iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** IX **Month of publication:** September 2022

DOI: https://doi.org/10.22214/ijraset.2022.46593

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

Stabilization of Soil by Using Polypropylene Fibers

Akhade Sachin N[1], Prof. W.S. Marathe[2]
[1]*P.G. Student, Civil Engineering Department, S. S. V.P's B.S.D, COE, Dhule.DBATU University, Lonere*
[2] *Assistant Professor, Civil Engineering Department, S. S. V.P's B.S.D, COE, Dhule.DBATU University, Lonere*

Abstract: This types of soil need to be stabilized in order to increase the shear strength of the soil, durability of the soil as well to prevent from the erosion. Various case studies have been carried out for these types of soil to increase the soil properties. In this case study raw fibre known as polypropylene fibre have been used to increase the soil properties and interlocking of the soil and has become the one of the major practices used in construction work. This paper purposes to conduct the case study to check the improvements in properties of sandy soil by adding raw material polypropylene fibre. Several lab tests have been carried out using varying percentage of reinforcement (0.05%,0.10%,0.15%,0.20% and 0.25%). The soil parameters like specific gravity, plastic limit, liquid limit, compaction test and direct shear test are studied. The results obtained, will strained towards the usability and effectiveness of the fibre reinforcement in the replacement of the deep foundation.
Keywords: polypropylene fibre, soil parameters, soil stabilization.

I. INTRODUCTION

A. Polypropylene

Polypropylene (PP) is a thermoplastic polymer widely used in quilting, blend concrete and it is fluently available. In synthetic fiber polypropylene is the world's alternate extensively product after polyethylene. Chemically, polypropylene filament is denoted as (C3H6).

Benefits of Polypropylene Fibers :-

1) Polypropylene (PP) is a low weight fiber.
2) It does not absorb water. It has good resistant towards water absorbtion.
3) Polypropylene has excellent chemical resistance. PP fibers are also good resistant to most acids and alkalis.
4) It has low thermal conductivity as compared to other fibers.

II. METHODOLOGY

In this research, laboratory experiments have been performed to search the use of polypropylene fibers to stabilize two types of soils. Various soil samples and polypropylene fiber mixtures were prepared in the laboratory and then examined for their engineering properties. The various tests like Proctor Compaction Test, CBR characteristics and the unconfined compressive strength of samples were investigated. This paper illustrates the findings from the laboratory experimenttions with particular emphasis on the use of above mentioned alternative materials that provide economic benefits as well as reduced environmental impacts comparatively. The various tests will have to perform to observe the engineering properties of soil.

A. Data Collection

Sample Collection:-

1) *Sample no. 1:* 12, Shiv colony, Londhe -414106 Type of soil :- Black cotton soil
2) *Sample no. 2:* 16, vajhari river, Daregaon -414106 Type of soil :-Alluvial Soil

III.EXPERIMENTAL INVESTIGATION

A. Specific Gravity

1) *Soil Sample-1*

Table No. 1 Specific Gravity of soil sample 1

sample number	1	2	3
mass of empty bottle (W1) in gms.	656	656	656
mass of bottle+ dry soil (W2) in gms.	866	960	1018
mass of bottle + dry soil + water (W3) in gms.	1667	1740	1772
mass of bottle + water (W4) in gms.	1542	1542	1542
specific gravity	2.471	2.851	2.729
Avg. specific gravity	2.684		

2) Soil Sample-II

Table No.2 Specific Gravity of soil sample 2

sample number	1	2	3
mass of empty bottle (W1) in gms.	653	653	653
mass of bottle+ dry soil (W2) in gms.	1108	1022	836
mass of bottle + dry soil + water (W3) in gms.	1817	1778	1646
mass of bottle + water (W4) in gms.	1542	1542	1542
specific gravity	2.527	2.774	2.316
Avg. specific gravity	2.539		

B. Particle Size Distribution

1) Soil sample-1

Table No. 3 Particle Size Distribution for Soil Sample 1

IS sieve Mm	Mass of soil retained (w) gm	%mass of soil Retained	Cumulative mass of soil retained	Cumulative % finer
10	35	4.67	4.67	95.33
4.75	86	11.47	16.14	83.86
2	133	17.73	33.87	66.13
0.6	298	39.73	73.60	26.40
0.425	38	5.07	78.67	21.33
0.3	21	2.80	81.47	18.53
0.15	75	10.00	91.47	8.53
0.09	31	4.13	95.60	4.40
0.075	33	4.40	100.00	0.00

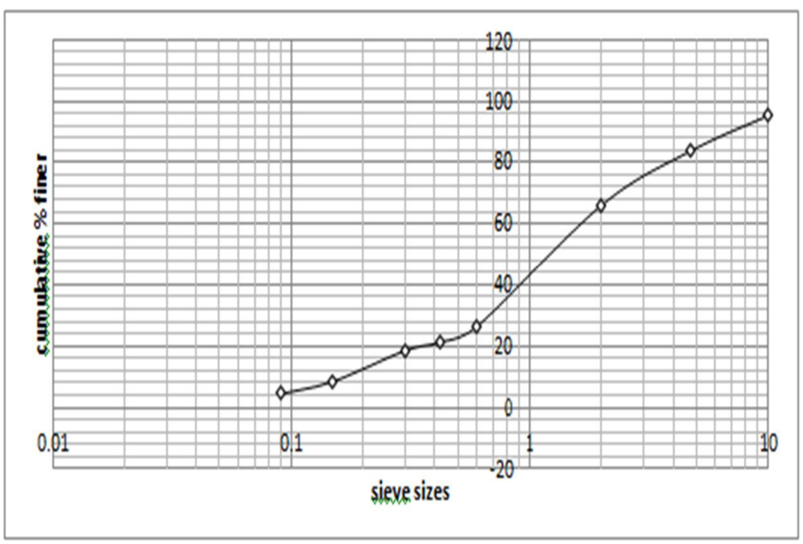

Fig. 1 Particle Size Distribution for Soil Sample 1

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IX Sep 2022- Available at www.ijraset.com

2) Soil Sample-2

Table No. 8 Particle Size Distribution for Soil Sample 2

Sieve size mm	Mass of soil retained (w) gm	%mass of soil retained	Cumulative massof soil retained	Cumulative % finer
10	10	1.33	1.33	98.67
4.75	70	9.33	10.66	89.34
2	125	16.67	27.33	72.67
0.6	302	40.27	67.60	32.40
0.425	64	8.53	76.13	23.87
0.3	34	4.53	80.66	19.34
0.15	72	9.60	90.26	9.74
0.09	67	8.93	99.20	0.80
Pan	6	0.80	100.00	0.00

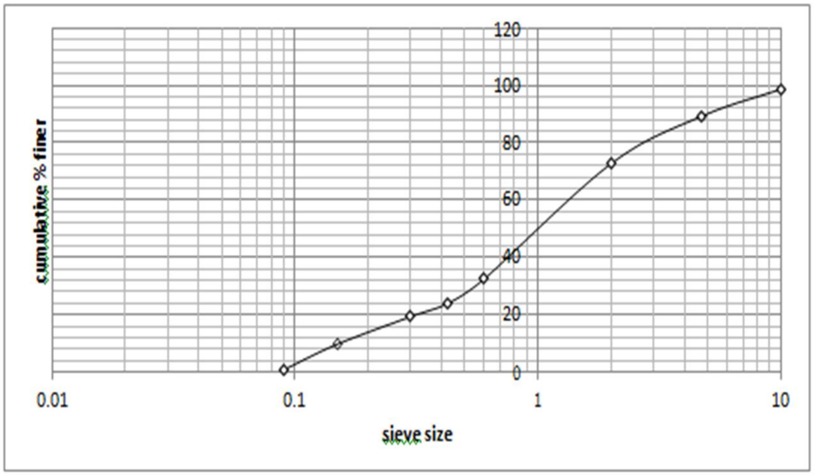

Fig 2 Particle Size Distribution for Soil Sample 2

C. Cohesion And Fiber Content

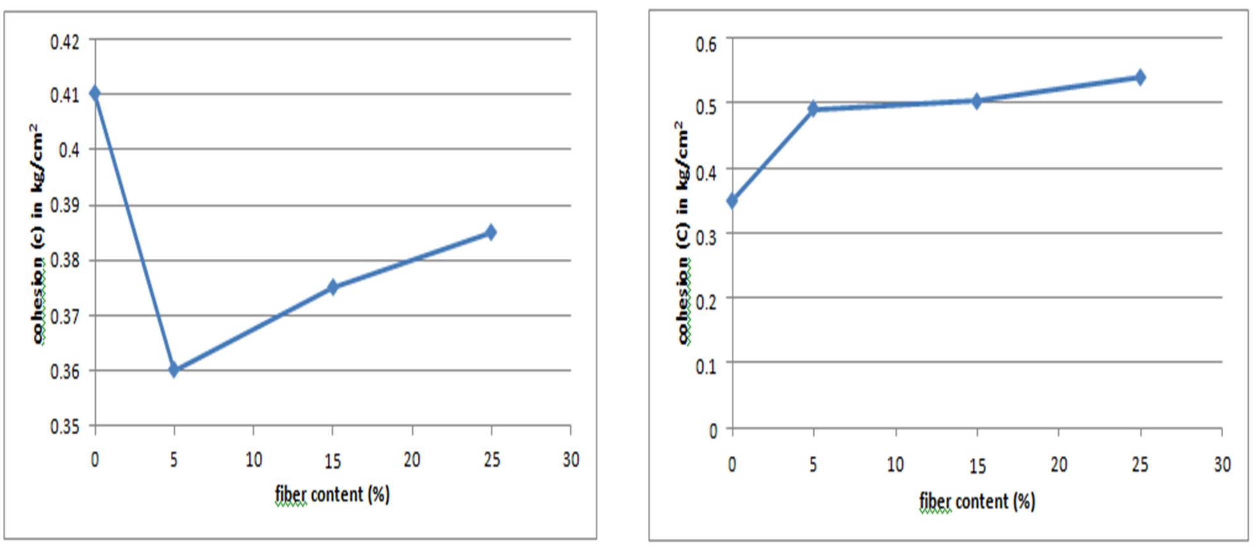

Fig 3 Cohesion and Fiber Content for sample 1and 2

D. Angle Of Internal Friction And Fiber Content

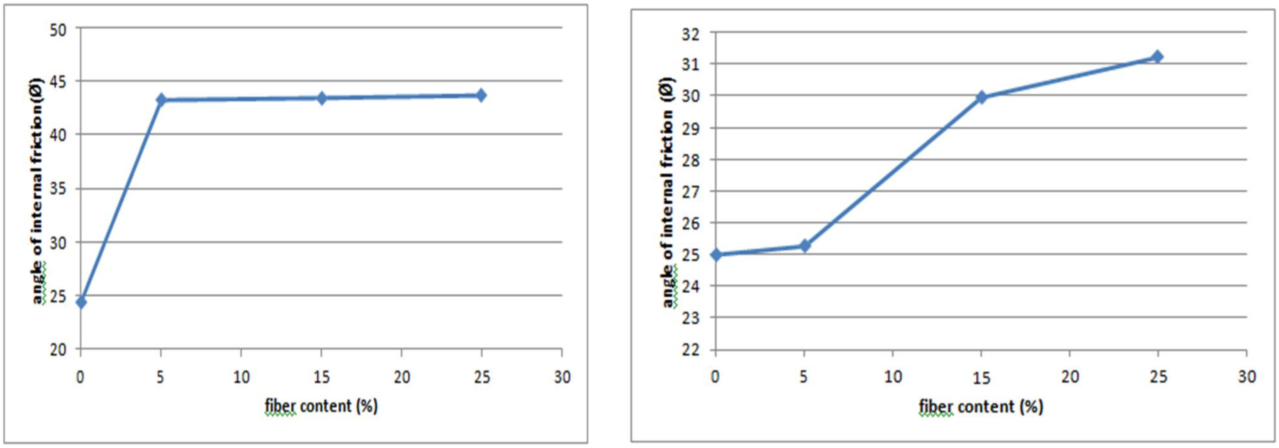

Fig 4 Angle of internal friction and fiber content for sample 2

E. Relationship Between The UCS And Fiber Content

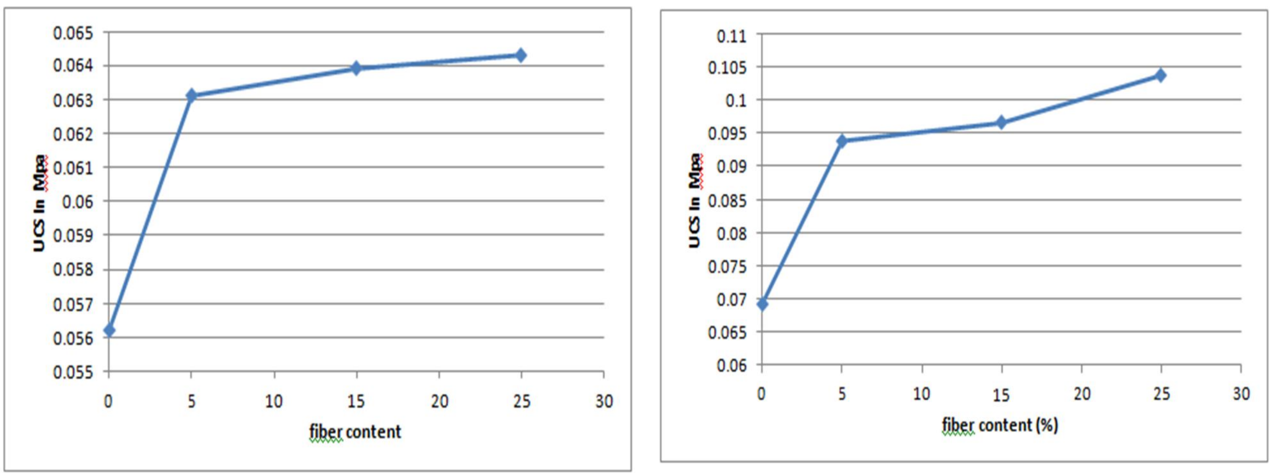

Fig 5 UCS and Fiber content for sample for sample 1 and 2

IV. CONCLUSIONS

1) On the basis of Direct shear test on soil sample no. 1, with fiber reinforcement of 5% there is a decrease in the cohesion of soil suddenly. After adding the fibers reinforcement of 15% & 25% there is an increase in the cohesion of soil sample from the cohesion value obtain in the shear test when 5% of reinforcement was added in a soil sample. But the final value of cohesion of soil after the addition of 25% of reinforcement is less than unreinforced soil sample. But when we adding the reinforcement in the soil in the proportion of 5%, 15%, 25% the value of the angle of internal friction increases from 24.41° to 43.22 °, 43.41°, 43.65° respectively. Therefore it should conclude that in given soil addition of PP fibers as reinforcement in given soil sample decreases the cohesion value of soil but meanwhile, it is increasing the value of an angle of internal friction marginally. So it should conclude that the use of PP fibers as soil stabilizer for given soil sample no. 1is not recommended.
2) The results of the UCS test for soil sample -1 are also similar that when we adding the reinforcement in the soil at the percentage of 5 %, 15 %, and 25 %, the UCS value of soil sample is an increase from 0.0562 Mpa to 0.0631 Mpa, 0.0639 Mpa and 0.0634 Mpa on a respective percentage of reinforcement which is not enough for future purposes for increases the strength of given soil sample.
3) The shear strength parameters for soil sample no. 2 - the given soil sample were had cohesion value equal to 0.35 kg/cm^2. when we adding the fiber in soil in proportion of the 5%, 15%, 25% the value of cohesion is 0.49 kg/cm^2, 0.504 kg/cm^2, 0.54 kg/cm^2 respectively. again the initial value of an angle of internal friction is 24.985°. after the addition of reinforcement 5%, 15%, and

25% the value of the angle of internal friction 25.26°, 29.94°, and 31.21° respectively. from the above results, it would conclude that the use of PP fibers as reinforcement is profitable and effective for soil sample no. 2.

4) On comparing the results from the UCS test of soil sample no. 2 the initial value of the UCS test corresponds to soil sample which is unreinforced soil was 0.0692 Mpa. after addition of reinforcement at 5%, 15%, 25% the value of the UCS test are 0.0938 Mpa, 0.0965 Mpa, 0.1037Mpa i.e. the UCS value increases at net percentage 49.8 %, which is good increment, therefore, it would conclude that PP fibers as reinforcement is good option for soil sample no. 2.
5) Overall it can be concluded that fiber reinforced soil can be considered to be good ground improvement technique specially in engineering projects on weak soils where it can act as a substitute to deep/raft foundations, reducing the cost as well as energy

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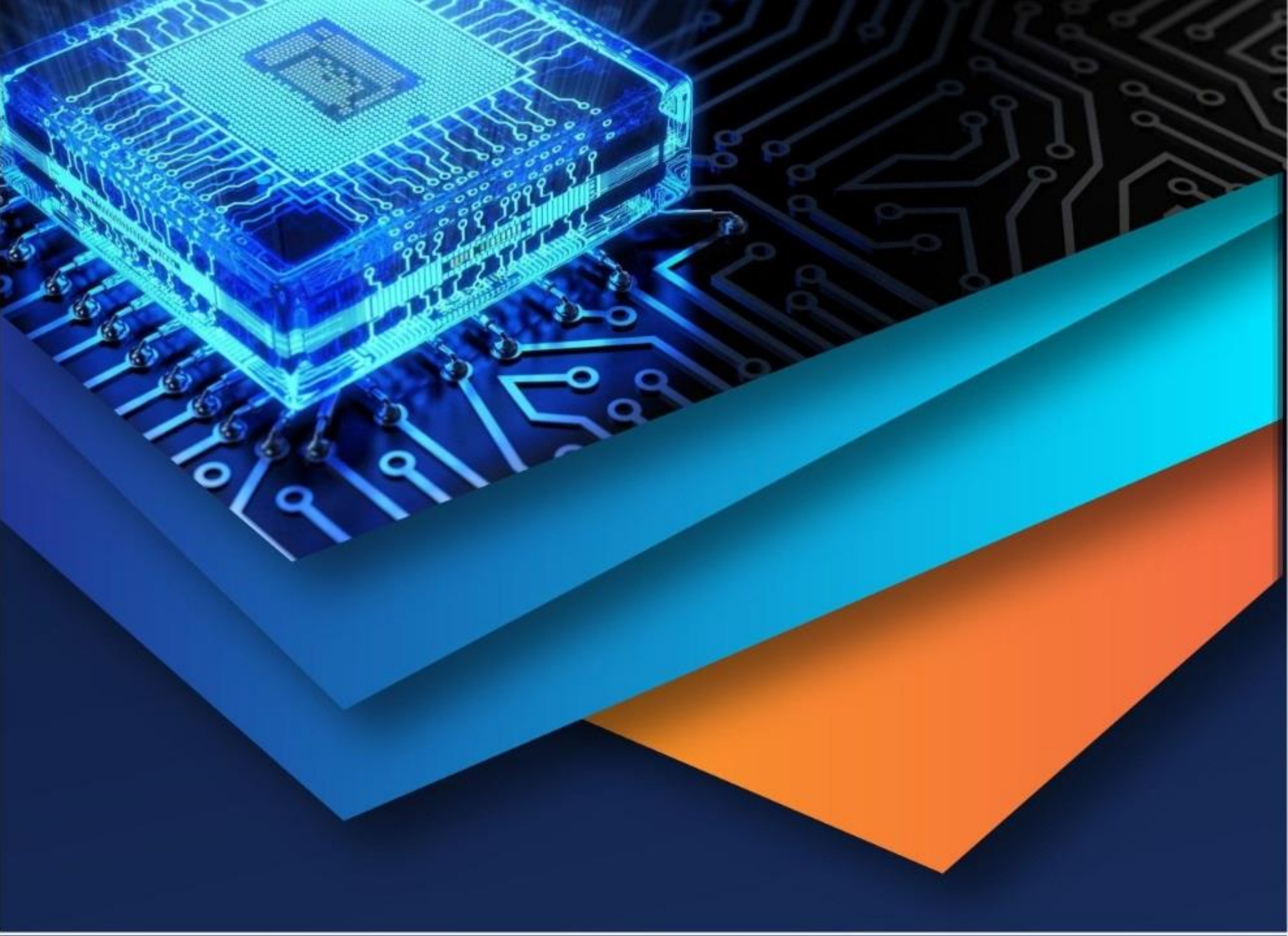

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