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EVALUATION OF THE EFFECT OF VARIOUS TYPES OF MOULDS ON COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

This research evaluated the effect of various types of moulds on the compressive strength of concrete. A total of 27 concrete cubes and 27 cylinders were cast using a mix ratio of 1:2:4 with water/cement ratio of 0.5. Three set of 9 cubes and 9 cylinders were cast using steel, plastic and wooden moulds. The cubes and cylinders were crushed after 7, 14 and 28 days respectively. and then the compressive strengths were determined. The compressive strength of the cubes and cylinders made with steel moulds were higher at all ages of curing, compared to those made with plastic and wooden moulds. The cubes and cylinders made with plastic moulds had higher strength after the steel moulds. The cubes and cylinders made with wooden moulds had the least compressive strength at all ages of curing. At 7, 14 and 28 days, the cube specimens for steel moulds had 20%, 35%, and 32% higher compressive strength than those for the cylindrical moulds. At 7, 14 and 28 days, the cube specimens for wood moulds had 11, 35, and 19.85% higher compressive strength than those for the cylindrical moulds. Concrete cured in plastic cubes and cylindrical moulds had the lowest compressive strength. At 28 days curing period, cube specimens had 28% higher compressive strength than the wood cubes, while that of the cylindrical specimens was 16% higher

Key Words: compressive strength, concrete cubes, concrete cylinders, moulds, steel, plastic, wood.

INTRODUCTION:

Concrete is a composite material composed of sand and gravel chemically bonded together by hydrated Portland Cement (McGregor, 1997).

In order to obtain the compressive strength of concrete in the laboratory, fine aggregate, coarse aggregate, cement and water are mixed. They are then placed in moulds for curing prior to crushing and testing for the compressive strength. Steel moulds are most often used for curing. The higher cost of steel has led to attempts to use other materials for the construction of moulds. These other materials include but not limited to plastic and wood. The reaction of water with cement is called hydration process and the results are called the products of hydration.

Curing is a process by which moisture loss is prevented at a particular temperature to enhance the hydration process of cement. The curing process not only increases strength and durability but also decreases

the porosity of the concrete.. To ensure that there is satisfactory development of strength during hydration process, it is necessary to prevent moisture loss, Kosmatka et. al. (2002).

Burg (1996) observed that a higher initial curing temperature increases the rate of the hydration process and early-age strength. Since the curing temperature is very important with respect to concrete strength because it contributes towards the rate of hydration, the material used for the construction of moulds must be able to retain heat. Also since the reaction of water with cement is responsible for the hydration process, an effective mould must be able to retain water.

Carrasquillo and Carrasquillo (1998) established that 150mm x 150mm cylinders made in plastic moulds had lower compressive strength than those made of steel moulds.

Day (1994) observed that some differences in compressive strength among the mould types (steel and wooden moulds) were traceable to differences in moisture loss during the first 24 hours of storage/curing. In the same study, he also observed that the compressive strength varies when the type of mould material and its size were varied. This study extended the investigation to include plastic moulds due to the ready availability of plastic moulds in the industry. The study corroborated the results obtained by Day (1994).

MATERIALS AND METHOD

Cement

Portland Lime Cement (PLC) Grade 42.5R manufactured by DANGOTE CEMENT INDUSTRIES Plc, was obtained from Mile 3 Building Materials Section, in Port Harcourt, Rivers State of Nigeria. The cement conformed to BS EN – 196.1 (2016).

Fine Aggregate

The fine aggregate used for this work was naturally occurring river sharp sand from Imo River in Oyigbo Local Government Area of Rivers State. The maximum size was 4.75mm. Impurities were removed and it confirmed to the requirements of BS EN 12620 (2013).

Coarse Aggregate

Coarse aggregate used is crushed angular and rough textured granite obtained from crushed rock industries at Ishiagu in Ebonyi State in South Eastern Nigeria.. Maximum size was 20mm. It was dried and confirmed to be free from moisture. The aggregates conformed to BS 812 – 106 (1985).

Water

The potable water used was obtained from the tap at the Civil Engineering Laboratory of the Rivers State University of Science & Technology. The water conformed to BS 3148 (1980)

Moulds

Steel cubes and cylindrical moulds available in the Civil Engineering Laboratory of the Rivers State University, Nkpolu, Port Harcourt were used. Plastic and wooden cubes and cylindrical moulds were prepared to similar sizes as those of steel cubes and cylinders.

Preparation and test of samples

The mix ratio used for the experiment is 1:2:4 by weight (cement: fine aggregate: coarse aggregate), while the water/cement ratio of 0.5 was used. Three set of 9 cubes and 9 cylinders were cast using steel, plastic and wooden mould, making a total of 27

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concrete cubes and 27 cylinders. At the end of 7, 14 28 days curing period, the concrete cubes were crushed in a cube crushing machine in accordance with BS EN 12390-3 (2009). The average results for each set of 3 cubes were recorded.

RESULTS

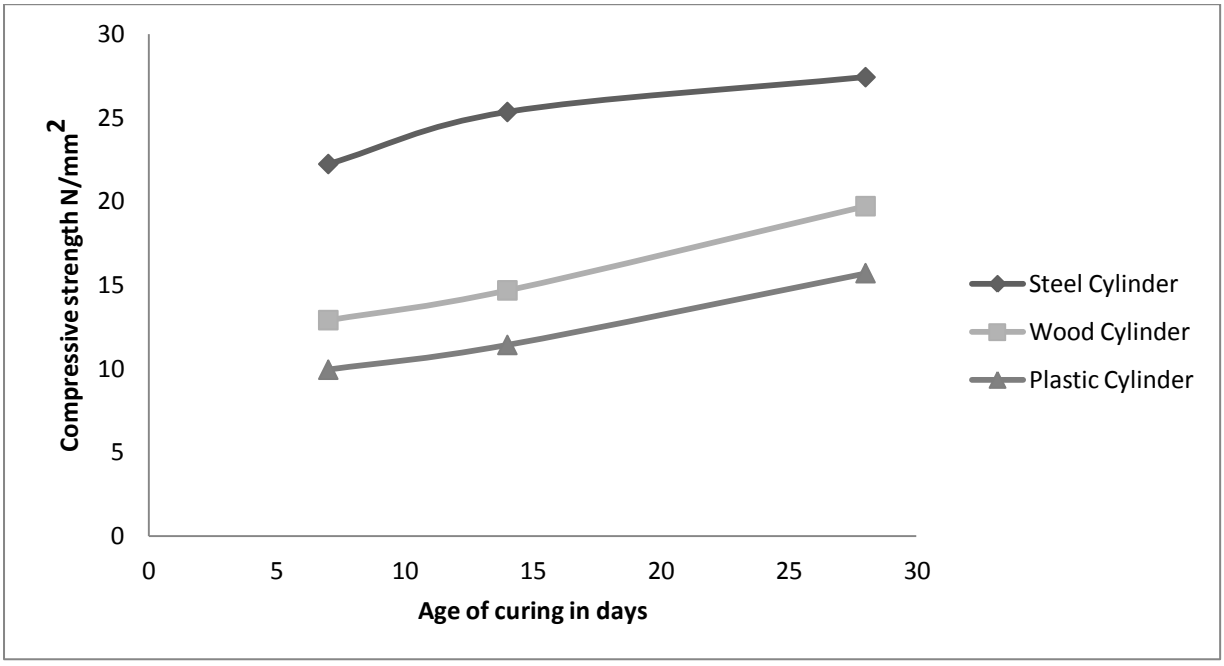

Fig. 1 - Compressive strength versus Age of curing in cylindrical moulds of various materials

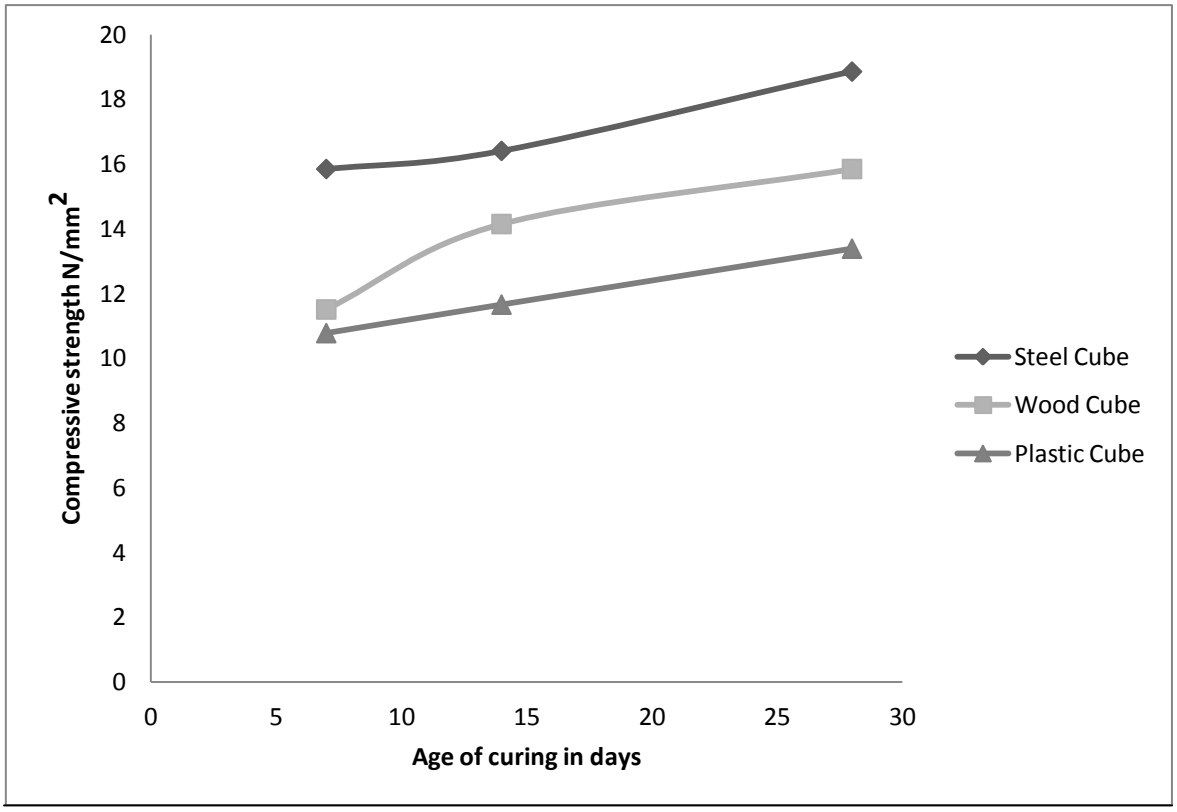

Fig. 2 - Compressive strength versus Age of curing in <u>cube</u> moulds of various materials

DISCUSSION

Figures 1 and 2 shows a plot of the compressive strength versus the age of curing of the concrete for cylindrical and cube specimens for steel, plastic and wooden moulds. It can be observed that the compressive strength for the cube and cylindrical concrete specimens cured in steel cubes and cylinders were higher than those cured in plastic and wooden moulds.

The concrete cube specimens (cubes and cylindrical) cured in wood had higher compressive strength than those cured in plastic. These results are due to the rigidity of the steel and wooden moulds. The steel moulds are able to retain water in the concrete which helps in the process of hydration. The plastic moulds hold water in the concrete more than the wooden moulds but the flexibility of the plastic moulds is responsible for the lowest compressive strength out of all three materials. These results show similarity with the work of Carrasquillo and Carrasquillo (1988), who concluded that 6 x 12 in cylinders made in plastic moulds had a slightly lower compressive strength than those made in steel moulds. They also found that 4 x 8 in cylinders made in steel, plastic and cardboard moulds had equal compressive strengths.

The following conclusions were made from the result of the study.

(i) Concrete cast in steel cubes and cylindrical specimens have higher compressive strength than those cast in plastic and wooden moulds.

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(ii) Concrete cast in wooden cubes and cylindrical specimens have the next higher compressive strength.
(iii) At 7, 14 and 28 days, the cube specimens for steel moulds had 20%, 35%, and 32% higher compressive strength than those for the cylindrical moulds.
(iv) At 7, 14 and 28 days, the cube specimens for wood moulds had 11%, 35%, and 19.85% higher compressive strength than those for the cylindrical moulds.
(v) Concrete cured in plastic cubes and cylindrical moulds had the lowest compressive strength.
(vi) At 28 days curing period, cube specimens had 28% higher compressive strength than the wood cubes, while that of the cylindrical specimens was 16% higher.

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