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Effects Of Urine, Detergent And Sulphuric Acid On The Compressive Strength Of Concrete

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ABSTRACT
Although, cement components are not supposed to be exposed to these aggressive agents like Urine, Detergent solution and Sulphuric acid areas such as toilet, laundries and soak-away tend to decolorize as well as loose of its smooth texture and abrasive resistance leading to structural failure or total collapse., it appears that it is difficult to change human in addressing this issue of exposure of concrete by willingly abiding the environmental regulations. This lead to the research in order to assess the effects of Urine, Sulphuric acid and Detergent solution on the compressive strength of concrete with a view to suggest ways to improving its application in construction. Concrete cubes of size 100mm with nominal mix ration of 1:2:4, w/c ratio of 0.55. Four different labels were assigned to the samples as W, U, S and D for the samples to be cured in water, Urine, Sulphuric acid and Detergent solution. Residual strength was tested at 3, 7, 14, 28 and 56 days. From the result, it was discovered that concrete subjected to detergent solution would receive a mild effects, while those subjected to aggressive environment that contain Urine and sulphuric acid of concentration above 2.5% will experience a high impact in its strength
Keywords: Concrete, Urine, sulphuric acid, Detergent solution, Compressive strength

INTRODUCTION
In a broad sense concrete is a product (mixture) of cementing material and aggregates with water in a predetermine proportion. Concrete can be produced with different types of cement as well as different types and sizes of aggregate. It can also contain pozzolana, additives, admixtures, polymers, and fibres. Whatever could be the content of concrete, it should be strong and durable. This is to enable a full service throughout its usage. Strength and durability are the two most important properties of concrete. And these are normally achieved through proper selection of the constituent materials, good design, correct batching, appropriate mixing, adequate compaction and proper curing (Bala, 2009). Unless, "technical know- how" is carefully exercised on the production activities of concrete, the desired qualities may never be achieved. In fact, the desired qualities of concrete should be preserved even after production through necessary actions towards protecting the hardened phase against aggressive agents. These aggressive agents include acids and sulphates. Generally, for concrete to be good, it is vital for the producer to have the "technical know-how" on its production activities. In the selection of materials for instance, both the cement and aggregates must be suitable for the intended job. In addition, adequate compaction is of great importance since presence of void in the freshly placed concrete could be seriously detrimental to both the strength and durability of the hardened phase. Furthermore, proper

curing is also necessary since different forms of curing yield concrete of varying characteristics. It is worth noting that curing could be through the normal moist curing or any other system of curing such as; steam curing, vacuum curing, etc. Environmental conditions keep changing over the years due to industrial growth, the atmosphere contains high content of acids and gases that could be detrimental to concrete structures. The aggressiveness or severity of aggressiveness of environment in which concrete is serving will determine how concrete will deteriorate. The agents of deterioration are acids in solution, acidic gases, and salts of sulfide among others. Lawal (2016) noted that the aggressive environmental influence or aggressiveness is a relative notion. This is because concretes made with different binding media perform differently under a given environment. When considering physical state, Lawal (2016), classified aggressive media as solid, liquid and gaseous. The mechanism of aggressive environment are therefore characterized as aggressive solid, liquid, and gases. Nigeria being a developing country, most dwellings have in-adequate Urinals and substandard drainages. Urine, dirty detergent water, and sometimes sulphuric Acid from battery charging points are not properly discharged or treated. Rather; these are poured on the bare floor, walls or substandard drains. It has been observed that concrete lose its desired properties when in contact with urine, detergent and electrolyte they are exposed to. Although, cement components are not supposed to be exposed to these aggressive agents, it appears that it is difficult to change human in addressing this issue of exposure of concrete. Observation shows that the general populace are not willing to abide by the environmental regulations.

In view of this, the present work seeks to investigate the effects of Urine Detergent and sulphuric acid on cement structures in toilets, laundries, battery shops, chambers, septic tanks and soak-away. The research hopes to establish a model for the prediction of the life-span of concrete structures exposed to these destructive agents.

Justification of the Study

It is a known fact that concrete subjected to Urine, Detergent water and Sulphuric acid areas such as toilet, laundries and soak-away tend to decolorize as well as loose of its smooth texture and abrasive resistance leading to structural failure or total collapse.

Aim of the Study

The aim of the study was to determine the effects of urine, detergent and sulphuric acid on compressive strength of concrete. This with a view that, to suggest mix design procedure for better concrete for use in laundry and toilet area.

Objectives of the Study

a) To assess the effects, of Urine, Detergent and Sulphuric acid on the compressive test of concrete.

b) To compare the degree of such effects with unaffected concrete produced from the same mix design

Scope

This research covered the determination of the workability of concrete and it's residual Compressive strength after exposure to 2.5% concentration of sulphuric acid for a periods of 3 days 7 days, 14 days, 28 days and 56 days All the samples were given equal treatment in order to make comparism. All along, the weights of concrete samples were measured.

Significance of the Study

This research is significant to the extent that it will not only compare the strength of affected concretes with un-affected from the same mix design, but further project a model that can predict the lifespan of concrete structures exposed to aggressive medium such as Urine, Detergent and Sulphuric Acid area

MATERIALS AND METHODS

Materials

The Materials used in this experiment were: Portland cement, fine aggregate, granite coarse aggregate, Urine, Detergent, sulphuric acid H_2SO_4 'and water.

Aggregate

There are many definitions of aggregate by many people. One of them is Anonymous (2009), who defined the term "Aggregates" as a collective term for the minerals materials such as sand, gravel and crushed stone that are used with a binding medium (such as water, bitumen, Portland cement and lime)

to form compound materials (such as asphalt concrete and Portland cement concrete). Aggregates are the essential ingredients that give body to concrete, reduce shrinkage, increase strength and effect durability and economy of concrete. The aggregates required to produce workable, strong, durable and economical concrete as opined by Gambhir (2002), must be of proper shape (either rounded or approximately cubical) clean, hard, strong, well graded and chemically stable. Granite (crushed stone) aggregate sample was obtained from local quarries in Dutsinma town and which was sieved in accordance with BS 812-103.1(19875). The fine aggregate used in this study was obtained from a riverbed in Kagara village, Dutsinma and it was sieved in accordance to BS 812 (1971).

Cement

Cement, in the general sense of the word, can be described as a material with adhesive and cohesive properties which when mixed with water has the ability of binding mineral fragments into a compact whole for constructional purposes, the meaning of the term cement' is restricted to the bonding materials used with stones, sand, bricks, building blocks, etc. The principal constituents of cement are compounds of lime, so that in building and civil engineering we are concerned with calcareous cement. The cements of interest in the making of concrete have the property of setting and hardening under water by virtue of a chemical reaction with it and are therefore, called hydraulic cement Neville in Sulaiman (2016)

Dangote brand of ordinary Portland cement was used throughout the study and it was obtained from a local Supplier in Dutsinma. It has satisfied the minimum requirements of BS 812 (1996).

Aggressive Media

Because of solubility of calcium sulfate is low, ground waters contain more of other sulfates and less of calcium sulfate. Ammonium sulfate is frequently present in agricultural soil and water from the use of fertilizers or from sewage and industrial effluents. Decay of organic matters in marshy land, shallow lakes often leads to the formation of some substance, which can be transformed into sulphuric acid by bacterial action. Water used in concrete cooling towers can also be a potential source of sulfate attack on concrete. Therefore, sulfate attack is a common occurrence in natural or industrial situations

Detergent and sulphuric acid (H_2SO_4) were obtained from Kwangila Zaria market and were ensured that they were not expired as chemicals. While the urine was tapped from toilets students hostels of Isa Kaita College of Education Dutsinma.

Water

Water for mixing and curing was obtained from the one supplied by Isa Kaita College of Education, Dutsinma Water works.

Experiments

Test Specimens, 150 number of concrete cubes (100mmX100mmX100mm) was casted, and 15 number specimens each were labeled as W, U, D and S. 24 hours after casting, the specimens were de-moulded. Those labeled W were immersed into tanks containing clean water, U were immersed into tanks containing the Urine solution tapped, D were immersed into tanks containing dissolved Detergent solution and S were immersed into tanks containing 2.5% concentration of Dilute Sulphuric Acid. Three samples of the specimens from each marked tank were tested for compressive strength at the age of 3, 7, 14, 21, and 56 days of curing

ANALYSIS OF RESULT AND DISCUSSION

After curing of the samples in to water, urine, sulphuric and detergent solutions, the results obtained from this research were presented and analyzed in table and graph below.

Table 1 below shows the compressive strength of concrete samples cured in different curing media

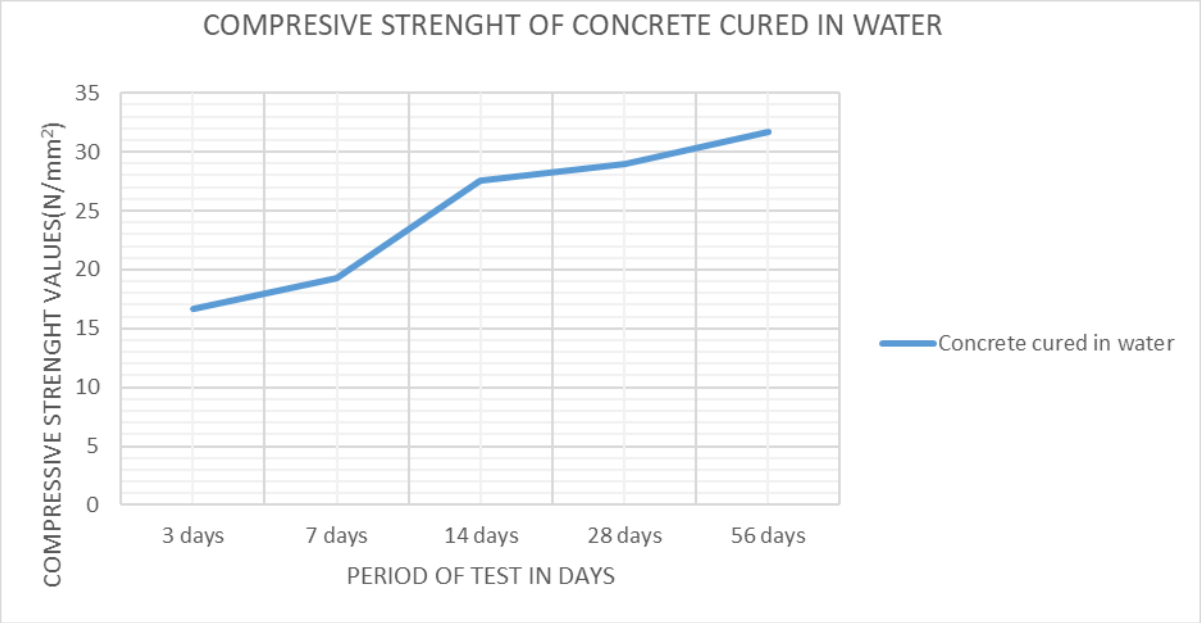

Figure 1 Compressive Strength Of Concrete Cured In Water

The figure 1 above shows the result of the compressive strength of concrete after normal curing, it indicated a progressive increase of strength throughout the experiment as 16.7, 19.30, 27.56, 29.00 and 31.70 for the periods of 3, 7, 14, 28 and 56 days respectively

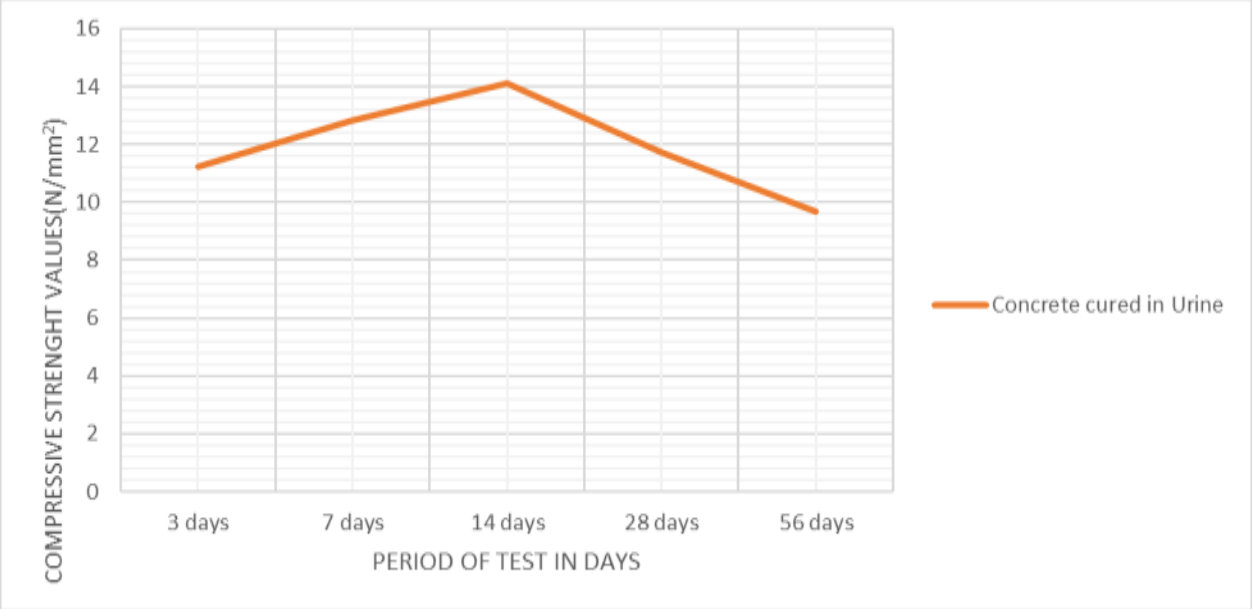

Figure 2. Compressive Strength of Concrete cured in Urine

Figure 2 showed the compressive strength of concrete samples cured in Urine solution, the results was slightly increased in strength and later decreased as indicated 11.23, 12.83, 14.56, 11.71 and 9.67N/mm^2 for the periods of 3, 7, 14, 28 and 56 days respectively

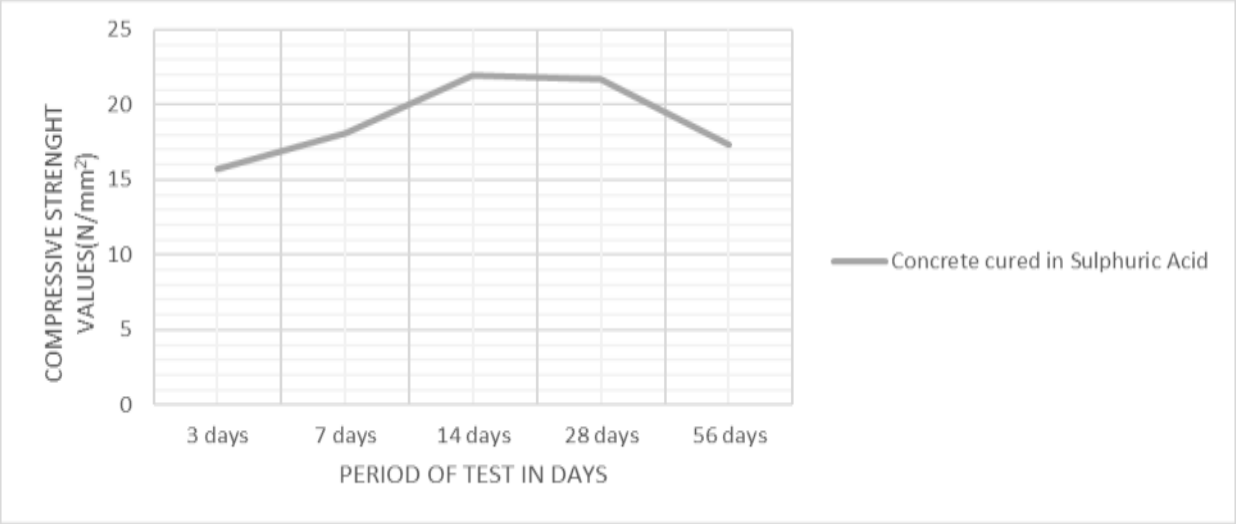

Figure 3. Compressive Strength of Concrete cured in Sulphuric Acid

Figure 3 showed the compressive strength of concrete samples cured in Sulphuric Acid solution, the results was slightly increased in strength and later decreased as indicated 15.70, 18.10, 22.00, 21.2 and 17.70N/mm^2 for the periods of 3, 7, 14, 28 and 56 days respectively

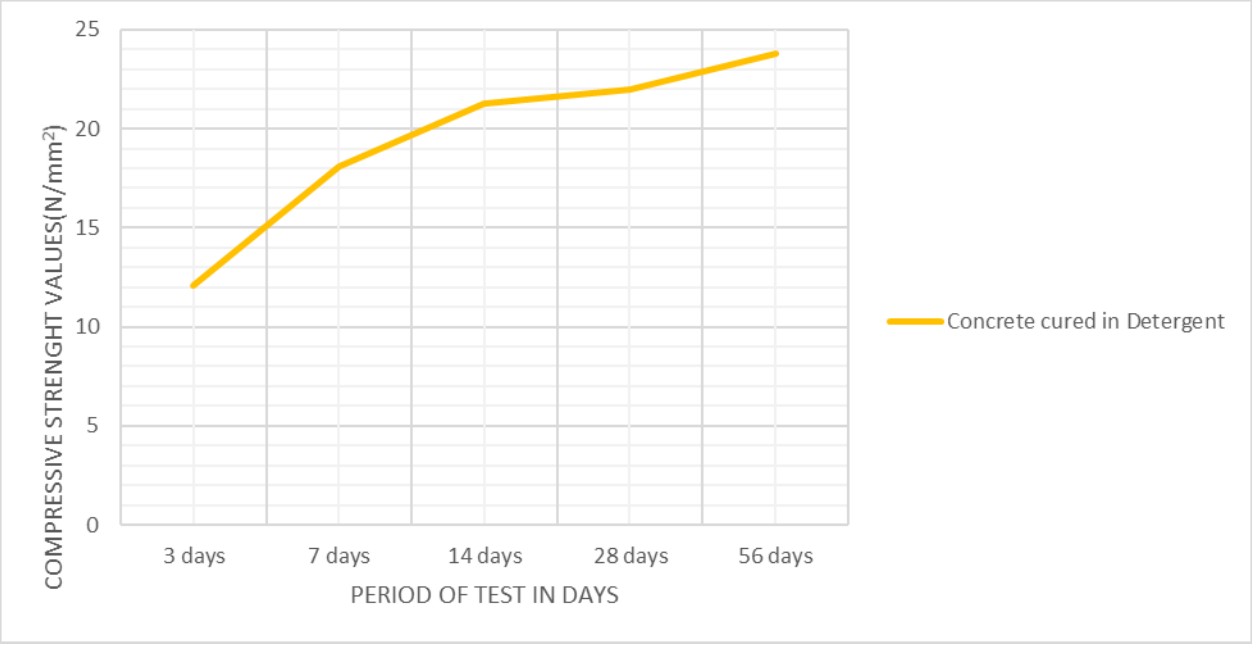

Figure 4. Compressive Strength of Concrete cured in Detergent

The figure 4 above shows the result of the compressive strength of concrete after cured in Detergent solution, it indicated a slightly progressive in strength throughout the experiment as 12.10, 18.10, 21.31, 22.00 and 23.80 for the periods of 3, 7, 14, 28 and 56 days respectively

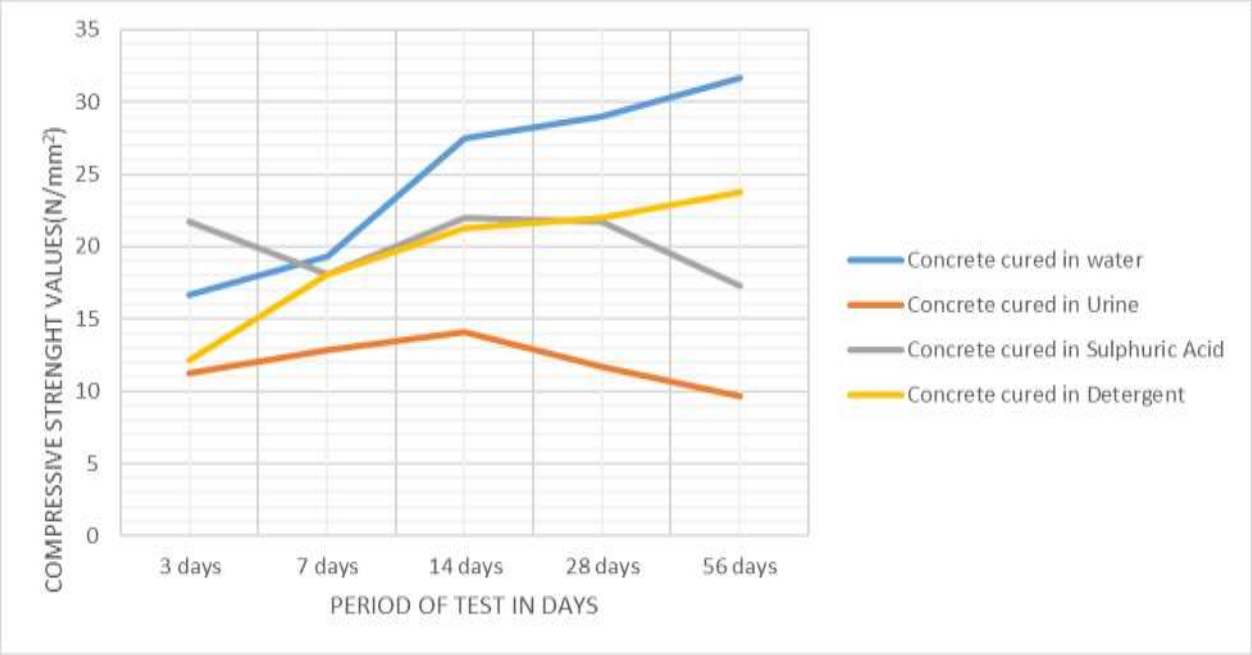

Figure 5. Compressive Strength of Concrete cured in different curing medium

Figure 5 compared the results of the Compressive Strength of Concrete samples cured in different curing medium. At the age of 3 days, the sample that received a normal water curing has a strength of 16.70N/mm^2, while comparing with others, the strength decreased by 32.75%, 5.99% and 27.55% for those cured in Urine, sulphuric acid and detergent respectively. At the age of 7 days, the normal curing has a strength of 19.30N/mm2 while others decreased by 33.52%, 6.22% and 6.22% for those cured in Urine, sulphuric acid and detergent respectively. At the age of 14 days the normal curing strength was 27.56N/mm^2 while others decreased by 48.84%, 20.17% and 22.71% for those cured in Urine, sulphuric acid and detergent respectively. Similarly at the age of 28 days the normal curing strength was 29.00N/mm^2 while others decreased by 59.62%, 25.17% and 24.14% for those cured in Urine, sulphuric acid and detergent respectively. Finally at the age of 56 days the normal curing strength was 31.70 N/mm^2 while decreased for those cured in Urine, sulphuric acid and detergent by 69.50% 45.43% and 24.91% respectively

CONCLUSION

In conclusion, it was evident from this study that, both Urine, Detergent and Sulphuric acid have some degree of effects in respect of the strength of concrete structure. Furthermore, this research work shown this effect occurs gradually with time in such that the concrete strength reduces gradually, as such the quality of the concrete is affected. The detergent has a mild effect compared with Urine and sulphuric acid.

RECOMMENDATIONS

Based on the findings from the study, the following recommendations are made

1. Concrete structures that may be subjected to sulphuric acid or Urine should not more than 2.5% concentration.
2. Concrete structures that may expose to more than 2.5% concentration of urine and sulphuric acid needs special surface treatment or additives in the mix

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