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Research Paper

# ANALYSIS OF INFLUENCE OF SILT/CLAY IMPURITIES PRESENT IN FINE AGGREGATES ON THE COMPRESSIVE STRENGTH OF CONCRETE

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This piece of research work aim is to assess the influences of silt/clay impurities present in fine aggregates on the concrete strength. Five samples of fine aggregates were taken from five different locations within Ado-Ekiti, Ekiti State Nigeria. The percentage of silt/clay in each sample was determined by sieve analysis test in the laboratory. The concrete cubes of mix 1:2:4 were prepared using water/cement ratio of 0.65 from the five fine aggregates samples. The cubes were crushed at ages 7, 14, 21 and 28days and the compressive strength determined. The same coarse aggregates, cement and water were used with these fine aggregates samples to prepare the concrete cubes. It was discovered that these fine aggregates samples do not have the same percentage of silt/clay content. Also, as the silt/clay content increases, the compressive strength of concrete decreases. The concrete produced from these fine aggregates samples do not have the same slump, the slump decreases as the percentage of silt/clay content increases.

Keywords: Influences, Silt/clay, Fine aggregates, Concrete strength, Compressive strength

## INTRODUCTION

Concrete is widely used as construction composite materials for various types of structure due to its durability. For a long time it was considered to be very durable material requiring a little or no maintenance (Vignesh *et al.*, 2014). Concrete can be a strong durable building material that can be formed into many varied shapes and sizes ranging from a simple rectangular column, to a slender curved dome or

shell, if the constituent materials are carefully selected (Olanitori, 2006). Many factors can adversely affect the durability of concrete structures such as poor design, poor supervision, impurities (such as clay/silt, debris), etc., (Olanitori and Olotuah, 2005; and Vignesh *et al.*, 2014). Concrete is a construction materials which consists of the mixture of fine aggregates, coarse aggregates, cement which is proportionally mixed with certain percentage of water (Ganiron, 2014).

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All these materials are expected to be free of debris, impurities, clay/silt content for optimum performance. The presence of any of these unwanted materials could slow down the hydration process thereby affecting the overall performance of concrete (BS 882, 1992). The overall relevance of concrete in virtually all Civil Engineering practice and building construction works cannot be overemphasized (Adewuyi and Adegoke, 2005).

Silt is generally considered to be materials between 0.06 mm and 0.002 mm while Clay are materials less than 0.002 mm particle size (BS 882, 1992). In analyzing the influence(s) of silt/clay on the concrete strength; if the silt/clay content is found to increase the concrete strength, it means silt/clay can partially replace fine aggregates. This will reduce the cost of concrete production but if otherwise, it will be a pivotal information to all concrete designers and users to ensure that fine aggregates are free from silt/clay impurities. Silt/clay is not as strong as typical fine aggregates. They can absorb water and their properties can change. In fresh concrete, silt/clay will interfere with the bonding of aggregates to cement. In hardened concrete, if the silt/clay come in contact with water in air voids, it can shrink or swell, either building internal pressure (swelling) or leaving larger voids and weakening the concrete (shrinking). Silt/clay is much finer than fine aggregates and having non-cohesive property due to which it does not react with cement, fine aggregates and with water it starts reacting like shrinking and swelling but still exists in concrete which cause unwanted hairline or sometimes major cracks in the concrete depending on percentage of silt/clay which should not be more than 4%. Failure of concrete structures leading to collapse of building has initiated various researches on the quality of construction

materials. This failure has resulted into injuries, loss of lives and investments has been largely attributed to use of poor quality concrete ingredients. The fine aggregates of high quality have high positive effect on the quality of compressive strength of concrete (Hannah *et al.*, 2014). The presence of silt/clay above certain percentage in fine aggregates requires more cement to coat other ingredients of concrete (Olanitori and Olotuah, 2005).

## MATERIALS AND METHODS

**Cement:** Portland cement was used for this research work and it was found to confirm with the requirements of BS EN 197-1(2000).

**Water:** The water used for this work is potable, clean and free from any visible impurities. It confirmed to BS EN 1008(2000).

**Coarse Aggregates:** Granites of 20 mm size were used for this work. They are free from debris and other impurities. They are angular in shape.

**Fine Aggregates:** The fine aggregates used were sourced from five different locations within Ado-Ekiti, Ekiti State. One of the sources is a quarry site within Ado-Ekiti, the fine aggregates from quarry is stone dust with 0% of silt/clay content.

The following tests carried out on these materials are sieve analysis, slump test and compressive strength. The procedure used in carrying out the tests conformed to that of British Standard 1881, parts 108 and 116.

**Slump Test:** This test is used to determine the workability of concrete. It measures the resistance of concrete to flow under its weight. The apparatus used is a hallow cone shaped mould test.

**Compressive Strength Test:** The compressive strength of concrete is one of the most important and useful properties of concrete. The primary purpose for design concrete is to resist compressive strength in structural members. Hence it is the role of a concrete designer to specify the expected characteristics strength of concrete/mix proportion to enable it resist external force. Concrete cubes produced from fine aggregates samples with the same coarse aggregates, cement and water were subjected to this test to determine variation in strength as regards the different percentage of silt/clay present in fine aggregates samples. The concrete cubes were cured by immersion in water. The concrete cubes were crushed using Universal testing machine.

**Sieve Analysis:** This is a test that is performed to determine the percentage of different grain sizes contain within the material. The mechanical or sieve analysis is performed to determine the distribution of coarser, larger-sized particles. The sieve analysis of this study was carried out on saw dust.

## RESULTS AND DISCUSSION

From the analysis carried out on results of tests performed, it was observed that sample A, B, C, D, E has 0%, 6.69%, 7.01%, 8.5%, and 9.88% of silt/clay content respectively as shown on Table 1 with average slump of 85 mm, 75 mm, 72 mm,

Samples	% of Silt/Clay
A	0
B	6.69
C	7.01
D	8.5
E	9.88

Figure 1: Bar Chart Showing Silt/Clay Content (%) in Each Sample

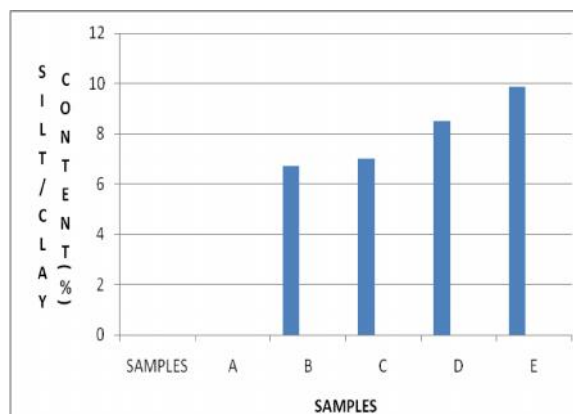
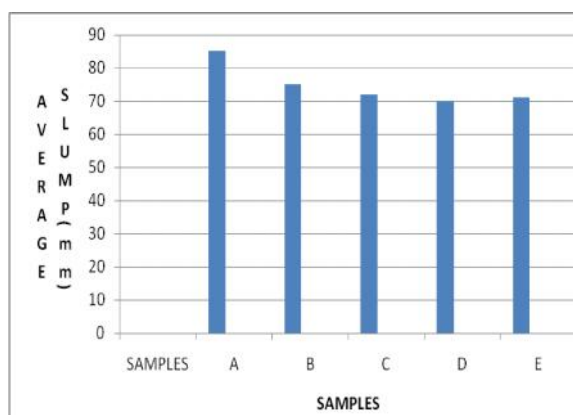


Table 2: Summary of Slump Test

Samples	Average Slump (mm)
A	85
B	75
C	72
D	70
E	71

Figure 2: Bar Chart Showing the Average Slump for Each Sample



71 mm and 70 mm respectively as shown on Table 2. Also, it was observed that as the silt/clay content increases, the compressive strength decreases as shown on Table 3.

Samples	Compressive Strength @ 7-days	Compressive Strength @ 14-days	Compressive Strength @ 21-days	Compressive Strength @ 28-days
A	10.70	14.64	17.64	19.22
B	7.50	11.44	14.44	16.02
C	7.39	11.33	14.33	15.91
D	7.14	11.08	14.08	15.66
E	6.96	10.91	13.91	15.49

Figure 3: Average Slump Against Silt/Clay Content (%)

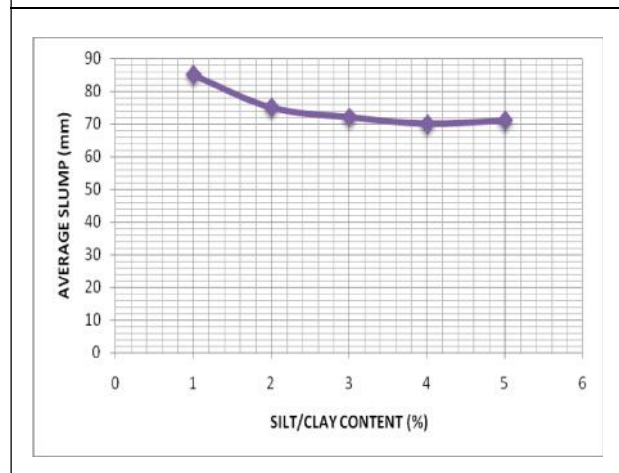
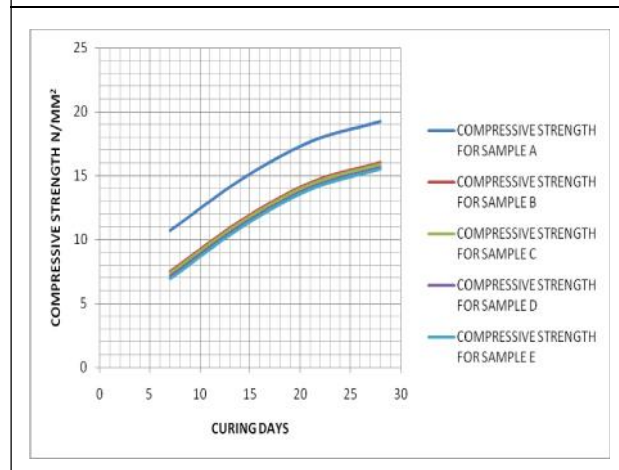


Figure 4: Compressive Strength Against Curing Days



### CONCLUSION

From the computed results obtained from the study, it is obvious that the compressive strength

of concrete decreases with increases in silt/clay content. This reduction in compressive strength is as a result of improper bonding of silt/clay materials. Compressive strength increases with curing days. The sieve analysis results indicated that the fine aggregates samples from various locations apart from stone dust from quarry contained silt/clay content which technically affects the concrete strength.

Also, the two essential properties of hardened concrete are durability and strength, both are affected by the voids and capillaries in the concrete, which are caused by incomplete compaction, improper bonding of aggregates or by excessive water in the mix.

### RECOMMENDATION

Based on the findings from the various laboratory tests carried out during this research work on fine aggregates samples obtained from various locations within Ado-Ekiti, Ekiti State, it is necessary in order to achieve durable and concrete of good compressive strength to limit the quantity of silt/clay content in fine aggregates to 3% maximum. It is also, recommend that the percentage of silt/clay in fine aggregates be determined in laboratory before using such aggregates because their physical appearance alone is not enough to determine it. Also, all fine aggregates sourced from any location apart from quarry must be tested with the aim of determining

its silt/clay content because result of the sieve analysis test shown that all fine aggregates samples from other locations apart from quarry have certain percentage of silt/clay content.

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