Review of Use of Marble Waste Powder And Ground Granulated Blast Furnace Slag With Black Cotton Soil

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Abstract- *The increased demand for soil bricks as a result of growing urbanisation may result in a scarcity of natural resources. As a result, the use of recycled materials in soil batching will assist to fulfil the needs of the moment without sacrificing the quality of soil. Marble Waste Powder (MWP), which is manufactured by marble companies during the cutting of marble stones, is one such waste material produced in India. The second type of waste is ground granulated blast furnace slag (GGBFS), which is generated by the furnace industry. In the ceramic business, around 20%-35% of output is wasted, which has a negative impact on the environment. This study examines the use of MWP and ground granulated blast furnace slag in soil bricks manufacturing, as well as their effects on various soil bricks qualities.*

Keywords- blast furnace, marble waste, cotton soil, strenth

I. INTRODUCTION

The black cotton soil is an expansive clay. The construction on expansive soil always creates a problem for civil engineers because of its swell and shrink behaviour. When the black cotton soil comes in the contact of water then excessive swelling is caused and when water content decreases shrinkage occurs in the soil. Because of this movement lightly loaded structures such as foundations, pavements, canal beds, linings, and residential buildings founded on them are severely damaged (Chen, 1988). It has been estimated that the annual damage to structural on expansive soil are $1000 million in USA, £150million in UK and $1000 million pounds in worldwide (Gourley et al., 1993). In India expansive soils covers about 0.8 × 106 Km2 area approximately 20% of surface area. The black cotton soil contains high percentage of montmorillionite mineral which imparts expansive behaviour to it. Disposal of waste materials generated from different industries causes many problems like environment pollution in the nearby locality, scarcity of land for disposal, etc. Industrial waste like blast furnace slag, fly-ash, silica-fume, rice husk ash and stone dust, etc., are considered as alternative materials for soil stabilization. The marble dust is generated from cutting and polishing of marble stone. The amount of marble slurry generated is very substantial, being in the range of 5-6 million tons per annum. This paper envisages the effect of marble dust powder on the index properties of black-cotton soil.

II. LITERATURE REVIEW

Touqeer Ali et al [1] Due to fast population expansion and growth in emerging nations like Pakistan, the output of industrial waste is increasing at an alarming rate. Stabilization of soil with industrial wastes not only makes good use of waste resources, but it also improves the overall cost-benefit ratio. The usage of ground granulated blast furnace slag (GGBFS) in the stabilisation of District KhairpurMirs' soil was attempted in this study. In general, there are naturally existing inappropriate soils in the building construction sector, such as foundations for structures, roadways such as subgrades as a foundation, and earthen dams as landfills. Different laboratory tests were performed on the soil of District KhairpurMirs, and the soil of District KhairpurMirs was determined to be rather inappropriate; as a result, various percentages of ground granulated blast furnace slag were added to make it suitable. Different percentages of slag are employed to enhance the concerned soil, and samples created in this manner were examined in the laboratory for this study endeavour. On controlled and stabilised soil samples, several laboratorial tests such as particle size distribution, Atterberg limits, Modified Proctor test, AASHTO soil classification, and CBR test were performed. The purpose of this study was to see how ground granulated blast-furnace slag (GGBFS) affected the index, compaction, and mechanical strength of natural KhairpurMirs' soil. Finally, laboratory testing revealed that GGBFS soil stabilisation improved the index, compaction, and strength characteristics of District KhairpurMirs soil.

Nguyen Nu Thiet. al. [2] GGBFS (ground granulated blast furnace slag) is a by-product of pig iron facilities that can be hazardous to land, soil, and water. As a result, research into

recycling GGBFS is critical. The use of GGBFS for soft soil improvement using the cement deep mixing method is described in this paper. GGBFS was used to substitute Portland cement from 0% to 100%, and 33 specimens were utilised to assess the unconfined compressive strength and deformation modulus of the treated soil. The experimental results showed that replacing GGBFS with 0-60% cement increased the treated soil's unconfined compressive strength and deformation modulus. GGBFS level of 30% of cement content was found to be optimal. In general, using GGBFS to improve soil properties could improve the properties of soft soil and cement-treated soil. The findings of this study will serve as a foundation for using GGBFS in ground improvement using the cement deep mixing method.

Uma.G.Hulluret. al. [3] India has a diverse range of soil types, with black cotton soils (BC soil) being one of the most important. Because of their complex behaviour, BC soils are rarely employed to support buildings or pavements. When saturated, BC soils have a relatively low bearing capacity and exhibit considerable swelling and shrinkage characteristics due to their increased degree of compressibility, resulting in settlements and, eventually, failure. However, because to a scarcity of space for our country's rising population, constructions supported on BC soil are required. As a result, stabilisation was used as an alternative way to improve the qualities and features of the BC soil in practise.

Rozan Abdulla and NadhmiahMajeedet. al. [4] Expansive soil produces major structural problems because it swells when it comes into touch with water and shrinks when it dries out. Soil stabilisation is a well-known approach for strengthening soil structures by enhancing the physical and technical qualities of the soil. By adding increasing proportions of marble dust (10, 20, 30 percent) of Penjwen, Said Sadiq, and Pirmam marble waste powder to expansive soil, the mechanical stability of different soils is assessed. Basic qualities like shear strength and consolidation factors including void ratio, compression index, and sample swelling index were determined. In the experimental programme, marble dust is obtained by cutting and grinding genuine marble from the Erbil marble industry. With an increase in the proportion of marble powder in swelling soils, adding marble dust lowers the swelling percentage. It is concluded that the swelling in Bastora soil is more than that of Erbil Airport soil, based on the swelling index studies.

Hassan A. M. Abdelkaderet. al. [5] During the cutting and processing stages, the marble processing sector in Egypt's Shaq Al-ouban region, which is located in East Cairo, creates a large amount of marble trash every day. Until now, the majority of these wastes have been dumped on open ground, causing considerable environmental issues. About 20 to 25 percent of the total treated stone is waste marble from the processing step. Egypt also has a problem with expanding soil, which covers a major portion of the country's land, particularly in the new towns that have been built on it. The primary goal of this research is to utilise this waste material in soil stabilisation, with the goal of using it as a local low-cost material and reducing its negative environmental implications. By dry weight of soil, the waste marble dust was combined with expansive soil samples in varied percentages of 5%, 10%, 15%, 20%, and 25% by dry weight of soil. For natural and marble dust stabilised soils, many tests were undertaken, including Atterberg's limits, standard Proctor compaction, unconfined compressive strength (UCS), California bearing ratio (CBR), swelling %, linear shrinkage (LS) tests, and XRF and XRD studies. The soil mixtures utilised in the UCS, CBR, and swell tests were compacted using the conventional Proctor compaction method and cured for 7 days at the optimum moisture content (OMC) and maximum dry density (MDD). The results of the testing revealed that increasing the characteristics of expansive soils has a substantial impact. The findings also revealed that as the quantity of marble dust in the plasticity index rises, the expansive clayey soil's swelling capacity diminishes. Furthermore, the maximum dry density increases while the optimal moisture content drops. In addition, as the amount of marble dust in the soil mixtures increases, so does the UCS, CBR, and calcite content.

Son Bui Truonget. al. [6] In Vietnam, soft soil is abundant, particularly around the shore. Soft soil, in engineering practise, cannot be utilised to create any structure and must be upgraded or treated prior to construction. Vietnam also has a large number of pig-iron or thermal power facilities, which create a large amount of granulated blast furnace slag each year (GBFS). As a result, the usage of this substance to enhance soft soil must be considered. The unconfined compressive strength (UCS) of three Vietnamese soft soils treated with Portland cement and Portland cement with ground granulated blast furnace slag is presented in this research (GGBFS). Binder dosages of 250, 300, and 350 kg/m3 were utilised in this investigation, with three different water/cement ratios of 0.8, 0.9, and 1.0, respectively. The UCS of soil-cement mixes is affected by soil type, water/cement ratio, cement type, and binder concentration, according to the findings. When a result, the unconfined compressive strength rose as the binder content, natural water content of soft soil, water/cement ratios, and clay content all decreased. The soil at Site II had the greatest value of UCS among treated soils, with Portland cement content, cement GGBFS, and water/cement ratio of 873 kg/m3, 2355 kg/m3, and 0.8, respectively. Furthermore, the water/cement ratio of 0.8 was shown to be adequate for reaching the greatest UCS

values of treated soil for all three soils and two binder types. The UCS of treated soil with cement GGBFS was similarly greater than that of treated soil with Portland cement, according to the findings. This demonstrated the efficacy of using Portland cement in conjunction with GGBFS to enhance soft soil. In Vietnam, there is a lot of opportunity for decreasing the environmental concerns caused by pig-iron manufacturing waste the construction cost as well.

AyhanGurbuzet. al. [7] Natural marble stone production produces a large amount of marble powder waste, which is often utilised as a building material. As a result, it is critical to make use of marble powder waste in order to reduce its negative impact on the environment while also gaining economic value. There are basically no research on the use of marble waste in the stabilisation of clayey soil during freeze–thaw effects in the literature. The usefulness of employing marble powder in the stabilisation of clayey soil in a road construction under freeze–thaw effects is evaluated in this study. Natural clay is combined with marble powder at various ratios, and the strength and durability of the mixtures are examined using unconfined compressive tests and mass loss during freeze–thaw cycles. When the marble powder concentration in the clayey soil approaches 10%, the unconfined compressive strength of specimens reaches a high, but the fluidity of mixes declines. At the end of freeze–thaw cycles, mass loss as a criterion for durability behaviour in marble powder-stabilized soils is over 5%. According to test results, marble powder might be employed as a freeze–thaw stabilisation material for clayey-type soils in sub-bases in highway building.

Kemal Aydinet. al. [8] The experimental investigation on fine-grained soil stabilisation utilising waste calcitice marble powder (CMP) and dolomitic marble powder is presented in this publication (DMP). Unconfined compressive strength (UCS) tests were performed on both pure and stabilised soil specimens with waste marble powder (MP) percentages of 5, 10, 20, 30, and 50 percent by weight. To evaluate the influence of curing duration and freezing–thawing on unconfined compressive strength (qu) and undrained elastic modulus, soil specimens mixed with two types of waste MP were cured for 7, 30, and 60 days and also exposed to 1, 3, 5, 7, and 11 cycles of freezing and thawing (Eu). Furthermore, during freezing–thawing cycles, mass losses (ML) of soil specimens were estimated. According to the test results, the values of qu and Eu of stabilised soil specimens increased significantly at 5% waste MP content, then declined as MP in highly plastic silt (MH) with a plasticity index of 21 increased. Depending on the waste marble type and content in both soil types of specimens, qu and Eu increased with curing time. The waste MP supplied fine-grained soils that were more resistant to freezing–thawing as a consequence of this investigation.

Anam Khanet. al. [9] The massive quantity of garbage that has accumulated is a source of concern for environmental safety since it impacts other hazardous concerns such as air pollution, land deterioration, and poisoning of water and soil through leaching. The most effective way to address such concerns is through effective recycling and solid waste management. The use of marble waste particles as reinforcement in the production of LDPE-MW (low density polyethylene-marble waste) composites by injection moulding has been researched. The mineralogical analysis of marble waste particles indicated the presence of dolomite (CaMg (CO3)2) and calcite (CaCO3) as significant minerals, with just a trace of quartz present (SiO2). Thermal and FTIR examinations of marble waste particles yielded similar findings. The density is 1.49 0.007 g/cc, and the porosity is 35 1.85 percent. The pH was set to 7.86 0.003 and the electrical conductivity was set to 3.78 0.061 mS/cm. The FE-SEM study revealed that the morphology of marble waste particles was uneven. Mechanical parameters of LDPE-MW composites such as tensile strength, tensile modulus, flexural strength, flexural modulus, and impact strength were determined. It was also observed that the thermal conductivity of LDPE-MW composites was high. The results revealed that including roughly 50% marble waste particles resulted in the greatest improvement in strength and thermal conductivity. The current study's findings revealed that there is significant potential for large-scale recycling of marble waste in the production of LDPE-based hybrid materials, which leads to the development of new applications such as architectural cladding wall panels, electrical insulating floor tiles, and damping pads.

Muhammad Sufianet. al. [10] Marble is today a widely utilised building material, and environmental deterioration is an unavoidable by product of its use. Marble trash is produced during the mining of resources employing shooting technology. The resulting components frequently have uneven geometry and tiny size, excluding them from usage in the stone industry. There is no systematic method of disposing of these vast heaps of rubbish, resulting in landfills and environmental damage. To address this issue, an attempt was made to mix discarded marble powder into clay bricks. Different percentages of marble powder, ranging from 5 to 30%, were investigated as a partial alternative for clay. A total of 105 samples were made in order to evaluate the prepared marble clay bricks' water absorption, bulk density, apparent porosity, salt resistance, and compressive strength. The resulting bricks were 1.3–19.9 percent lighter than standard bricks. The bricks containing 5–20% marble powder showed

appropriate compressive strength in comparison to the values needed by international standards. With increasing marble powder content, their compressive strength and bulk density fell but their water absorption capacity and porosity improved. The empirical equations developed agreed well with the experimental data. The use of leftover marble powder in the building sector not only saves project costs, but it also minimises the possibility of soil erosion and water contamination. This is a critical determinant for economic growth in agricultural output.

WojciechSaset. al. [11] The growing need for construction materials in the road industry raises the prospect of a new supply of high-quality aggregates. More emphasis is being placed on anthropogenic soils and industrial solid wastes in order to safeguard natural resources. A range of geotechnical and environmental tests must be performed before these types of soil may be used successfully. The migration of heavy metals into the groundwater environment is a possible concern in the reuse of wastes from thermal deterioration in the building sector, notably in reinforced concrete (RC) construction. A geotechnical examination of blast furnace slag (BFS) qualities is described in this article. To assess the viability of BFS use in earth construction, we conducted a series of CBR and oedometric experiments. The compression properties of the oedometric test findings are satisfactory, falling within the range of natural aggregates. According to the CBR, this material can be utilised as a pavement subbase. During the oedometric test, we also observed the preconsolidation pressure anomaly in both Proctor and vibro-compacted soil. The compression index and recompression index values indicate that the compression properties are similar to those of dense sand. Based on the findings discussed in the article, blast furnace slag is a candidate for technological use and has the potential to become a component of sustainable development by reducing the negative environmental effect of building material production and usage.

Darius Žurinskaset. al. [12] There have been several research on the use of alkali activated binders to enhance the mechanical characteristics of clayey soils. Alkali activated slag (AAS) was employed in this study to increase clayey soil strength, and it strengthened the clay. The findings of an inquiry into the use of ground-granulated blast-furnace slag in the reinforcing of clay soils are presented in this publication. As a result, employing alkali activated slag as a binding material might result in considerable cost reductions. Following curing, these samples were subjected to X-Ray fluorescence analysis (XRF), X-Ray di raction (XRD), scanning electron microscopy (SEM), and strength testing. When compared to the unreinforced samples, the AAS-reinforced clay samples had greater shear stress, cohesiveness, and internal friction angle. The highest shear strength was achieved by using the highest amount of AAS (30%). This shear stress of the unreinforced clay samples could be increased from 63.2 to 137.4 kPa (117.4%) and from 123.2 to 257.4 kPa (108.9%) when the normal stress value of 100 and 500 kPa was used, respectively. The increase in shear strength is closely related to the compact contact zone between AAS and clay. Moreover, the new formed cementitious compounds of AAS had a positive influence on the shear strength of samples as well.

PayalBakshiet. al. [13] Large amounts of marble trash are created by marble processing machines and discharged onto open land regions. This causes environmental issues by polluting soil, water, and air, which has a negative impact on the health of all living species. In this paper, we discuss how to employ calcium-rich marble waste particles (MPs) as inexpensive reinforcement in recyclable polypropylene (PP) to create sustainable composites using the injection moulding process. The technique was refined to create lightweight, thermally insulated, sustainable composites. The processed marble waste particles were subjected to extensive physicochemical, mineralogical, and microscopic characterisation. Following that, composite samples were made using the injection moulding process with various filler concentrations (0 percent, 20%, 40%, 60%, and 80%) on weight fraction at temperatures of 160, 180, and 2000C. The mechanical and thermal characteristics of the produced composites were thoroughly examined. The density of the composites ranged from 0.96 to 1.27 g/cm3, with a very low water absorption capability of 0.006–0.034 percent. The tensile and flexural strength of the sustainable composites were found to be significantly increased by marble waste particles, ranging from 22.06 to 30.65 MPa and 43.27 to 58.11 MPa, respectively, for a moulding temperature of 160 0C. The impact strength of the sustainable composites was observed to increase with filler concentration, with the greatest impact strength being 1.66 kJ/m2 with 20% particles reinforcement at a moulding temperature of 200 0C. The thermal conductivity of the particulates-reinforced sustainable composites was as low as 0.23 W/mK at a 2000C moulding temperature with 20% and 40% filler concentrations, and it reached a maximum of 0.48 W/mK at a 160 0C moulding temperature with 80% filler concentration. Our findings have shown a technically feasible option for manufacturing a lightweight composite with better mechanical and thermal properties using marble waste particulates as a potential civil infrastructural material.

Osman Sivrikayaet. al. [14] Geotechnical engineers are still researching the recycling of waste marble powder (MP) for soil stabilisation in order to improve weak soil

qualities. The influence of calcitic marble powder (CMP) and dolomitic marble powder (DMP) on the geotechnical characteristics of fine-grained soils was examined in this work. To investigate the efficiency of employing waste marble powders in soil stabilisation, consistency limits, linear shrinkage, expansion index, and one-dimensional consolidation tests were performed on non-stabilized and stabilised samples containing 5, 10, 20, 30, and 50% waste CMP and DMP. For both MH and CH samples, the marble powder ratio that produced the greatest results was discovered to be 50%. The laboratory test results revealed that the waste marble powders were effective in soil stabilisation by lowering the plasticity index from 49 to 26 for the CH samples and from 21 to 9 for the MH sample, the expansion index from 45 to 20 for the CH sample and from 32 to 7 for the MH sample, the swelling index from 0.0030 to 0.0012 for the MH sample, the compression index from 0.013 to 0.010 for the MH sample, and the linear shrinkage from 16.2 to 10.5 for the CH In soil stabilisation based on volume change, the waste MP content and fine-grained soil type must be considered.

PartabRaiet. al. [15] The impact of waste marble powder and magnesium phosphate cement on soil parameters were explored in this study. The use of waste marble powder (MP) and magnesium phosphate cement (MPC) as a new ingredient has resulted in substantial environmental and economic benefits to soil stabilisation. Specific gravity, Atterberg limits, sieve analysis, unconfined compression strength test, Direct shear box test, modified Proctor test, California bearing ratio, and Scanning electron microscopy test were performed on soil samples prepared with different percentages of MPC and MP, i.e. 0 percent, 2.5 percent, 5 percent, 7.5 percent and 0 percent, 5 percent, 10 percent, 15 percent, respectively. Following 7, 14, and 28 days of curing period, an unconfined strength test was utilised to acquire the requisite comprehensive strengths. The total experimental findings suggested that MP and MPC may be introduced to improve soil stability. While usabilityand effectiveness of MPC and MP are cost-effective and eco-friendly as the substitution of natural soil for deep foundations.

Mohamed A. H. Sakret. al. [16] The purpose of this paper is to reduce and detect the environmental impact of radioelement concentrations and waste marble powder (WMP) in the surrounding environment, as well as to improve the characteristics of the expansive soil and investigate the effect of stabilisers on the swelling soil in order to use it as a foundation layer. To determine the physical and mechanical properties of typical clay samples, several geotechnical laboratory experiments were undertaken. The swelling pressure and swelling potential are lowered from (805.7 to 576 kN/m2) and (15.78 to 7.11 percent), respectively, according to the data. By adding leftover marble powder, the plasticity index reduced from 35.9 percent (high plasticity) to 19.4 percent (low plasticity), and the free swell index became zero. Geospatial approaches were also employed to create distribution layers with various geotechnical properties and radioelement concentrations. These layers were combined to create a geographic model. This model demonstrated a significant improvement in the characteristics of clayey soils with the addition of waste marble powder, which varied from low to high expansion. The radioelement concentrations in all samples are within an acceptable limit, with the exception of 40K, which is beyond the allowed range. WMP should be replaced at a rate of 40%, according to this study. This amount is appropriate and cost-effective for this type of treatment due to its beneficial solutions to protect the environment from pollution and minimise building costs.

III. CONCLUSION

The present study reviewed the effect of use of ground granulated blast furnace slag and marble waste dust in the soil. The detail review shows that the use of ground granulated blast furnace slag on soil helps to improve the engineering properties of soil i.e. compressive strength, split tensile strength, atterberg's limit etc. Similar effects can be seen by addition of marble waste dust in soil. From study it was also observed that there are very less findings on use of combination of Marble Waste Powder and ground granulated blast furnace slag together in soil. Therefore, this review proposed to study the effect of different composition of Marble Waste Powder and ground granulated blast furnace slag with soil.

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