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Research Article

Investigation of Compressive Strength of Concrete from Cement and Iron-Ore Tailings Mixture

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Abstract: Iron-ores tailings which is amounting to several tonnes in piles which can in the future, lead to disposal problems was used as additives on these cements. In our previous work, the setting time was investigated [1]. This work is to carry out experiment by using the tailings as additive to cements and to assess the compressive strength attained. This will go a long way to prevent dangers and waste of resources and also to minimize cost of construction. Burham, Dangote and Elephant cements were investigated to ascertain their compressive strength. The result shows that the tailings have positive effects on the cement characteristics that is; the compressive strength. Future work will address the contents of tailings which when added would provide the maximum benefit.
Keywords: Itakpe iron-ore Tailings, Cements, Compressive Strength

INTRODUCTION

The Scope of this research work:

- To analyze Itakpe Iron-ore tailings which is the by-product from purification of iron-ore for its components and to check its effect(s) on cement's compressive strengths when employed into usage.
- To recommend to the cement users the types and brands of cements that is/are suitable for different conditions and different constructions.

Itakpe iron-ore tailings and its analysis

Bolarinwa Gabriel. Oladeji, Aniki et al. [1], the tailings is amounting to several thousand tones in the pile. As the operation continues, a point would be reached when there would be any space to accommodate the tailing and this can lead to disposal problems [2]. This issue is now viewed from another perspective that since the tailings consists of almost the same constituents as the Portland cement; the tailing could now be used to improve cement characteristics. More information about the tailings, its sieve analysis and other can be found in our previous work.

Assessments of three brands of cement samples as regards their characteristics.

Three brands of cements, Burham, Dangote and Elephant Portland cements were assessed and analyzed for few of their characteristics and inferences were made on their actions as regards their compressive strength when water-cured with time (days) and their rates of setting (setting time)[3,4,5].

Limitations of this work

In this research work, it is not possible because of non availability of some testing equipment, standard laboratory in where many of the conditions being climatic or others can be maintained and inadequate provision of some research institutes that are to be used for some research works in testing and accessing most of the cement characteristics but this project constrains itself to the analysis of compressive strengths.

EXPERIMENTAL

Tests for compressive strength of cement

Materials and Equipment

Cement samples, local sand, clean water, 50mm cubes moulds with base plates, 250ml graduate, mixing pan, trowels, compression testing machine, water tank for the cubes, shovel, tailing, lubricating oil coarse aggregates, spanner, tamping rod.

Procedure

Cement sample, sand and coarse aggregates were mixed in ratio 1:3:6 in the mixing pan and 10% weight equivalence of dry material (sand + cement + aggregates) was added and were mixed thoroughly. Immediately after mixing, the moulds were oil-coated and the mixture was poured into the oil-coated moulds in three layers. Compaction was then made after each layer using 35 blows as stipulated by British standard with the aid of a tamping rod. After 24 hours, the cubes made were removed and further cured in the water tank filled with water. These cubes were now tested in a compression testing machine after 3 days, 7 days and 14 days. The compressive strengths gained by the cubes were recorded.

The above steps were carried out for the three brands of cement and also for the mixture of the Itakpe Iron Ore tailings, cement, and aggregates in ratio 0.25: 1: 3: 6.

The tests were carried out three times during recording steps and the mean values were used.

Precaution

- All the movable parts of the apparatus were lubricated before the experiment.
- All the readings were taken at eye level.
- All the readings were taken thrice and the mean values were recorded.

RESULTS

Tables -1 and 2 shows the result obtained for different sizes of concrete samples from 3-14 days. The compressive strength and time were plotted accordingly to arrive at figures 1 and 2.

Table-1: Compressive Strength for Cement Only (Using 50mm Cube)

Cement Only (50mm cube)	Time (days)	Load (KN)	Weight (Kg)	Compressive (F/A) Strength (N/mm^2)
BURHAM	3	1.5	0.14	0.6
	7	2.5	0.25	1.0
	14	4.0	0.27	1.6
ELEPHANT	3	3.5	0.23	1.4
	7	5	0.29	2.0
	14	6.5	0.31	2.6
DANGOTE	3	6.5	0.28	2.6
	7	11	0.31	4.4
	14	11	0.26	4.4

Table-2: Compressive Strength for Cement - Tailings (Using 50mm Cube)

Cement + Tailings (50mm cube)	Time (days)	Load (KN)	Weight (Kg)	Compressive (F/A) Strength (N/mm^2)
BURHAM	3	1.5	0.17	0.6
	7	4.0	0.29	1.6
	14	6.0	0.30	2.4
ELEPHANT	3	3.0	0.28	1.2
	7	7.0	0.33	2.8
	14	8.0	0.35	3.2
DANGOTE	3	5.0	0.32	2.0
	7	12.0	0.36	4.8
	14	13.0	0.28	5.2

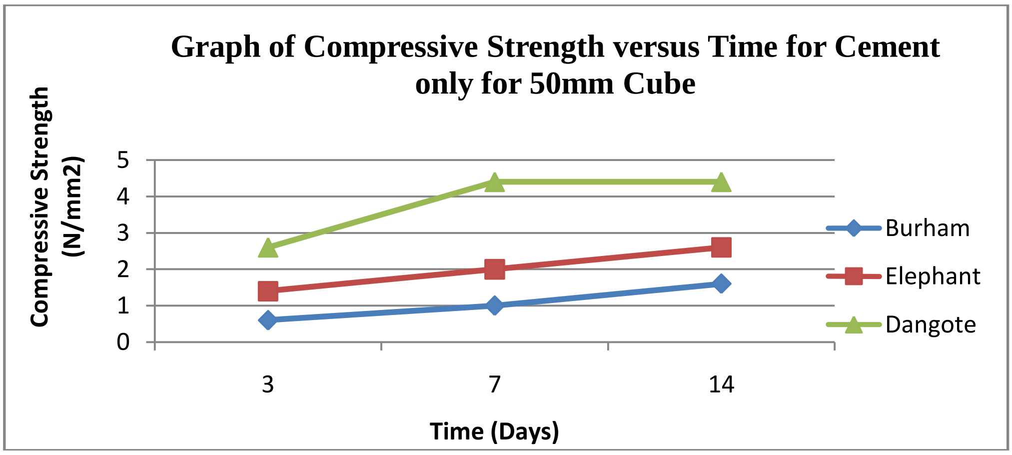

Fig.1: Compressive Strength for Cement only for 50mm cube

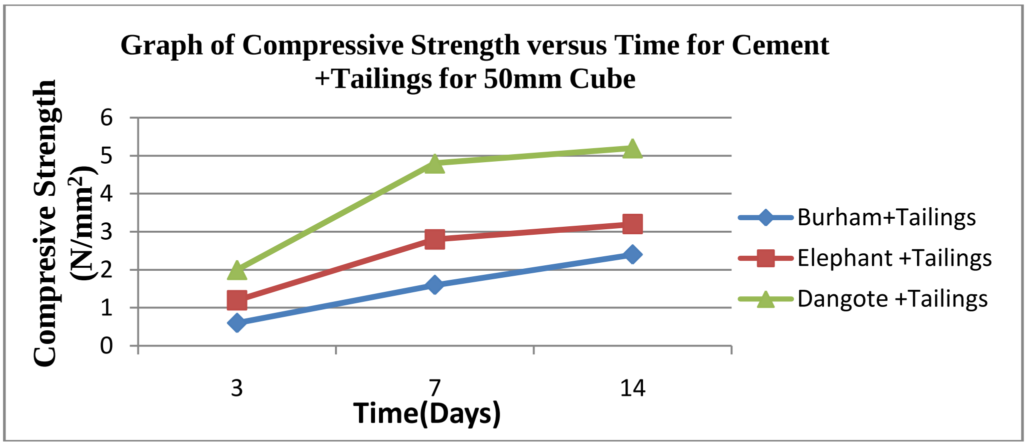

Fig.2: Compressive Strength for Cement + Tailings for 50mm Cube

DISCUSSION

Compressive Strength

As could be read from tables and 2 where the values of the strength attained at 3rd, 7th and the 14th day were recorded. When the cements only were tested for their compressive strengths, at the 3rd day. Burham has the least followed by Elephant and highest the Dangote Cement. On the 7th day, Burham Elephant and Dangote increased in strength but at different rates. As the days increases, Dangote cement strength which has the highest reached a point where the strength almost remained constant which probably implies that it lost the water content in it very rapidly thus aids the formation on strength. On the Burham cement, it has almost the same attributes with Dangote cement. Elephant has the least at the first instance but as the time goes on, the rate at which the strength formed increased substantially and this is because of the presence of the finest particles which at the early age the reaction will be slow but after the reaction is completed, there is proper coagulation of the cement particle and this leads to formation of the highest strength as shown on Fig-1.

On addition of the tailings, the interstitial spaces between the cement particles were being filled up and reduce the porosity which enhances the reaction between the cement and the water and thus increase the rate of strength formation. Fig-2 illustrates that there were increase in the rate of strength formation with the presence of the tailings. Conclusively Iron-ore tailings help the cohesive forces strength.

Summary

Burham initially gained strength a bit rapidly, but with days, the rate reduced. Elephant at the early stage gained strength very slowly, but to a very high value and the strength is proportional with days.

Dangote was the fastest as regards strength gain at the early age but it reached a time when the strength almost remained constant with days.

With addition of tailings, for all the brands of cements discussed above, the rate of gaining strength was improved.

CONCLUSION

Dangote from the graphs at its early age has a fastest rate of strength development almost linearly with increase in days. Burham does almost the same but unlike Dangote. The least rate strength development was recorded for Elephant cement but with increase in days, there is a substantial increase in strength development rate which constitutes a rapid strength development in cements. Summarily, the addition of tailings improves the rate of hardening and improves compressive strength.

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