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Effect of Marble Dust and Paddy Straw on the Strength characteristics of Clayey Soil

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Abstract - This paper mainly includes the study of strength parameters of clayey soil with the admixtures of marble dust and paddy straw. Soil cracks are the main problem in intermittent irrigation. In this study, effects of adding paddy straw and marble dust on some soil physical characteristics and cracks were studied for clayey soil. Soil properties change a lot and development of structures relies a great deal upon the bearing capacity of the soil, henceforth, we have to settle the soil which makes it simpler to foresee the heap bearing limit of the soil and even improve the heap bearing limit. The degree of the soil is additionally a significant property to remember while working with soils. The soil might be well-evaluated which is alluring as it has less number of voids. In this way, it is smarter to combine various kinds of soils to improve the soil quality properties. Utilizing these waste materials will not only reduce the pollution but will also reduce the human dependability on the natural resources, thus leading to a more sustainable approach of construction. From the literature it was found that the optimum dosage of marble dust and paddy straw revealed in significant improvement in strength, durability and reduction in swelling and plasticity properties of the clayey soil. Based on the results, it is recommended that marble dust and paddy straw admixture be considered a viable option for increasing the strength characteristics of clayey soil.

Key Words: Strength Characteristics, marble dust, paddy straw, material properties.

1. INTRODUCTION

The Engineering Properties of soil are relied upon the numerous focuses like minerals, water table, soil water conduct and so on which fluctuate according to zone to zone. Because of which we can't get want properties reasonable to our needs of development. To determine this issue we have procedure called adjustment which intends to stable or to alter or to improve the dirt properties in positive way. Over 90% of the world's rice is delivered and expended in Asia-Pacific Region (Papadimitriou et al., 2000). In Asia, practically 84% of the water withdrawal is utilized for horticultural purposes, contrasted with 71% for the world. Rice speaks to about 45% of all inundated yield regions in Asia and 59% of rice is watered (Facon, 2003). Over 75% of rice development in Iran is in the Guilan and Mazandaran Provinces. In Guilan, 230,000 ha of land are utilized for rice development. Water is the principle constraining variable in paddy fields. Two strategies are polished for water system of paddy fields: nonstop progression of water (ponding) and discontinuous technique. In the discontinuous strategy, in the wake of soaking the dirt, water system is halted and the following water system is applied when the water profundity on the dirt surface is near zero. At this stage, soil begins to break. In Iran, the predominant water system strategy for the paddies is ponding. Notwithstanding, irregular strategy is much of the time applied when water is insufficient. After arrangement of the splits in a paddy soil, undeniably more water is expected to inundate the documented than a field without breaks. Also, splits can harm plant roots and diminish the yield, while high soil natural issue substance can forestall breaking or decrease its power. Along these lines, water the executives in broke paddy fields is significant. Conventional materials like earth, sand, stone, rock are being utilized as significant materials in the expressway development and establishment works. Customary development materials are acquired from the current normal assets and harm nature because of their consistent abuse. All things considered, during the way toward acquiring and moving different crude materials, high fixation dirtying gases (carbon monoxide, sulfur dioxide and so forth.) are constantly radiated to the air by the apparatuses. Presentation to such lethal gases discharged to the earth leads to significant sullying of air, water, soil, verdure, fauna, and oceanic life lastly impacts human wellbeing and their living conditions. Because of high transportation expenses of these crude materials and ecological effects, it is fundamental to discover utilitarian substitutes or somewhat swap added substances for conventional development materials in the development division to amplify utilization of side-effects. In perspective on the significance of vitality sparing and protection of assets, productive reusing of every strong waste (Paddy straw, fly debris, slag, marble dust and so on.) is presently a worldwide concern requiring broad innovative work progress in the direction of investigating more up to date applications and augmenting utilization of existing advances for a supportable and naturally solid administration.

Stabilization of soil is mostly undertaken in soft soils such as organic soil, clayey peat, silt to achieve desirable engineering properties of soil. To achieve the stabilization most important is to performed laboratory tests introduced by field tests which may need in order to find out the engineering and environmental properties. Soil is as a material which obtained from the geologic cycle when goes on continuously in nature. The geologic cycle of soil consists of erosion, transportation, deposition and upheaval of soil. The exposes rocks are eroded and separated by various physical and chemical processes. Erosion of soil is pick up by agencies of transportation like water and wind and are carried it into different place or locations where it is deposited. When the soil remind in its formation just above the parent rock it is called as sedentary soil and when the soil is place away from its origin it is called transported soil. The most of the engineering properties of sedentary soils vary considerably from the top layer to bottom layer. The engineering properties of transported soils are mostly different from the properties of the rock at the place of deposited. Transported soil become quit and thick and deposition and are usually uniform.

1.1 Soil classification

Soil classification is a way of consistently categorizing soils according to their probable engineering characteristics. The classification of a soil is based on its particle size distribution and if the soil is fine-grained then on its plasticity (LL and PI).

Liquid limit

The "liquid limit" might be characterized as the base dampness content at which the dirt will stream under the use of an exceptionally little shear power. At this dampness content the dirt is professed to vindicate for all intents and purposes as a fluid. "As far as possible" might be characterized all in all term as the base dampness content at which the dirt stays in a plastic condition. This lower point of confinement of pliancy is ideally self-assertively characterized and as far as possible might be further recognize as the least dampness content at which the dirt can be folded into a string of 1/8 in. (3.2mm) distance across without breakdown (Paul h. Wright/Karen k. Dixon, 2004).

Plastic index

The plasticity index of soil is characterized as the numerical contrast between the fluid and plastic cutoff points. It hence proposes the evaluation of dampness content over which the dirt is in a plastic condition. Sandy soil and residues, particularly those of the stone flour type, have typically low PIs, while earth soil shows the high estimation of the versatility record.

Generally, the soils that are highly plastic as demonstrated by a high estimation of the pliancy record are additionally profoundly compressible. It is likewise clear that the plastic record is the proportion of cohesiveness, with a high estimation of the P1 demonstrating a high level of union; Soils that don't have plastic points of confinement, for example, attachment fewer sands are accounted for as being nonplastic (NP). (Paul h, wright and Karen k. Dixon 2004).

1.2 Engineering properties of soil

Cohesion: It has fine grained particle size of 0.002mm. It has great quality of compaction with clay soil.

Capillarity: It transmits moisture content to the soil in all direction. The height of capillary rise in soil is almost equal in wet soil and dry soil.

Permeability: When the moisture content passage through the pores of soil and when soil have percolation porous enough it is called permeability.

Elasticity: Soil is called elasticity when it has gain its previous shape of volume or bulk after removing the load applied.

Compressibility: Soil has compressive nature because it can expel air and moisture and gives result of reduction in volume when compression load is not withdrawn.

2. Need and advantage

Soil is only materials which is easily available on the earth and used in many purposes in construction of structure. Soil stabilization varies a great deal and improves the bearing capacity and maintenance. Stabilization of soil is benefits to increased higher resistance values, reduction in plasticity, lower permeability, reduction of pavement thickness, elimination of excavation, and importing new materials and it also provides “all weather’ access onto and within project sites. Thus, various types of soil can mix with different admixture to improve the strength properties of soil and increase load bearing capacity of the soil. Soil stabilization is very useful specially arid and dried weather condition to prevent formation of dust or soil erosion. Soil stabilization also improved the durability and workability and reduces the volume of soil due to change in moisture content.

3. Material Properties

3.1 Clayey soil properties

Individuals portray soil types in all sort of ways, for example, light, substantial, poor or great, earth and topsoil. Soil researcher recognizes the dirt sort by how much mud, residue and sand are available is called as surface. It is conceivable to change the surface by including a few added substances. Changing surface can help in giving the correct condition expected to plant development.

Sand is the biggest molecule in the dirt and when you rub it, it feels unpleasant. This is on the grounds that it has sharp edges. Sand doesn't hold numerous supplements. Residues are soil molecule whose size is among sand and earth. Sediment feels smooth and fine. At the point when wet, it feels smooth however not clingy. Dirt is the littlest piece of particles. Dirt is smooth when dry and clingy when wet. Soils are called heavy soils if it is high in clay content. Clay also holds a lot of nutrients but doesn't let air and water through it well. The clayey soil properties are listed in Table 1.

Sr. No.	Soil Properties	Value
1	Specific Gravity	2.71
2	Liquid Limit (%)	35
3	Plastic Limit (%)	21
4	Plasticity Index (%)	18

Table.1: Properties of clayey soil

3.2 Marble dust

Marble Dust is a waste product of the marble stone industry. This dust is produced in the process of cutting of marble stone. Marble stone is a type of metamorphic rock that is produced as a result of transformation occurred in the lime stone. In India, marble processing industry generates around 7 million tons of wastes mainly in the form of powder during sawing and polishing processes. Out the total waste generated, the state of Rajasthan alone contributes around 6 million tons of marble dust annually i.e. about 95% of the total marble dust production. This poses a huge threat to the environment and the people because most of this dust is dumped into the open area which causes amaj or environmental concern. Although there are proper areas dedicated to the dumping of this waste, but marble dust being a very fine powder is capable off lowing away with the wind. Thus the marble dust spreads along the outer areas also and gradually settles on the plants and animals of the surrounding areas. The spreading of marble dust in the surrounding areas certainly creates necrotic ecological conditions for flora and fauna thereby changing the landscapes and habitats gradually. Thus it becomes very important to utilize this huge amount of waste in a proper manner. It consists of mainly 40% amount of Cao and 28% SiO_2. The chemical composition and physical characteristics of marble dust powder are shown in Table 2 & 3.

S.No.	Oxides	Content percentage
1	Sio_2	0.78
2	Al_2O_3	0.22
3	Fe_2O_3	0.07
4	Cao	54.82
5	MgO	0.26
6	SO_3	0.25
7	Na_2O	0.11
8	K_2O	0.03
9	P_2O_5	0.05
10	Cl^-	0.06
11	Sr0	0.05
12	L.O. I	43.22
13	Total	99.92
14	Humidity	0.507
15	Water content	23.860

Table.2

S. No.	Parameter	value
1	Specific surface area (cm^2/gm)	11.4[illegible]0[illegible]
2	Bulk density (kg/m^3)	986
3	Specific gravity	2.5

Table-3 : Physical characteristics of marble dust

3.3 Paddy Straw

Paddy straw is obtained from the burning of rice. The physical properties of paddy straw are listed in Table 4

S. No.	Properties	Paddy straw
1	Average diameter (mm)	2.5
2	Average tensile strength (N/mm^2)	12
3	Fiber density (g/cc)	0.38

Table- 4: Properties of paddy straw

4. Literature Review

Prabhakar and Sridhar (2002) directed examinations on C-ϕ soil gathered from Bhopal, India with sisal filaments as fortification. The sisal filaments were included length of 1 cm, 1.5cm, 2cm and 2.5 cm and they were included at various rates of 0.25, 0.5, 0.75, and 1. The shear quality and attachment were found to increment with the expansion of sisal fiber and ideal was accounted for as 0.75% of 2 cm length fiber. Bouhicha et al. (2005) led examines on clayey silty soil, silty sand, and earth sandy soil utilizing grain straw as support. The grain straw strands were included length of 1cm, 1 cm, 2 cm, 4 cm and 6 cm and they were included at various rates of 1, 1.5, 2, 2.5, 3 and 3.5. It was seen that the compressive quality expanded upto 1.5 % after which it was appeared to diminish. The impact of support was progressively articulated in clayey soil. Sarbaz and Ghiassian (2007) led considers on fine sand utilizing palm filaments as fortification. The palm filaments were included length of 2 cm and 4 cm and they were included at various rates of 0.5, 1, 2, 3 and 4. It was seen that the CBR estimation of the dirt was found to increment with the consideration of fortification. Marandi et al. (2008) led considers on silty sand utilizing palm filaments as fortification. The palm strands were included length of 2cm and 4 cm and they were included at various rates of 0.25, 0.5, 0.75, 1, 1.5, 2 and 2.5. It was seen that the CBR esteem expanded as the rate and length of fortification expanded. Santhi Krishna and Sayida (2009) led examines on dark cotton soil utilizing sisal strands as fortification. The sisal strands were included length of 1.5 cm, 2 cm, 2.5 cm and 3 cm and they were included at various rates of 0.25, 0.5, 0.75 and 1. It was watched CBR and unconfined compressive quality were found to increment with expansion of sisl fiber. The ideal rate and length were accounted for as 0.5% and 2.5 cm separately.An investigation of splitting soils was led to research soil the board rehearses on invasion rate (Islam et al., 2004). It was seen that administration of breaking soils has a huge effect on penetration rate. Among the administration rehearses, the hand digger activity was seen as superior to stomping on to diminish splitting. Soil mass thickness relies upon numerous components including surface, natural issue substance, and root profundity. It has been demonstrated that the expansion of natural alterations to soil has improved soil structure and diminished mass thickness (Tester, 1990). Adams (1973) and Rawls et al. (1998) demonstrated a negative relationship between's natural issue substance and mass thickness of soil. In an examination by Gupta et al. (1977), soil-water maintenance was expanded by joining of sewage muck into a sandy soil. A large portion of this expansion came about because of water adsorbed by natural issue. Mass thickness diminished as the pace of ooze expansion expanded. So as to improve air circulation and water penetration in the Middle Awash territory of Ethiopia, green excrement (dolicus lab-lab), ranch fertilizer, and bagasse were consolidated in the dirt (Girma and Endale, 1995). The invasion rate expanded somewhat after fuse of dolicus lab-lab. Conversely, lower mass thickness and more noteworthy all out soil porosity were acquired after the fuse of farmstead fertilizer. Hudson (1994) expressed that natural issue could retain water up to multiple times its weight, forestalling dryness, shrinkage, and breaking of the dirt. In an examination by Bandy opadhyay et al. (2003) it was discovered that all the breaking parameters were essentially adversely connected with the water substance of the 0–15 cm soil layer while split width and volume were decidedly related with mass thickness of a similar layer. Use of compost diminished the extent of various splitting parameters. The impact of straw mulching on split arrangement during the decrepit period was researched on an Epiaqualf and a Pellustert in the Philippines (Cabangon and Tuong, 2000). Breaks didn't close totally subsequent to rewetting, bringing about high misfortunes of water (152-235 mm) during land arrangement of the control plots, for example no dirt administration treatment. Straw mulching helped ration dampness in the dirt profile and diminished the mean split width by 32% of the control. Mulching didn't essentially decrease break profundity and the measure of water utilized in land planning. Straw mulching limits soil shrinkage by lessening dissipation from soil surface (Hundal and Tomar, 1985). As indicated by Bhushan and Sharma (2002), break volume and surface region diminished by 36-76% and 19-37%, separately, by long haul expansion of biomass. One method for discarding paddy straw after rice collect is copying the yield deposits. As indicated by Chan et al. (2002), consuming the harvest buildup diminishes the measure of natural substances. Consuming wheat straw decreased water dependability of whole soil and number of night crawlers (Wuest et al., 2005). It likewise diminished dry totals of 0.5–2.0 mm size, yet didn't influence all out C, absolute N, or ponded penetration rate.

5. CONCLUSION

1. It can be concluded that Soil stress may increases significantly by adding paddy straw to sandy soil. Generally, whenever paddy straw proportion increases the stress increases.

2. The optimum paddy straw content that gives the maximum stress is in the range of 0.75 percentages by weight.

3. The (S/d) ratio decreases by adding paddy straw reinforcement to sandy soil and decreases by increasing paddy straw proportion.

4. The minimum (S/d) ratio has been noticed at paddy straw percentage of 0.75 by weight. The soil stress decreases with increase of the slope angle.

5. Adding 2-7% of paddy straw expanded soil dampness content when contrasted with the control treatment. Silty mud soil with 7% straw had the most elevated and sandy topsoil soil with no straw had the least soil dampness content.

6. Addition of paddy straw diminished soil mass thickness. Control treatment in sandy topsoil soil had the most noteworthy and 7% straw treatment in silty dirt soil had the least mass thickness.

7. By supplanting soil its dry load by marble powder it gives most extreme improvement in the growing and direct shrinkage properties of dark cotton soil.

8. The expansion of the marble residue to the dirt lessens the mud substance and in this way increments in the level of coarser particles.

9. It lessens as far as possible, diminish as far as possible and increment in the pliancy list of the dirt and decrease the growing rate as a result of progress in degree of clayey soil by blending marble dust.

10. The attributes of soils fluctuate essentially with Marble dust. The Optimum Moisture Content (OMC) increments and Maximum Dry Density (MDD) diminishes with increment in level of Marble dust.

11. As contrasted with untreated soil, the rate increment in OMC at 15% expansion of Marble dust is 22.39% because of progress in versatility record and fluid point of confinement.

12. The CBR estimation of the dirt is expanded with expanding request of marble dust rate. The ideal outcomes were discovered when soil was settled with 15% marble dust. The CBR esteem is expanded from 2.36% to 14.86%.

13. Above consequences of CBR test and MDD of soil with 20% marble shows that the CBR after effects of this dirt is sufficient to development for medium traffic volume streets. So we can use more marble squander in adjustment process.

REFERENCES

[1]. Adams, W. A. 1973. The Effect of Organic Matter on the Bulk and True Densities of Some Uncultivated Podzolic Soils. J. Soil Sci., **4**: 10–17.

[2]. Adesodun, J. K., Mbagwu, J. S. C. and Oti, N. 2001. Structural Stability and Carbohydrate Contents of an Ultisol under Different Management Systems. Soil Till. Res., **60**: 135-142.

[3]. Bandyopadhyay, K. K., Mohanty, M., Painuli, D. K., Misra, A. K., Hati, K. M., Mandal, K. G., Ghosh, P. K., Chaudhary, R. S. and Acharya, C. L. 2003. Influence of Tillage Practices and Nutrient Management on Crack Parameters in a Vertisol of Central India. Soil Till. Res., **71(2):** 133-142.

[4]. Black, C. A., Evans, D. D., White, J. L., Ensminger, L. E. and Clark, F. E. 1965. Methods of Soil Analysis. Part 2. Agronomy Monograph 9. ASA, Madison, WI.

[5]. Blake, G. R. and Hartge, K. H. 1986. Bulk Density. Part 1. In: "Methods of Soil Analysis", (Ed.): Klute, A. 2nd Edition, ASA, Madison, WI, PP. 363-375.

[6]. Bhushan, L. and Sharma, P. K. 2002. Long term Effects of Lantana (Lantana Spp. L.) Residues Additions on Soil Physical Properties under Rice-wheat Cropping. I. Soil Consistency, Surface Cracking and Clod Formation. Soil Till. Res., **65**: 157-167.

[7]. Cabangon, R. J. and Tuong, T. P. 2000. Management of Cracked Soils for Water Saving During Land Preparation for Rice Cultivation. Soil Till. Res., **56**: 105-116.

[8]. Chan, K. Y., Heenan, D. P. and Oates, A. 2002. Soil Carbon Fractions and Relationship to Soil Quality under Different Tillage and Stubble Management. Soil Till. Res., **63**: 133-139.

[9]. Facon, T. 2003. Water Management in Rice in Asia: Some Issues for the Future. FAO Corporate Document Repository, Regional Office for Asia and the Pacific.

[10]. Gee, G. W. and Bauder, J. W. 1986. Particle Size Analysis. Part 1. In: "Methods of Soil Analysis", (Ed.): Klute, A.. 2nd Edition, ASA, Madison, WI, PP. 383-411.

[11]. Girma, T. and Endale, B. 1995. Influence of Manuring on Certain Soil Physical Properties in the Middle Awash Area of Ethiopia. Commun. Soil Sci. Plant Anal., **26**: 1565-1570.

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