape. Unconfined Compressive Strength Tests and California bearing ratio tests are conducted for soil and shedi soil with the varying rubber powder percentage i.e. 0%, 5%, 10% and 15% and the results were noted and compared.

3. EXPERIMENTAL PROGRAMME

3.1 Materials

In this section, the details pertaining to soil, used in this investigation are discussed. The soil is collected from kottala, Chandragiri Mandal, Chittoor District. Lime is collected from Chittoor. The soils are designated for reference. The soil samples are collected by digging trail pits. The top soil up to 1.0 m is excluded as it is in loose condition and contains microbial activity/ organic matters The required amount of soils are collected from the trial pits at a depth of 2m above form the ground level, Sufficient care has been taken to see that the collected soils samples are fairly homogeneous. The soils so obtained are air dried, crushed with wooden mallet and passed through 4.75mm sieve. These soils so obtained are kept in polythene bags and stored in steel drums for further testing.

3.1.1 Tyre powder

Since the wheel got invented, it has been redesigned and recreated according to convenience of humans. Today, we can see there is a heavy load of traffic on roads. This load is more in the case of urban areas as compared to rural areas due to difference in life style and infrastructure. The number of vehicles (cars, buses, trucks, motorcycle) are increasing exponentially with time. These vehicles run on the road through wheels by means of tyres. Granules of rubber and iron can be obtained in various final grain sizes. This has become meaningful because processed rubber is becoming more and more acceptable on the market due to increasing raw material prices. Waste tyre rubber powder is widely used to build the playground, highway road, etc

Table 3.1 Physical Properties of Tyre powder

Physical properties	Test result
Density	0.83
Size	80 µm – 1.6 mm
Elongation (%)	420
Rate of steel fiber	0%

The tire is made up mainly by rubber. Its constitution varies a little between the car tires and heavy truck tires. Rubber consists of a complex mixture of elastomers, polyisoprene, polybutadiene and stirene-butadiene. Stearic acid (1.2%), zinc oxide (1.9%), extender oil (1.9%) and carbon black (31.0%) are also important components of tyres

3.1.2 Soil properties

The properties of obtained by the laboratory are presented in the Table 3.2.

Expansive soil from kottala was used for the determining the basic properties of the soil such as wet and dry sieve analysis, Atterberg Limits, Standard Proctor Test, Differential Free Swell Test and Swelling Pressure Test,. The tests were performed on samples with lime content varying from 2%, 4%, 6% and then compared to the results obtained from soil without tyre powder.

Table 3.2 Properties of soil sample

S.No	Perameter	Value
1	% Gravel	4
2	% Sand	9
3	% Silt	13
4	% Clay	74
5	Specific gravity	2.65
6	Free Swell Index	90
7	Degree of expansion	Very high
8	Coefficient of uniformity	5.20
9	Coefficient of curvatue	1.20
10	I S Soil clssification	CH
11	Optimum moisture content(%)	18
12	Max Dry density(g/cc)	1.85
13	Angle of internal friction	43 deg
14	Cohesion(Kpa)	25

3.1.3 Experimental program with addition of tyre powder

The following tests are conducted in the laboratory and shows the variation of properties of the soil i.e liquid limit, plastic limit, free swell index, maximum dry density of the given soil sample.

3.1.4 Liquid Limit

The liquid limit of the treated soil varies between 53.2% to 59.5% (IS 2720 Part 5 -1985). The liquid limit of the soil decrease with increase in tyre powder up to 4% after it goes on increasing with increase in lime content. Thus the optimum lime content is between 4% to 6% for, maximum effect on liquid limit

3.1.5 Plastic limit

Plastic limit did not change distinctly (range b/w 32% to 40%) with increase tyre powder, the lowest value was reached at a tyre powder of about 4%.

3.1.6 Proctor compaction test

The standard proctor test results show that the maximum dry density remains constant with variation in tyre powder whereas the optimum moisture content lies b/w 23 %to 30% from is code (2720 part 7 -1980) with a decreasing tendency as tyre powder content increases.so addition of lime did not improve the compaction characteristic of the soil

3.1.7 Free Swell index

Free swell index n change distinctly (range b/w 120% to 35%) with increase tyre powder, the lowest value was reached at a tyre powder of about 4%.

4.1 Test Results

The variation test results are represented below in table

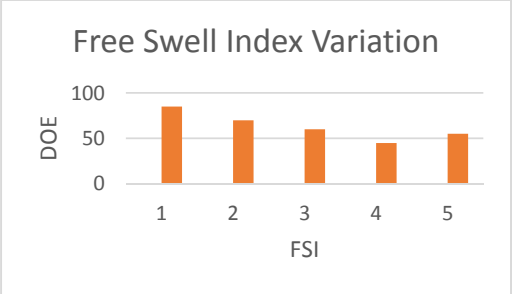

Fig 1.1 Variation of free swell index

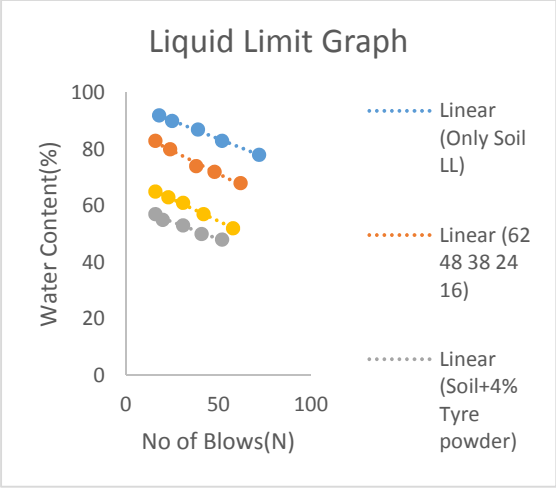

Fig I Variation of liquid limit with and without addition of Tyre powder

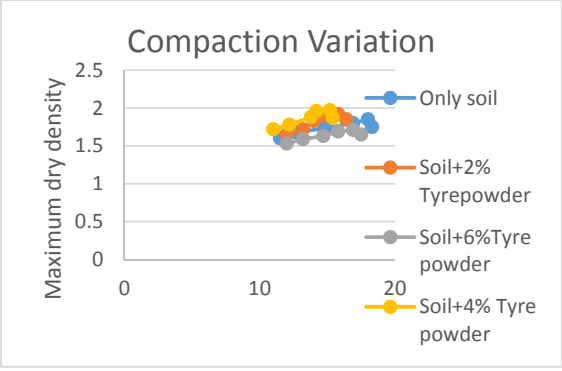

Fig II Variation of Compaction properties with and without addition of Tyre powder

Table 4.1 Properties of Soil after adding tyre powder

S.No	Property	Soil	S+2%	S+4%	S+6%
1	Liquid Limit	90	85	55	63
2	Plastic limit	40	35	24	30
3	FSI	85	60	45	50
4	MDD(g/cc)	1.85	1.92	1.97	1.71
5	OMC	18	15.8	15.2	16.9
6	Cohesion	25	32	41	28
7	CBR	2.34	2.40	2.43	1.19

5 Conclusions

An immediate benefit obtained by the addition of tyre powder to swelling soils is to reduce the potential for swelling upon contact with water. The plastic nature of the soil decreases and the stiffness of the soil increases as the tyre powder content increases. For improving the properties described in this paper, the optimum tyre powder content was found to be within the range of 4% to 6%

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