ASSESSING QUARRY DUST AS A POSSIBLE REPLACEMENT OF RIVER SAND IN HOLLOW BLOCKS

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Abstract: This research was carried out to investigate the effect of replacing river sand with quarry dust. 45 numbers of 450 x 225 x 225 mm of hollow blocks with 0, 25, 50, 75 and 100% quarry dust replacement were produced and tested for compressive strength at 7, 14 and 28 days and also for density and water absorption at 28 days, respectively. Experimental results shows that replacement of river sand with quarry dust improves the performance of the sandcrete blocks at all ages, as increase in compressive strength and density were observed while there was considerable reduction in water absorption.

Keywords: Sandcrete blocks, quarry dust, compressive strength, block density

Introduction

Sandcrete blocks are walling materials made of fine aggregates (river sand) or crushed rock dust mixed with cement in certain proportion and water, and moderately compacted into shapes (Tyagher *et al*., 2011). Sandcrete Blocks are used extensively in virtually all African countries including Nigeria. Their use and associated popularity necessitated the attention given to them by various researches (Mohammed & Anwar, 2014; Odeyemi *et al*., 2018; Olufisayo, 2013).

Sandcrete blocks have been generally accepted to the extent that when an average individual thinks of building, the default mindset is the use of sandcrete hollow blocks. Sand, the main constituent of sandcrete block, is a natural product obtained from riverbeds, the mining of which is expensive. River sand particles are fine, but likely to vary in size and it is most suitable for plastering work. Erosion sand is similar to river but coarser than river sand. It is cheaper than river sand and has higher crushing strength because of its coarse nature (Uzomaka, 1977). Quarry dust is a by-product of the rock quarrying process whose size ranges from below 63 micrometers to 5 millimetres. Various researches showed that quarry dust can be effectively used in concrete as sand partial replacement (Balamurugan & Perumal, 2013; Chauhan & Bondre, 2015; Karthick *et al*., 2014; Shweta *et al*., 2017; Shyam & Rao, 2016).

The present research work mainly deals with the influence of different replacement proportion of river sand with quarry dust in making sandcrete block.

Material and Method

Materials

The quarry dust used in the research was obtained from quarry site produced by Dantata and Sawoe Construction Company, Dutse Site in Jigawa state, Nigeria; it has a specific gravity of 2.49. River sand was obtained locally along river Wudil bank and allowed to dry; it has a specific gravity of 2.05. Water used for both mixing and curing was ordinary tap water, which is fit for human consumption in accordance with (BS-EN1008, 2002). Cement used in the study was Dangote Portland limestone cement which conforms with (NIS-44., 2003).

Methods

Sieve analysis for river sand and quarry dust

Particle size distribution test was done on both the River sand and the quarry dust in accordance with (BS882, 1983).

Sandcrete block production

450 x 225 x 225 mm hollow blocks were produced and used for this research. The constituent materials include cement, sand, quarry dust and water. A standard mix ratio of 1:6 was used, that is one part of cement to six parts of aggregates. The blocks were moulded manually. This involves mixing the required materials (cement and sand), then followed by addition of calculated amount of water. The river sand was replaced by 25, 50, 75 and 100% quarry dust using the same mix ratio. A total of 45 blocks were produced and tested for compressive strength, water absorption and density after 7, 14 and 28 days curing.

Compressive strength test

The compressive strength of the block samples was determined in accordance with (BS2028, 1968). To determine the blocks density, the weights of the block samples were taken before the compressive strength test was conducted. Three sample blocks were crushed each at 7, 14 and 28 days after casting at different replacement levels using compressive testing machine.

Water absorption test

The water absorption test was conducted on the block samples in accordance with NIS-87 (NIS-87, 2004) at 28 days.

Results and Discussion

Sieve analysis

The result of the sieve analysis for the river sand and the quarry dust is shown in Fig. 1. The particle size distributions of both the river sand and the quarry dust were found to fall within the limits of grading zone 2 of (BS882, 1983). Therefore they are suitable for making sandcrete blocks.

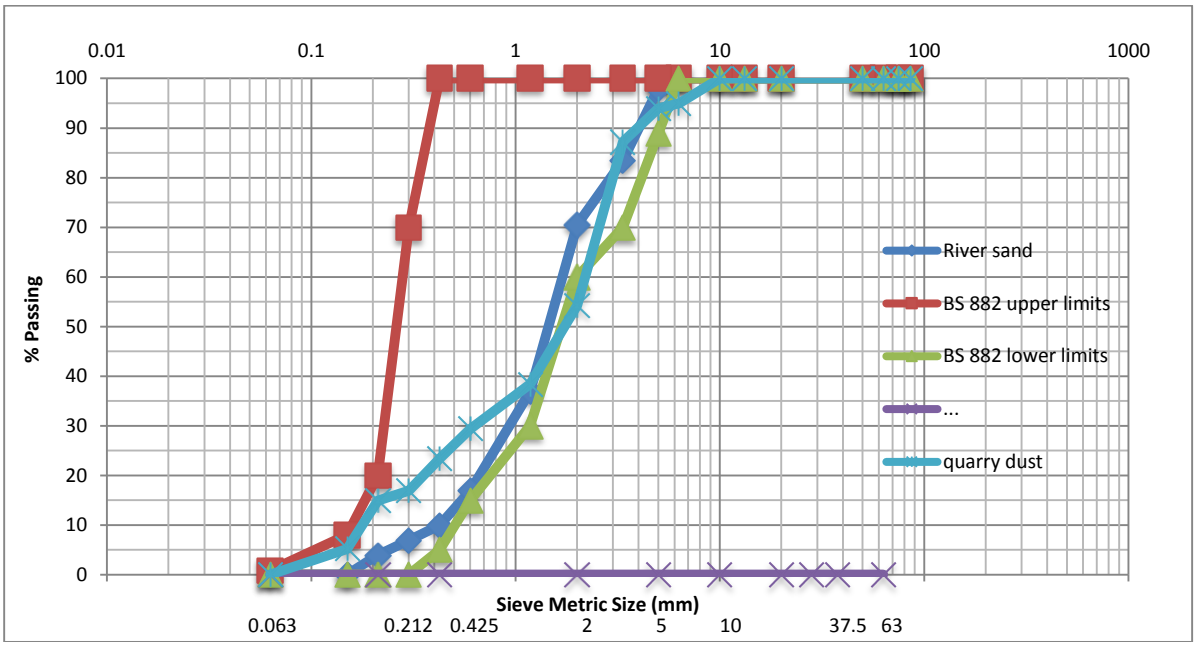

Fig. 1: Particle size distribution of river sand and quarry dust

Compressive strength

The result for the compressive strength for all the blocks is presented in Fig. 2. The compressive strength increases with increase in quarry dust replacement. The compressive strength of the specimens containing quarry dust at all replacements and all ages are better than the control specimen (0%). According to NIS 87 (NIS-87, 2004), the average minimum compressive strength of load bearing hollow blocks for hand compaction is 2.0 N/mm^2. In view of this, all the specimens containing 50, 75 and 100% quarry dust replacement performed better.

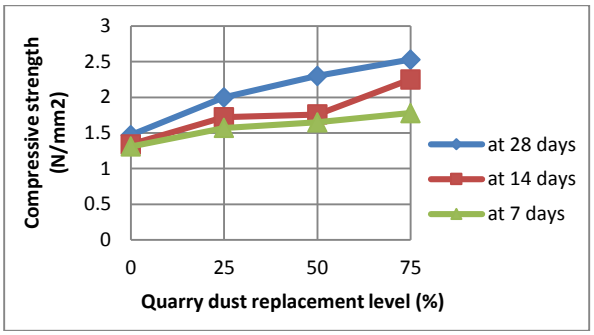

Fig. 2: Effect of quarry dust replacement level on compressive strength

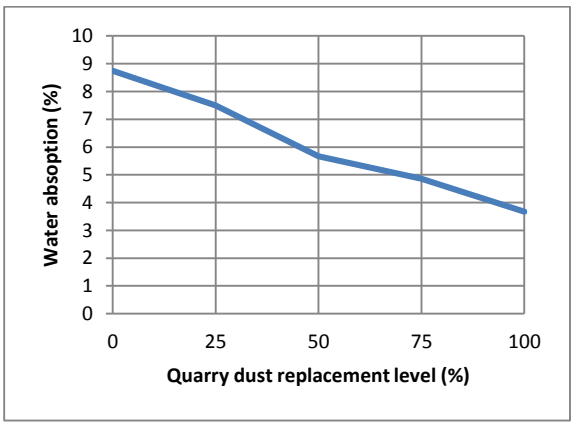

Fig. 3: Effect of quarry dust replacement level on water absorption

Water absorption

The effect of river sand replacement with quarry dust on Water absorption of the sandcrete blocks is presented in Fig. 3. The result shows a considerable decrease in water absorption with an increase in percentage of replacement, this shows that quarry dust absorb less water than river sand which is the material been replaced. The amounts of water absorbed by the blocks are within the limit specified by the code (NIS-87, 2004) (i.e. absorbed water shall not exceed 12% of the dry mass).

Density

The effect of river sand replacement with quarry dust on density test of the sandcrete blocks is presented in Fig. 4. It can be seen that density of the block increases as the percentage of replacement increase. This could be attributed to the difference in the weight of the materials (the specific gravity of quarry dust is more than that of river sand).

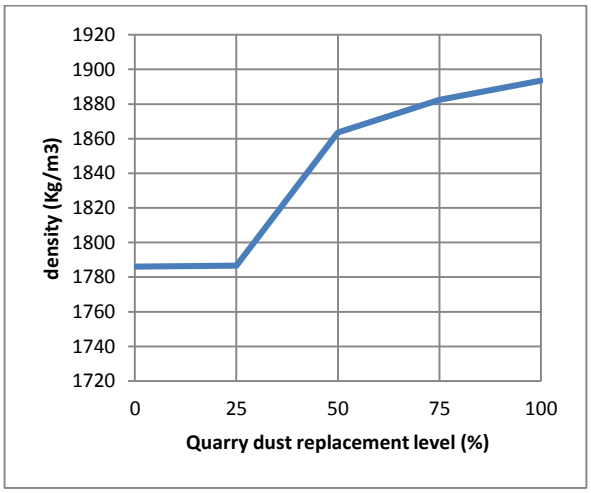

Fig. 4: Effect of quarry dust replacement level on density

Conclusion

The following conclusions were drawn from this study:

1. It can be concluded that the replacement of river sand with quarry dust improves the performance of the sandcrete blocks at all ages.
2. The density of the blocks increases with an increase in the quarry dust replacements (i.e. the higher the quarry dust contents the higher the density and vice-versa).
3. The rate of water absorption decreases with an increase in quarry dust contents, the amount of water absorbed by the blocks are within the limit specified by the code (i.e. absorbed water shall not exceed 12% of the dry mass).

Recommendation

From the result of the study, the use of Quarry dust as an aggregate for the production of block for building is recommended. To meet the (NIS-87, 2004) requirements, river sand should be replaced by 50 to 100% quarry dust and the blocks be cured for 28 days. There is a need for more research on the durability of sandcrete blocks containing quarry dust.

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