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COMPARATIVE STUDY OF SOIL STABILIZATION WITH GLASS POWDER, SCRAP RUBBER TIRES & SEA SAND: A REVIEW

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ABSTRACT: The soil is an essential component of every construction project. Understanding the soil's characteristics and how it acts requires research and study. When utilised as a subgrade for pavements, expansive soils, such as black cotton soils, cause problems due to their high upward pressure and the fact that their volume increases by 20% to 30% to its original volume. When the pressure increases to a certain point, it has the tendency to raise the foundation. Fractures in the upper structure are caused by this backpressure in the foundation. At their base, the fissures are rather shallow, but they enlarge as they ascend. Building foundations and road pavements cannot be supported by these. Their Unconfined Compression Strength Values and California Bearing Ratio are Lower. and With the ever-increasing demand and necessity, stabilising these sorts of soils is now the greatest difficulty. Here, a wide range of additional ingredients are used to enhance the soil's characteristics. In this review article, we will look at ways to stabilise black cotton soil using waste products like glass powder, scrap tyre crumbs and rubber, all of which are byproducts of our increasingly industrialised society. Natural waste products, such as sea sand, are also being investigated for potential use in stabilisation, in addition to these waste materials. This is accomplished by reviewing prior research and comparing the findings of several soil laboratory tests, such as the Atterberg limits, California Bearing Ratio test, Unconfined Compression Strength test, etc., with the guidelines that have been stated.

INTRODUCTION

Urbanisation and industrialization are expanding at a fast pace to accommodate the world's growing population. This led to an increase in building projects. Buildings are rising vertically, thus finding a suitable location is becoming more important for this reason. The soil is an essential component of every construction project. Understanding the soil's characteristics and how it acts requires research and study. The building conditions of certain soils may not be suitable for others. Other types of soil, such as expansive soils, are found all over the planet, and in certain regions of several countries, they are very weak. For Civil Engineering projects, certain types of soils provide an issue. Weaker soils cannot support the large loads that would be present during and after construction, according to earlier research. Soil stabilisation is therefore an absolute need for these types of soils in order to achieve the building necessities. The use of stabilising chemicals may strengthen poorer soils, according to new research.

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Worldwide, trash production is skyrocketing as a result of expanding metropolitan areas and manufacturing facilities. The three main types of trash generated are used rubber tyres, fly ash, and powdered glass. A larger proportion of these wastes are produced by India as well. Constant production of these wastes leads to enormous dumps, according to recent survey reports from the Indian government's environmental committee. They are biodegradable, for the most part. Extreme harm to ecosystems, human health, and animal welfare results from these wastes' incorrect management and disposal. Therefore, efforts are being undertaken to use these waste elements into building operations as stabilising agents in order to lessen their influence on humans. Recent investigations have shown that waste products are being employed as soil stabilising agents. Using case studies pertaining to the utilisation of waste materials in soil stabilisation, this inquiry compares approaches to using waste materials to improve soil qualities in the realm of civil engineering.

I. LITERATUREREVIEW

1) Rizgar A. Blayia et al, Department of Civil Engineering, Faculty of Engineering, SoranUniversity, Soran, Kurdistan Region, Iraq, Reported that the Expansive soils expand and losetheir strength when wetted and shrink when dried, and this makes a considerable volume change.Therefore, the improvement of expansive soils is crucial, especially for road construction. Thestrength improvement of these types of soils can be gain by adding waste glass powder (WGP)was selected for their study. The WGP was crushed and mixed with the soil sample with variouspercentages by the dry weight of the soil. The soil sample was taken from Hamilton Soran-Jundean road in Soran city/Iraq at about 1 m–2.7 m depth. According to the gradation curve ofthe soil, about 47 % of the soil is clay, and 82 % of WGP is silt where WGP works as an innermaterial, and the ability of water absorption of WGP particles is less than clay particles. Thestudy reflects that the majority percentages of WGP consist of silica, which is about 72 %. As aresult of that, a portion of the expansive soil replaced with non-plastic material; therefore, the LLwas reduced and the PL was slightly changed (from 24.81 % to 16.44 %). As a result the PI wassignificantlydecreasedfrom19.39%to5.84%%,andtheLSwasreducedfrom9.17%to2.63 % when the WGP added up to 25 % by dry weight of the soil.

Thevarioustestswereconductedandaretabulatedasfollows:

Specimens	UCS(kPa)	OMC(%)	MDD(g/cm3)	FS(%)	CBR(%)
Untreatedsoil	205.01	18.5	1.74	5.28	4.5
Soilwith 2.5%of WGP	216.62	18.15	1.77	5.06	5.6
Soil with 5 % ofWGP	242.8	17.7	1.81	4.63	7.2
Soil with 10 % ofWGP	305.4	16.85	1.87	3.65	9.9
Soil with 15 % ofWGP	36.01	15.93	1.94	2.69	12.2
Soil with 25 % ofWGP	332.54	13	1.9	0.88	10.8

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Research shows that with higher concentrations of WGP, Atterberg's limits are lowered. Up to 25% WGP reduced the free swelling of expansive soil, both untreated and treated. As WGP was added to the samples, the Optimal Moisture Content fell and the Maximum Dry Density rose by 11.5%. As the percentages of WGP grew up to 15%, the UCS values evaluated increased by about 75.6%; however, at 25% of the WGP, the values declined by 7.7%. The results of the direct shear tests reveal a 61% increase in the angle of internal friction. However, according to the data presented in the tests, the cohesiveness of mixes drops by 19% as the amount of WGP increases up to 25%. With a 171 percent rise in CBR values and a 15 percent increase in WGP percentages added to the CL, a decent reduction was then seen. Because the expansive soil's geotechnical qualities continue to decrease beyond this level, the ideal weight-for-grade (WGP) percentage for increasing CL is about 15% by dry weight of the soil sample.

The mechanical properties of scrap tyre crumb-clayey soil mixtures were determined by a team of researchers from China's Shandong University of Science and Technology and Fuzhou University. The researchers used laboratory tests like the Proctor compaction, direct shear, cyclic direct shear, consolidation, and unconfined compression tests. Researchers in China found that 600 million tyres were discarded in 2015, with an additional 200 million tyres sitting in storage. Not only that, but other nations also produced massive amounts of discarded tyres. Land filling or hoarding old tyres can lead to a host of environmental issues, including overcrowding in already-populated areas, potential health risks from insects and rodents, and air pollution from fires that could break out due to the accumulation of tyres. Research using waste tyre crumbs ranges in diameter from half a millimetre to four and a half millimetres. For this research, researchers utilized10%,20%, and 30% CSTC, or scrap tyre crumbs.

We spoke about how the CSTC changed the mixes' mechanical characteristics. Tests conducted in accordance with ASTM C127 (2007) found that the specific gravity of tyre debris was 1.15. Findings indicate that mixes with a higher percentage of scrap tyre crumbs have a lower maximum dry unit weight and an optimal moisture level, suggesting that they might be useful as a lightweight filler. The shear strength of mixtures increases by about 20% when CSTC is up to 30%, while the residual strength decreases by about 15%, compared to pure clayey soil. It is not possible to prepare the mixture when CSTC exceeds 30% because cracks appear in the mixture after it is removed from the mould. If the shear stress is large and the vertical pressure is low, the mixes will dilate during shearing. As CSTC increases, the maximum dry unit weight and optimal moisture content of the combinations also decrease.

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The mixes' direct shear strength grows as the vertical pressure rises and falls as the shear rate falls for a certain CSTC. In addition, shearing causes the mixes to dilate, especially when the CSTC is high and the vertical pressure is low. As the CSTC rises, the consolidation settlement, compressive strength, and residual shear strength all fall dramatically; at 20% and beyond, they begin to fall marginally. Additionally, as compared to pure clayey soil, a combination of scrap tyre crumbs and clayey soil had better shear strength, lower density, and less consolidation settling as CSTC increases. The combination has a wide range of geotechnical uses, including embankments on soft compressible soil and backfills behind retaining structures.

3)An experimental programme was conducted by M. Ismeik et al. to assess the potential of using sea water as a stabilisation agent to enhance the geotechnical qualities of low-quality soils found in coastal areas. In order to determine the possible degrees of improvement achieved by using sea water, both natural and stabilised soils were subjected to a battery of laboratory experiments. These tests included Atterberg limits, compaction, and unconfined shear strength. Soil stabilisation by salt water improved engineering characteristics, as shown by the findings. A decrease in the plastic limit and an increase in the liquid limit made soils less plastic. Maximum dry unit weight rose and optimal moisture content dropped when compaction settings were adjusted. Additionally, the values of the unconfined compressive strength were enhanced. Using water from the Dead Sea improved soil categorization. Due to its higher salinity, the stabilising advantages of Dead Sea water were often greater than those of Red Sea water. These results show a lot of promise and may be utilised to improve the geotechnical qualities of poor soils used for pavement systems or foundations by adding salt water. In situations when regular water is unavailable or too expensive to carry, this becomes crucial for reducing the impact of soil geotechnical features. Furthermore, compared to more costly traditional methods of soil restoration, improving soils with saline water may have significant economic and environmental benefits.

II. CONCLUSION

Using different percentages of waste materials (e.g., glass powder, scrap rubber tyres, and salt water) to stabilise soil is examined in this research, along with a comparison of the soil's many engineering qualities. After reviewing many studies, we came to the following conclusions:

• By incorporating various waste elements into the soil in varying amounts, the engineering qualities of expansive soils may be improved to a certain extent, resulting in soils with sufficient constructional strength.

• It is clear from this research that the improvement in several technical qualities was achieved at intermediate waste material mixing amounts.

Improper processing and disposal of contemporary wastes causes tremendous difficulties for the

environment, human life, and animal life; however, efficient and appropriate use of these wastes lowers these impacts.
• The materials that were examined here—used glass powder, scrap rubber tyre chips, and sea sand—are not only inexpensive but also readily accessible.
• These materials may be used as a substitute for traditional soil stabilisers.

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