Drip Curing Technique on Concrete For Water Conservation And Improved Compressive Strength

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Abstract— Concrete and its curing is an inevitable process of any construction. Curing of concrete is the process of maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties for concrete such as developing the concrete microstructure and pore structure thereby improving its durability and performance. Water is largely used in curing process and is becoming a scarce material day by day. Even if the conventional concrete mix used has various advantages it also has disadvantages as cracking, low strength, high water consumption and brittleness. There is an urgent need to do research work pertaining to saving of water and improving strength of concrete by making modifications in curing process. The study leads to comparison of 3ways of curing techniques by means of compressive strength at 28th day. In this study the IS standard specimen tested and identified drip curing method is adaptable for different concrete need of construction. Also for curing, the drip curing method inspired from the drip irrigation system is used. This combination results in conservation of water without compromising properties of concrete.

Index Terms— Ceramic waste aggregate, Compressive strength, Concrete, Drip irrigation, Drip curing, Curing, Strength, Water conservation

1 Introduction

Concrete reduce the growth of strength gain at its early stages due to improper curing that leads the concrete not achieving the desired compressive strength.It makes the failure of total structure. The vertical member like column, in particular, is one of the most victimized RCC element-which must be carefully cured, as the entire dead and live load of super structures are supported by columns and transferred to the foundation. Unfortunately, adequate curing is not given much importance at most of the sites and traditional mathods of curing are adopted, which leads to reduction in durability of the structure [1]. The improper curing causes loss in large amount of water, evaporation of water from surface and reduction in the durability of the concrete [2]. In major cities it is banned to use domestic supply of water supplied by corporation to use [tap water] for the purpose of construction.

It is evident in form of cracks which are easily noticeable by naked eye. Unfortunately adequate curing is not given much important at most of the sites and traditional methods of curing are adopted which leads to reduction in durability of concrete and loss of large quantity water [3]. Here a comparison on 3 types of curing is done-they are immersion curing, spraying and drip curing. These types are done on normal concrete mix (M20) and also concrete containing Ceramic Waste Fine Aggregate (CWFA).

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For the study purpose a normal concrete cube and concrete containing CWFA as per IS standards (15cm x 15cm x 15cm) are casted and tested. Studies have been done in importance of curing but no study had occurred in analyzing advantages of drip curing on concrete containing CWFA.

2 Materials and Methodology

The properties of constant materials and details of mix proportion are shown in table 1. Table 2 shows that M20 (CC) grade concrete mix propotion.

TABLE 1
PROPERTIES OF CONSTANT MATERIALS

MATERIALS	*DENSITY (Kg/m3)*	*SPECIFIC GRAVITY*	*SURFACE MOISTURE*
Cement	*1438*	*3.15*	*-*
Fine aggregate	*1620*	*2.74*	*Nil*
Coarse aggregate	*1800*	*2.90*	*Nil*
CWFA	*1700*	*2.78*	*Nil*

Table 1 shows that CWFA have almost same density and specific gravity as fine aggregate and coarse aggregate .Ceramic waste are higher resistant to chemical, biological and physical degradation forces and are durable and harder.The properties of these materials make them a good and suitable choice that can be used in concrete.The use of ceramic waste in concrete effects the characteristics of green and hardened concrete and make it more durable.

TABLE 2
CONCRETE MIX PROPORTION

CEMENT(Kg)	*FINE AGGREGATE(Kg)*	*COARSE AGGREGATE(Kg)*	*W/C RATIO*
339	*754*	*1290*	*0.53*

Table 2 shows that mix proportion of M20 concrete with water cement ratio of 0.53.

2.1 Preparation of CWFA

Ceramic wastes sourced from construction and demolition wastes where crushed using a quarry metal hammer. It was sieved into fine aggregate according to the standards. This aggregate was used in the preparation of rapid curing compound by replacing conventional aggregates in various Percentages (5%, 10%, 15%, 20%, 25% and 30%) and concrete was produced. Cube was casted and cured as above mentioned three types of curing methods. 28 days compressive strength of these cubes were found according to type of curing method [5].

3 TEST PROCEDURES

The 15 x 15 x 15 cm specified concrete cube casted and cured as per different curing methods as immersion, spraying and drip up to the age of 28 days. After removal of moisture content in the specimen it is tested for compressive strength of concrete as Figure 1.

Fig. 1 Testing of cube in universal testing machine

3.1 Immersion Curing

In this concrete cubes are submerged into the water tank till the curing period gets over and every time the buckets are toped up with water to compensate the loss of water due to exothermic reaction of concrete. In this concrete gets in contact with the water for almost all the time and thus the water requirement for concrete is 100% [4].

3.2 Sprying

Sprinkling of water continuously on the concrete surface provides an efficient curing. Spraying of water is only started after the final setting period of 10 hrs. The concrete cube is kept wet continuously by sprinking water on the surface [3].

3.3 Drip curing

At site a number of pipes are used for drip curing. The network consists of mains, sub mains, secondary pipe, tertiary pipes and drip pipes. The drip pipes are the largest member of network which is kept in contact with concrete (figure 2). These pipes are connected to mains. The water is supplied to mains from an overhead water tank by gravity. The discharge is controlled by a nob attached to the main [5].

Fig. 2 The concrete cube enclosed with drip pipes.

4 METHODOLOGY

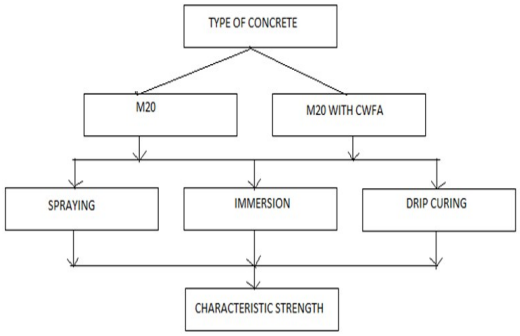

Fig. 3 methodology of reserch

Figure 3 shows that the testing procedure of research. In this three types curing method s are adopted for strength attaining for concrete at early ages (28 days)[6]. After each method of curing the specimens are tested and analysed in the terms of variation of compressive strength.

5 RESULTS AND DISCUSSION

TABLE 3

COMPRESSIVE STRENGTH OF CONCRETE

NAME OF MIX	CURING METHOD		
	SPRAYING	IMMERSION	DRIP
CC	19.51	20.1	21.33

TABLE 4

COMPRESSIVE STRENGTH OF VARIOUS MIXES UNDER DIFFERENT CURING METHODS

NAME OF MIX	% OF CWFA	CURING METHOD		
		SPRAY-ING	IMMER-SION	DRIP
CWFA-5	5	19.4	19.6	20.1
CWFA-10	10	19.6	19.9	20.2
CWFA-15	15	19.2	20.6	20.8
CWFA-20	20	19.7	21.2	21.6
CWFA-25	25	21.7	23.1	24.2
CWFA-30	30	19.8	20.1	20.8

Table 3 shows that the higher value of compressive strength of cc cube was obtained with drip curing compared to other two method of curing. Drip curing method was able to give a compressive strength of 21.33N/mm² which is the maximum out of other two methods. It may be due to countiuous moisture content at required level makes to prevent the water evaporation from the concrete when the C-S-H gel formation taken place.

Table 4 shows that the new concrete mix containing replacement of fine aggregate with CWFA was able to give higher compressive strength than that of CC cube. From the test conducted it was found that maximum percentage of CWFA as replacement of fine aggregate was 25%. Beyond this percentage of addition the compressive strength went on decreasing. It may be due to the small quantity of fine aggregate does not effect the strength of concrete. But the large quantity makes the change of zone in fine aggregate. It makes to degredation of compressive strength. Also the best result was obtained when the cube was provided with drip curing technique.

Practically drip curing is the most effective method of curing.It produced the highest level of compressive strength practically at site.This is due to non stop supply of required water to cool down the exothermic reaction of concrete,resulting from greater degree of cement hydration reaction uniformily.Since the water spreads over the area giving the concrete to absorb water and fulfill its water requirement.Without compromising with the quality and strength of concrete we can achieve the result with very less quantity of water.

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