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CERAMIC TILES WASTE AS AGGREGATE IN CONCRETE PRODUCTION

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ABSTRACT
In construction industry, the use of course aggregate and consumption of ceramic materials is increasing every day. While a reasonable quantity of ceramic tiles material ends up as waste the use of these waste in the production of concrete can be an efficient measure in disposing of these waste and in keeping the environment clean and improving the properties of concrete. Compressive strength test was carried out on the cubes produced with ceramic tiles waste of 5%, 10%, 20%, 30% 40% and 50% with natural coarse aggregate. After analyzing all the results, obtained, the highest compressive strength value was obtained at 5%. This shows that 5% replacement of ceramic tiles for all the replacement and all the curing days has the highest compressive strength value (12.07, 21.78 and 20.71). after 20% ceramic waste tile, the compressive strength starts decreasing as compared to control sample of 14 curing days.
Keywords: Ceramic tiles waste, Replacement, Course aggregate, concrete production.

INTRODUCTION

Senthameriai and Devadas (2005) estimated that almost 30% of tiles produced daily in ceramics industries are considered as waste product presently this waste has not been recycled in any form as a result of ceramic industries under a great pressure to come up with a solution as to how to discard ceramic waste. Urgently, there is a need to produce concrete with non-conventional aggregates materials because conventional aggregates that are usually available are being exhausted fast especially in some desolated area of the world (sentha material and manoharam 2005). In construction industry, the necessary material required for the production of concrete are aggregates and cement, which had led to the uninterrupted increment in the demand of natural materials used for the production of concrete. One of the most important construction material used in virtually tile. The production of ceramic tiles usually begins with raw material, grinding, mixing, granulating by spray drying, pressing, firing or polishing and glazing (wattanasiri wech et al 2009)

According to Nigeria Environmental society (NSE), over 60 million tones of wastes are generated annually in Nigeria, and one of the most challenging issues of this ere is how to manage the waste (Rawaid khanate al (2012). Annually around the globe, millions of waste materials are available and usually disposed. In controlling of pollution problems, recycling of this waste into a sustainable construction material seems like a feasible solution.

MATERIALS AND METHODS.

Materials: the materials used in this study are the following ceramic tiles waste, cement, sand, granite, water, and fine aggregate. The ceramic waste tiles was gotten from physical planning development (PPD) of landmark university omu-aran Kwara state. The ceramic wastes were manually broken by using hammer. The cement used is the dangote (crushed ceramic tiles) was used as partial replacement for the production of the samples.

Methods: The ceramic tiles aggregate was produced manually in the laboratory by crushing the ceramic tiles into smaller particles sizes by using heavy hammer. The production of concrete cubes was done by concrete cubes was done by placing the concrete inside the mould up to the layer of depth 50mm and compacted. The cubes were later cured for 7, 14, and 28 days respectively, and compressive strength test was conducted on the cubes, and the results tabulated.

RESULTS AND DISCUSSIONS

Compressive Strength Test

Compressive strength test was carried out on the concrete cubes of size 150mmx150mmx150mm with partial replacement of ceramic tiles waste of 5, 10, 20, 30 and 40%. After these samples have being cured for 7 days, 14 days and 28 days respectively with the mix ratio of 1:1.5:3. The result obtained after crushing the cubes is in table 4.1 with the respective curing days.

Table1: Compressive Strength of concrete cubes

Replacement of Ceramic tiles Waste (%)	Fcu(N/mm) for 7days curing	Fcu(N/mm) for 14days curing	Fcu(N/mm) for 28days curing
0%	6.44	15.11	12.62
5%	12.07	21.84	20.71
10%	11.67	15.24	16.56
20%	9.98	14.53	15.18
30%	7.24	14.02	11.69
40%	4.84	13.60	9.47
50%	4.09	10.24	9.11

The illustration on the graph shows that **5%** placement of ceramic tiles has the highest compressive strength value (i.e. **12.07**) and **50%** has the lowest value which is **4.09.** The chart in Fig 4.1 above shows that the compressive strength value of cubes with 5, 10, 20 and 30% replacement of ceramic tiles (**12.07, 11.67, 9.98** and **7.24** respectively) is higher than that of the control sample value (**6.44**) while the value of 40 and 50% (**4.84** and **4.09** respectively) is lower than that of the control sample. Therefore, from the results obtained from the 7 days curing, 5, 10, 20 and 30% replacement of ceramic tiles waste are suitable for use in the production of concrete because they have higher value of compressive strength compare to the control sample while the ones with the low value to the control sample value are not really suitable for use as there compressive strength value is below the value of the control sample.

Fig 4.2 above shows the chart of 14days curing of cubes and in this 5% replacement still has the highest value of compressive strength value (21.84) just like the previous chart (Fig 4.1). comparing the values obtained from the replacement of coarse aggregate with the control sample for 14 days curing we can see that only 5% and 10% has the value higher than the control sample (i.e. **21.84** and **15.24** is greater than **15.11) w**hile 20%, 30%, 40% and 50% has compressive strength value below the control sample.

Figure 4.3: Chart of % of ceramics waste tiles against Fcu for 28days curing. For 28 curing day the sample with the highest compressive strength still remains 5% (20.71) just like that of 7 and 14days in chart fig 4.1 and 4.2 above. While 10 and 20% also has values above the value of the control sample (16.56 and 15.18 is greater than 12.62) but for 30%, 40% and 50% their compressive strength value is below the value of that of the control sample (i.e. 11.69, 9.47, 9.11 are less than 12.62)

Figure 4.4 shows a typical illustrates of all the replacement ranging from 5, 10, 20, 30, 40 and 50%, the control sample result and also all the curing days 7, 14 and 28days respectively. From the chart above all the replacement are greater than the control sample for each replacement and curing days. The 5% of 14 days (**21.78**), followed by the 5% of 28days. This shows that 5% replacement of ceramic tiles for all the replacement and all the curing days has the highest compressive strength value (**12.07**, **21.78** and **20.71**). After 20% coarse ceramic waste tile aggregate the compressive strength starts decreasing as compared to control sample in 14 curing days, from the 30% replacement ceramic waste tile aggregate the compressive strength starts decreasing as compared to control sample of concrete for 7days and 28 days. However, there is decrease in compressive strength of the samples with replacement of ceramic waste tiles aggregate beyond 30%, 40% and50% as the use of ceramic waste tiles aggregate increases in the production of concrete, there is decrease of compressive strength. From the results obtained in this research work it shows that only 5% and 10% of ceramic tiles wastes can be conveniently replaced with coarse aggregate in concreting to produce strong and safe concrete.

CONCLUSION

The study has determined the effect of using ceramic tiles waste as a partial replacement for coarse aggregate in concrete production. The results shows that 5%, 10% and 20% was suitable for use in 7 days and 28days curing, while just 5% and 10% was suitable for use in 14 days curing. Therefore, the results obtained shows that only 5% and 10% of ceramic tiles can be conveniently replaced with coarse aggregate in concreting to produce strong and safe concrete.

RECOMMENDATION

It is recommended that diverse research be carried out on ceramic tile wastes. This will help to discover other usefulness of these wastes and how important it can be to construction industry and the society as a whole.

APPENDIX: TEST RESULTS FOR MECHANICAL PROPERTIES OF CERAMIC TILES WASTE

Replacement of ceramic tiles waste (%)	Sample A (kN)	Sample B (kN)	Fcu A (N/mm)	Fcu B (N/mm)	Average Fcu (N/mm)
0%	146	144	6.49	6.40	6.44
5%	273	270	12.13	12.00	12.07
10%	264	261	11.73	11.60	11.67
20%	229	220	10.18	9.78	9.98
30%	166	160	7.38	7.11	7.24
40%	110	108	4.89	4.80	4.84
50%	94	90	4.18	4.00	4.09

14 DAYS OF CURING

Replacement of ceramic tiles waste (%)	Sample A (kN)	Sample B (kN)	Fcu A (N/mm)	Fcu B (N/mm)	Average Fcu (N/mm)
0%	341	329	15.16	15.06	15.11
5%	493	490	21.91	21.78	21.84
10%	343	343	15.24	15.24	15.24
20%	334	320	14.84	14.22	14.53
30%	319	312	14.18	13.87	14.02
40%	312	300	13.87	13.33	13.60
50%	118	116	15.33	15.16	10.24

28 DAYS OF CURING

Replacement of ceramic tiles waste (%)	Sample A (kN)	Sample B (kN)	Fcu A (N/mm)	Fcu B (N/mm)	Average Fcu (N/mm)
0%	288	280	12.80	12.44	12.62
5%	482	450	21.42	20.00	20.71
10%	375	370	16.67	16.44	16.56
20%	343	340	15.24	15.11	15.18
30%	266	260	11.82	11.56	11.69
40%	214	212	9.51	9.42	9.47
50%	210	200	9.33	8.89	9.11

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