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GEOPHYSICAL USE OF QUARRY DUST (AS ADMIXTURE) AS APPLIED TO SOIL STABILIZATION AND MODIFICATION-A REVIEW

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ABSTRACT

The availability of build able land is fast drifting away each day due to scarcity of lands with good natural bearing capacity. This leads to construction of buildings on poor soils which eventually lead to structural foundation failures. It has become very imperative to improve soils or the quality of grounds by the adoption of suitable improvement methods depending on the materials available. However, during soil or ground improvement, cost effectiveness is one of the major factors considered cardinal. Consequent upon this, there is a paramount need to adopt the use of admixtures during cement/soil improvement or stabilization. This necessitated the review on a very important admixture in geotechnical engineering and in cement stabilization of soils during pavement construction. However, quarry dust which is a waste product from aggregate production could replace some proportions of sand/soil. This admixture not only replaces some proportions of soil for cost effective soil improvement but according researches carried over the years on this waste product, improves the geophysical properties of the joint mixture; cement/soil/quarry dust. Since the introduction of quarry dust improves the engineering behavior of soils, this review work exposes those qualities and applications that make quarry dust a good replacement or admixture during soil improvement and for a more economic approach. The present review also gives researchers and geotechnical engineers a clue on the application of quarry dust and the limit for its usage.

Keywords: geophysical review, modification, soil, quarry dust, admixture, stabilization.

INTRODUCTION

The technique of soil stabilization is usually adopted with the purpose of rendering plastic soils coherent to the standards and requirements of engineering projects.

A variety of ground improvement technique have been developed and successfully applied in several areas. The selection of appropriate ground improvement technique depends on the soil that is to be treated, the availability of materials required and economic viability. All the techniques basically involve introduction of different material in the soil deposit.

Quarry dust/crusher dust is obtained as soil solid wastes during crushing of stones to obtain aggregates.

Now a day's different types of materials like lime, cement, fly ash etc. are used. Quarry dust exhibits high shear strength which is highly beneficial for its use as a geotechnical material Soosan *et al*. (2001a). It has a good permeability and variation in water content does not seriously affect its desirable properties.

Quarry dust can be used as a substitute for sand to improve the properties of lateritic soil Soosan *et al*. (2001b). Sridharan *et al*. (2005), conducted studies on the effect of quarry dust on the geotechnical properties of soil used in highway construction and concluded that the CBR value steadily increased with increase in percentage of quarry dust.

And the improvement in CBR value can be contributed to the significant improvement in angle of shearing resistance. Higher CBR values of soil-quarry dust mixes enhance their potential for use as a subbase for flexible pavement.

Quarry dusts are considered as one of the well accepted as well as cost effective ground improvement technique for weak soil deposits. They provide the primary function of reinforcement and drainage, and thus improve the strength and deformation characteristics of weak soil deposits.

Sridharan *et al*. (2006) conducted studies on the shear strength of soil-quarry dust mixtures. The results showed that the quarry dust proved to be a promising substitute for sand and can be used to improve the engineering properties of soils. The dry density increased with the addition of quarry dust with attendant decrease in the optimum moisture content.

EFFECT OF QUARRY DUST IN LATERIZED CONCRETE

Laterized concrete is defined as concrete in which stable laterite fine replace aggregate (i.e., Sand) Salau (2008).

Adepegbo (1975), was identified as the first to study the effect of using laterite as fine aggregate in concrete and also be compared resistance to high temperature, modulus of elasticity and compressive and tensile strength of Laterized concrete mixes (1:2:4, 1:1.5:3 and 1:1:2 by weight) with that of normal concrete. He concluded that for high strength and workability only 25% percent of sand in concrete should be substituted with lateritic fine, while the mix ratio should be 1:1.5:3 (Cement: sand/laterite: granite) with a water/cement ratio of 0.65.

According to Osunade (2002), laterized concrete is concrete in which the fine aggregates are lateritic soils.

Laterite is a mixture of clayey iron and aluminum oxides and hydroxides formed as a result of the weathering of basalt under humid, tropical conditions. It is readily available in all parts of Nigeria.

The quest of having concrete which is cheaper has prompted many researchers to work on Laterized concrete. Different properties of Laterized concrete have been considered at all different stages with far reaching recommendations in favor of laterite as suitable for use in the construction industry.

Working on shrinkage deformations of Laterized concrete, Salau *et al*. (1998), recommended that Laterized concrete with up to 25% laterite content of the aggregate could be used in load-bearing structural elements. It was also found in another work by Balogun *et al*. (1982), that the most suitable mix for structural application of Laterized concrete was 1:1.5:3 with about 0.65 water/cement ratio provided that the percentage of laterite content was kept below 50%. They asserted also that compressive strength of not less than 25N/mm^2 was obtained at 28days for the mix with laterite content of about 25-50%.

Efe *et al*., (2010), showed that normal concrete cannot withstand appreciable load above 250°C while laterised concrete with 25% laterite in the fine aggregate is able to resist higher load with increase in age and at temperature up to 500°C. They achieved compressive strength of up to 30.44N/mm^2 for Laterized concrete with 25% laterite and 75% sand at 500°C. They also observed that there is economic saving if Laterized concrete is used in areas of high temperature up to 500°C. This differs from the findings of Udoeyo *et al*., (2010a) that the strengths of Laterized concrete and normal concrete decreased in a similar manner when subjected to elevated temperatures of between 200°C and 600°C.

Udoeyo *et al*. (2010b), also found that the workability of laterized concrete increases with laterite content with slump values ranging from 2-20mm, while the water absorption showed a reverse trend, i.e., decrease with increase in laterite content.

Salau (2003) observed that there were not many variations between the creep deformations of Laterized concrete and normal concrete short columns and he further recommended 25% laterite content of the aggregate for long-term resistance and usage in load-bearing short column.

USES OF QUARRY DUSTS IN SOIL STABILIZATION

The use of quarry dust is to ensure economic stabilization of soil and also used under flexible pavements to increase the load carrying capacity of the pavement by distributing the load through a finite thickness pavement Eze-Uzoamaka and Agbo (2010)
The quarry dust can be used to know the compressive and tensile strength of the stabilized soil.

The effect of quarry dust on the stability of soil-aggregate mix used in a base course and summarizes that the quality of quarry dusts in a soil=aggregate mix has a major influence on maximum density, strength, frost resistance and drainage.

CONCLUSIONS

For safety of constructing it is necessary to improve the quality of ground by adoption of some suitable ground improvement materials and techniques.

The method of ground improvement technique adopted depends on the soil to be treated and availability of materials required for improving the soil and also on the cost effectiveness.

The use of quarry dust in soil stabilization is to improve engineering properties of soil.

Quarry dusts are considered as one of the well-accepted as well as cost effective ground improvement for the stabilization of weak soil deposits.

When quarry dust is added with expansive soil it is expected that it will make it more porous, less durable, reduce cohesion etc, and also quarry dust has rough, sharp and angular particles and as such causes a gain in strength due to better interlocking.

RECOMMENDATIONS

The followings are recommendations to the crushed stone industry regarding the use of quarry dusts in soil stabilization.

Before use of stabilized quarry dusts as a base material, it must be determined whether it can perform under durability restraints of freeze, thaw, shrinkage, moisture etc.

REFERENCES

Adepegba D. 1975. The effect of water content on the compressive strength of Laterized concrete. Journal of Testing and Evaluation. 3: 1-5.

Balogun L. A. and Adepegba D. 1982. Effect of varying Sand content in Laterized concrete. International Journal of Cement and composite and lightweight concrete. 4: 235-240.

Efe E. I. and Salau M. A. 2010. Effect of heat on Laterized concrete. Maejo International Journal of Science and Technology. 4(1): 33-42.

Eze-Uzoamaka O.J. and Agbo D. 2010. Suitability of Quarry Dust as Improvement to Cement Stabilized-Laterite for Road Bases. EJGE. 15(K): 1053-1066.

Osunade J. A. 2002. Effect of replacement if lateritic soils with granite fines on the compressive and tensile strengths of Laterized concrete. Building and Environment. 37(5): 491-496.

Salau M. A. 2003. Long-Term deformations of Laterized concrete short columns. Building and Environment. 38(3): 496-477.

Salau M. A. 2008. Abunndaant Local Structural Engineering Materials without Affordable structures. An inaugural lecture delivered at the University of Lagos, Nigeria 23rd April.

Salau M. A. and Balogun L. A. 1998. Shrinkage Deformations of Laterized Concrete. Building and Environment. 34(2): 165-173.

Soosan T. G., Jose B. T. and Abraham B. M. 2001a. Improvement of ground and highway sub-bases using quarry waste. Proceedings of international Seminar on Civil Engineering, ICCE, IISc. Bangolore. pp. 730-737.

Soosan T. G., Jose B. T. and Abraham B. M. 2001b. Use of quarry dust in Embankment and Highway Construction. Proceedings of Indian Geo-technical Conference, December, Indore. pp. 274-277.

Sridharan A. and Soosan T. G. 2005. Utizilation of quarry dust to improve the Geotechnical properties of soils in Highway construction. Canadian Geotechnical Journal. 28: 391-400.

Sridharan A. and Soosan T. G. and Babu T. J. 2006. Shear strength studies on soil-Quarry dust mixtures. Journal of Geotechnical and Geological Engineering. 24: 1163-1179.

Udoeyo F. F., Brooks R., Udo-inyang P. and Canice I. 2010a. Residual Compressive Strength of Laterized Concrete Subjected to Elevated Temperatures. Research Journal of Applied Sciences, Engineering and Technology. 2(3): 262-267.

Udoeyo F. F., Brooks R., Udo-inyang P. and Ukpong E. C. 2010b. Effect of non-standard curing methods on the compressive strength of laterized concrete. ARPN Journal of Engineering and Applied Sciences. 5(2): 6-20.