IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 2, July 2023

Effect of Marble Dust and Banana Peel Powder in Strength Improvement of Clayey Soil

Muhammed Shahanas N[1] and Arathy M T[2]
M Tech Student, Department of Civil Engineering[1]
Assistant Professor, Department of Civil Engineering[2]
St. Thomas Institute for Science and Technology, Kattaikonam, Trivandrum, Kerala India

Abstract: *Effect of industrial and agricultural waste has been increasing day by day also the cost of products using for significant soil stabilization. To avoid the failures in in engineering structures soil must be stabilized to required amount, especially weak soil like clayey soil. Changes in soil properties by chemical and physical means in order to enhance the engineering properties of soil. Construction on clayey soil is challenging and cost hiking procedure. This research paper mainly focus on the stabilization of medium clay using waste marble dust and banana peel powder. Marble dust (MD) is one of the harmful waste product formed due to the industrial application of marble stone cutting and polishing. Peel from the banana can cause lots of pollution in air and water in its unprocessed form. Marble dust contains lime, calcium, silica elements and banana peel contain potassium, calcium elements which impart the strength of soil. Consumption of food and its waste generation is increased day by day Marble dust is added in 2%, 4%, 6%, 8%, 10%, 12%, 14%, and 16% by the weight of sample and Banana peel powder (BPP) is added by 1%, 2%, 3%, 4%, 5%, 6%, 7% and 8% by the weight of soil. Studies of index and engineering properties of each sample and mixture is carried out. Settlement analysis of each sample is carried out using plate load test. A comparative study is conducted to evaluate the effect of marble and banana peel powder in the clay.*

Keywords: Banana Peel Powder, Marble Dust, Clayey soil, Steel tank, Steel Plate

I. INTRODUCTION

The growing call for marble products within the construction enterprise is growing the technology waste marble dust. Marble reducing flowers sell off waste marble powder into all a close-by pit or open areas near their unit, although the mentioned regions have been marked dumping. This results in serious environmental and dirt pollution and occupying a big vicinity from the ground. Marble powder is considered an industrial waste and causes several problems marble production, causes agencies in a free nation using this MD (Marble dust) as a stabilizing agent can extensively lessen the ability for waste era Marble consists of lime, carbonates and silica, that may enhance the geotechnical residences of clay. Waste marble dust is utilized in diverse programs and purposes as reinforcement or uncooked material. The cause of this study became to investigate the applicability of waste marble dust and banana peel powder in development of difficult soils. Banana peel powder is taken for the study which retained on 600 micron sieve. Also the day by day the agricultural waste production is increased so to control these waste generation and the property of banana peel powder. Study focused on to finding out the optimum percentage of banana peel and marble dust by conducting tests like Atterberg's limit, compaction test, and unconfined compressive strength test and settlement analysis.

II. LITERATURE REVIEW

Hassan A. M. Abdelkader et.al (2022) Influence of waste marble dust on the improvement of expansive clay. The primary purpose of this study is to use this waste material in the soil stabilization in point of view utilization of this waste as local low-cost materials and elimination of their negative environmental impacts. The waste marble dust was mixed with expansive soil samples with various percentages of 5%, 10%, 15%, 20%, and 25% by dry weight of soil. Different tests including Atterberg's limits, standard Proctor compaction, unconfined compressive strength (UCS),

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 2, July 2023

California bearing ratio (CBR), swelling percentage, linear shrinkage (LS) tests, and XRF and XRD analyses were conducted for natural and marble dust stabilized soils.

Anukant Lohia et.al (2021) An experimental study of soil stabilization using marble dust. In this study, waste limestone dust and waste dolomitic marble dust, by-products of marble industry, were used for stabilization of clayey soils. The marble dust addition ratios which have been studied were 10%, 15 % and 20% by weight. Marble dust had a noticeable role in the hydration process because of high calcium content.

III. MATERIALS AND METHODOLOGY

3.1 Materials

Clay soil is taken from Chenkkal in Thiruvananthapuram at 1m depth from normal ground level. Soil have high moisture content in its natural state and the clay is highly plastic and prone to high swelling and shrinkage due to montmorillonite presence. Marble dust is taken from quarry and banana peel is collected and dried to powder. Steel tank of size 60 x 60 x 45 cm and steel plate of size 150 x 150 x 10 mm.

Fig.1 Chenkal clay

Fig. 2 Marble Dust

Fig.3 Banana Peel Powder

Fig. 4 Steel Tank

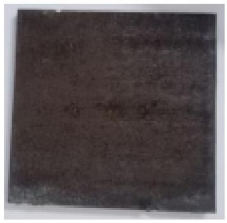


Fig. 5 Steel Plate

3.2 Methodology

The natural water content of the soil is noted and find out the geotechnical properties of soil like Atterbergs limit, specific gravity, maximum dry density and optimum moisture content. Settlement analysis is also carried out from the optimum percentage of marble dust and banana peel powder. This study to find out the optimum percentage of marble dust and banana peel powder required for the stabilization of the clay. Interpretation of results also shown in this study.

IV. TEST RESULTS AND DISCUSSIONS

4.1 Study on natural soil sample

TABLE I Properties of natural soil sample

Property	Test result
Water content	35 %
Specific gravity, G	2.15
Liquid limit	72 %
Plastic limit	25%
Percentage of clay	63%
Percentage of silt	32 %
Unconfined Compressive strength	64.2 kN/m^2

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 2, July 2023

Maximum dry density	15.12 kN/m^3
Optimum moisture content	26%

4.2 Study on Marble dust and Bananan peel Treated Soil Sample

1) Atterberg's Limit

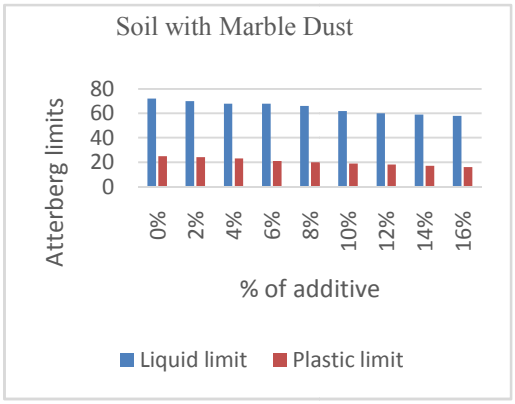


Fig. 6 Soil with MD

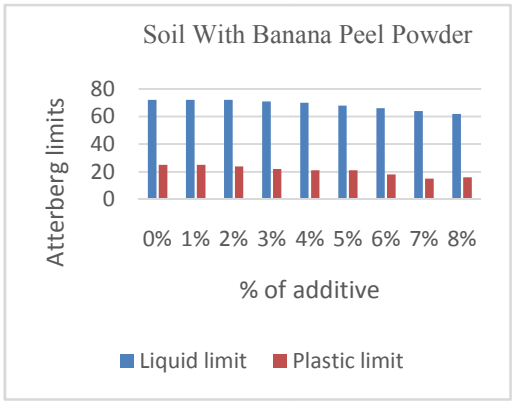
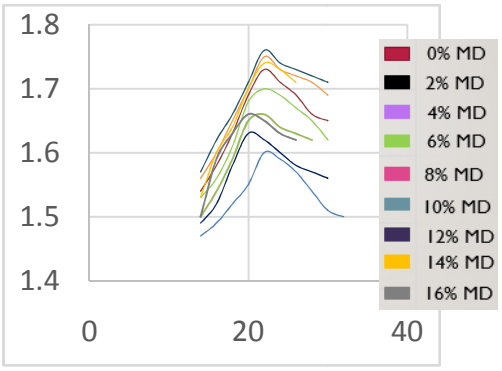


Fig. 7 Soil with BPP

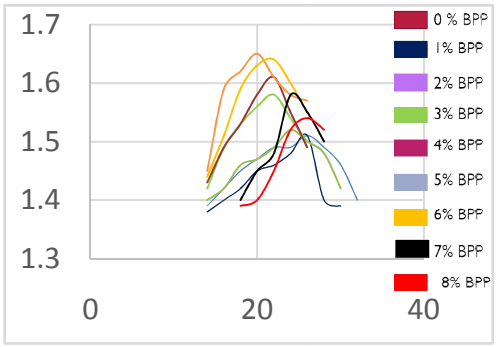
2) Standard Proctor Compaction Test



MD %	MDD (kN/m^2)	OMC %
0	15.15	22
2	16.3	24
4	17.3	23
6	18	21
8	18.6	20
10	18.9	21
12	19	20
14	18.4	24
16	18.1	24

OMC %

Fig. 8 Compaction Chart using MD TABLE II Compaction Test Resultsusing BPP



MD %	MDD (kN/m^2)	OMC %
0	15.15	26
1	15.15	26
2	15.2	25
3	15.8	23
4	16.1	22
5	16.5	20
6	16.4	22
7	15.8	24
8	15.4	25

Fig. 9 Compaction chart using BPP

TABLE II Compaction Test Resultsusing BPP

WWW Kn/m^2

DOI: 10.48175/IJARSCT-12147

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 2, July 2023

3) Unconfined Compressive Strength

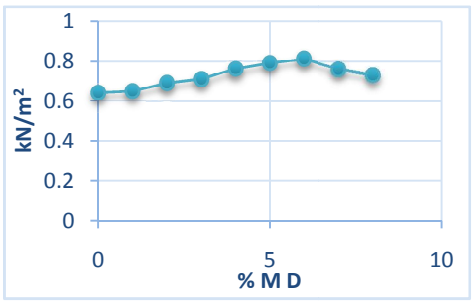


Fig.10Variation in UCS with % MD

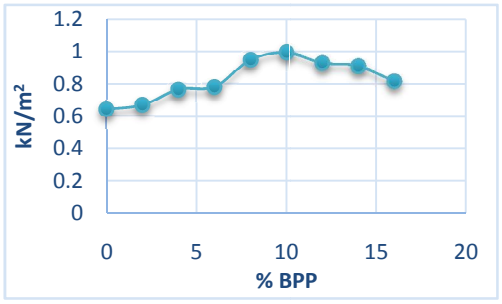


Fig.11 Variation in UCS with % BPP

4.3 Settlement Analysis

- It is conducted in plate load apparatus
- Steel tank of size 60 x 60 x 45 is taken
- Analysis is carried out in virgin soil and soil samples with MD and BPP
- Steel plate of size 150 x 150 x 10 mm is used
- 10% of MD and 6 % of BPP is taken

Fig.12 Settlement Analysis using Plate load Apparatus

TABLE IV Comparison of settlement analysis

LOAD	CLAY (mm)	CLAY WITH MD (mm)	CLAY WITH BPP (mm)
0.2	1.68	1.4	1.6
0.4	2.54	2.1	2.3
0.6	7.7	5.7	7.4
0.8	10.6	8.9	10.2
1.0	14.9	11.3	15.3
1.2	19.2	14.6	18.6
1.4	24.9	18.3	22.9

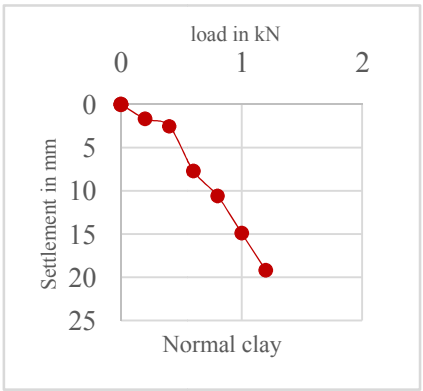


Fig. 13 Settlement analysis of normal clay

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 2, July 2023

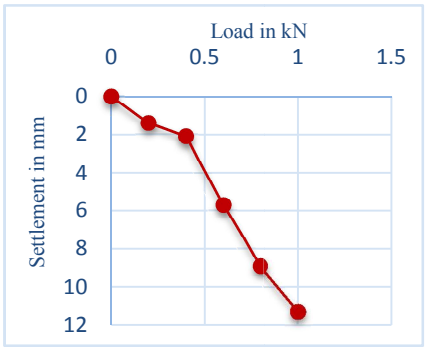


Fig. 14 Settlement analysis of Clay with MD

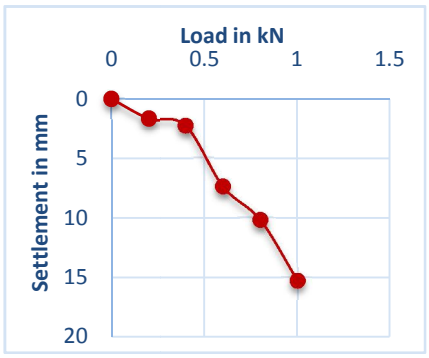


Fig. 15 Settlement analysis of Clay with BPP

V. CONCLUSION

From the Atterbergs limit test both BPP and MD can reduce the plasticity of clay

- 10% of MD have higher strength in UCS
- 6% of BPP have higher strength in UCS
- 12% MD shows higher density
- 5% BPP shows higher density
- Sample shows the MDD in 6% of BPP and 12% of MD
- UCS value increase up to 12.3% in BPP and 35.6% in MD
- MDD increases up to 8.18% in BPP and 16.6 % in MD
- Sample with MD shows reduction in settlement
- BPP sample shows negligible reduction in settlement compared to virgin clay

REFERENCES

[1]. Anukant Lohia et.al (2021) An experimental study of soil stabilization using marble dust. International Journal on Emerging Technologies 9(1): 9-14(2018) ISSN

[2]. Ammar Rouaiguia et.al (2020) Enhancement of the Geotechnical Properties of Soils Using Marble and Lime Powder Geotechnical and geological engineering 38, 5649- 565(2020) https://doi.org/10.1007/s10706-020-01368-5

[3]. Bharti Jy P, Khan W, Kumar P, Gupta KD (2017) Combined effect of addition of marble dust and fly ash on expansive soil. J Mater Civil Eng

[4]. Brooks R, Adeoye FF, Takkalapelli KV (2010) Geotechnical properties of problem soils stabilized with fly ash and limestone dust in Philadelphia. J Mater Civ Eng 23(5):711–716

[5]. Babu S, Mary S (2017) Soil stabilization using marble dust. Int J Civil Eng Technol (IJCIET) 8(4):1706–1713

[6]. Hassan A. M. Abdelkader (2022) Influence of waste marble dust on the improvement of expansive clay soils

[7]. Ravindran-Gobinath et.al (2019) Banana Fibre-Reinforcement of a Soil Stabilized with Sodium Silicate.

[8]. Saygili A (2015) Use of waste marble dust for stabilization of clayey soil. Mater Sci 21(4):601–606

[9]. Sabat AK (2012) A study on some geotechnical properties of lime stabilised expansive soil–quarry dust mixes. Int J Emerg Trends Eng Dev 1(2):42–49

[10]. Li LG, Huang ZH, Tan YP, Kwan AKH, Chen HY (2019) Recycling of marble dust as paste replacement for improving strength, microstructure and eco-friendliness of mortar. J Clean Prod 210:55–65

[11]. Saboya F Jr, Xavier GC, Alexandre J (2007) The use of the powder marble by-product to enhance the properties of brick ceramic. Constr Build Mater 21(10):1