

# STUDY ON INFLUENCE OF CURING BASED ON STRENGTH OF CONCRETE

Balaji. B<sup>1</sup>, Gokul. T<sup>2</sup>, Janathanan. T<sup>3</sup>

<sup>1,2,3</sup>Final year PG Students, Bannari Amman Institute of Technology, Sathyamangalam, INDIA

**ABSTRACT:** This experimental work was carried out to investigate the effect of concrete strength in terms of compressive and split tensile strength of normal strength M20 and medium strength M40 grade concrete by adopting Immersion curing, Wet gunny bags curing and Accelerated warm water curing as per 10262:1999, IS 9013:1978. Traditionally, quality of concrete in construction works is calculated in terms of its 28 days compressive strength. If after 28 days, the quality of concrete is found to be dubious, it would have considerably hardened by that time and also might have been buried by subsequent construction. What is essentially needed for assessing quality of controlled concrete is an acceptance test which can supply results, within about 24 hours after casting. With the assistance of reliable test methods employing accelerated curing techniques, it is now possible to test the compressive strength of concrete within a short period and thereby the test results of compressive strength and split tensile strength having good agreement with the specified strength at 28 days. The results of the investigations demonstrate that superior strength is achieved by Immersion curing than the other two types of curing. But the strength achieved in Accelerated curing is nearby to Immersion curing. So, Accelerated curing can also be used for curing also it is very much useful in Precast construction.

## I. INTRODUCTION

Concrete is a construction material which has been widely used in construction industry. Curing of concrete is a pre requisite for the hydration of the cement content. Traditionally, quality of concrete in construction works is calculated in terms of its 28 days compressive strength, this procedure requires 28 days of moist curing before testing, which is too long a period to be of any value for either concrete construction control or applying timely corrective measures. Accelerated curing is any method by which high early age strength is achieved in concrete. These techniques are especially useful in the prefabrication industry, wherein high early age strength enables the removal of the formwork within 24 hours, thereby reducing the cycle time, resulting in cost-saving benefits. The need for having a reliable and fast method for evaluating controlled concrete in the field using accelerated curing technique was recognized by Cement and Concrete Sectional Committee and as a result, the Committee decided to evolve a standard method of determining compressive strength of test specimens cured by accelerated curing methods.

## II. EXPERIMENTAL SETUP

After the specimens have been made, they shall be left to stand undisturbed in their moulds in a place free from vibration at a temperature of 27+ 2oC for at least one hour, prior to immersion in the curing tank. The time between the addition of water to the ingredients and immersion of the test specimens in the curing tank shall be at least 1hour 30 minutes but shall not exceed 3hour and 30 minutes. The specimen in their moulds shall be gently lowered into the curing tank and shall remain totally immersed at 55+ 2oC for a period of not less than 19 hours 50 minutes. The specimens shall be removed from the water, marked for identification, removed from the moulds and immersed in the cooling tank at 27+ 2oC before the completion of 20 hours 10 minutes from the start of immersion in the curing tank. They shall remain in the cooling tank for a period of not less than 1 hour. After that the specimens shall be tested while still wet, not more than 2 hours from the time of immersion in the cooling tank.

## III. RESULT AND DISCUSSION

In this study a total of 42 cubes and 42 cylinders were cast and tested. Out of those, 18 cubes and 18 cylinders were tested for each Immersion curing and wet gunny bags curing. Remaining 6 cubes and 6 cylinders were tested for Accelerated warm water curing method. For Immersion curing and wet gunny bag curing methods 9 cubes and 9 cylinders each were tested for M20 as well as M40 grade of concrete.

TABLE1: COMPRESSIVE STRENGTH RESULTS

GRADE OF CONCRETE	M20			M40		
	7 (days)	14 (days)	28 (days)	7 (days)	14 (days)	28 (days)
Immersion Curing (N/mm <sup>2</sup> )	13.88	18.67	24.6	26.83	33.83	43.6
Wet Gunny Bag Curing (N/mm <sup>2</sup> )	12.5	17.7	23.2	25.56	32.2	41.3
Accelerated Curing = 22.43(N/mm <sup>2</sup> ) (AT 55°C IN 1 DAY)				Accelerated Curing = 40.7(N/mm <sup>2</sup> )		

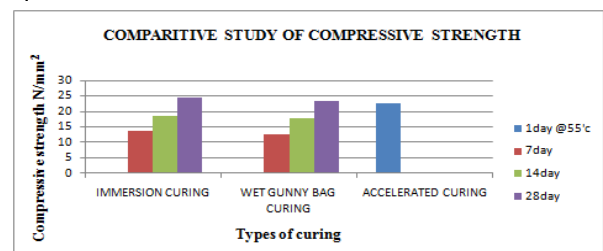


FIG 1: EFFECT OF THREE TYPES OF CURING ON COMPRESSIVE STRENGTH OF CONCRETE FOR M20 GRADE OF CONCRETE

The compressive strength of concrete cubes by immersion curing method has been achieved that 56.42% and 74.8% of 28 days strength in 7 days and 14 days respectively as shown in Fig.1. On the other hand the compressive strength of concrete cubes by wet gunny bags curing method has been achieved that 53.8% and 76.2% of 28 days strength in 7 days and 14 days respectively.

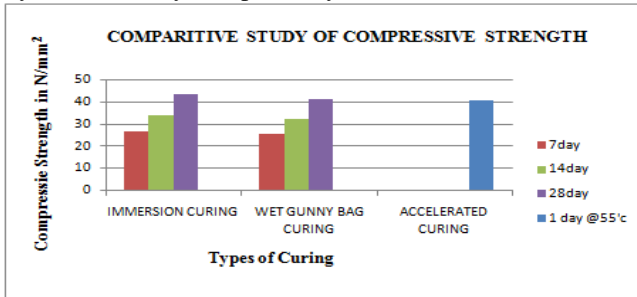


FIG 2: EFFECT OF THREE TYPES OF CURING ON COMPRESSIVE STRENGTH OF CONCRETE FOR M40 GRADE OF CONCRETE

The compressive strength of concrete cubes by immersion curing method has been achieved that 61.5% and 77.5% of 28 days strength in 7 days and 14 days respectively for M40 grade of concrete. The compressive strength of concrete cubes by Wet gunny bags curing method has been achieved that 61.8% and 77.8% of 28 days strength in 7 days and 14 days respectively for M40 grade of concrete. It was observed that the compressive strength of concrete by Immersion curing method yield higher strength when compared to the other curing methods. Since, the Immersion curing method can't be applied in practice directly; it is reliable to compare with only wet gunny bags curing method. The results indicate that the strength obtained from Wet gunny bags curing was 1.03% and 1.01% higher than Accelerated curing and 1.06% and 1.05% lesser than results obtained from Immersion curing for M20 and M40 grade of concrete respectively.

TABLE 2: SPLIT TENSILE STRENGTH RESULTS

GRADE OF CONCRETE	M20			M40		
	7 (days)	14 (days)	28 (days)	7 (days)	14 (days)	28 (days)
Immersion Curing (N/mm <sup>2</sup> )	0.87	1.26	1.63	1.61	1.95	2.47
Wet Gunny Bag Curing (N/mm <sup>2</sup> )	0.71	1.16	1.54	1.49	1.82	2.35
Accelerated Curing = 1.51(N/mm <sup>2</sup> ) (AT 55°C IN 1 DAY)				Accelerated Curing = 2.28(N/mm <sup>2</sup> )		

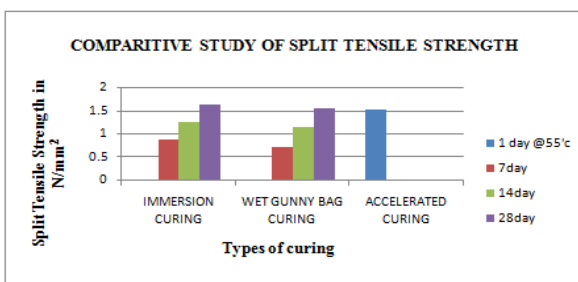


FIG 3: EFFECT OF THREE TYPES OF CURING ON SPLIT TENSILE STRENGTH OF CONCRETE FOR M20 GRADE OF CONCRETE

It was found that 53% of the strength was achieved at 7 days by Immersion curing whereas 43% of the strength was achieved at 7 days by Wet gunny bag curing. After 28 days it was seen that the strength achieved by Immersion curing and Accelerated curing was 1.06% higher and 0.98% lesser than Wet gunny bag curing respectively as shown in Figure 3.

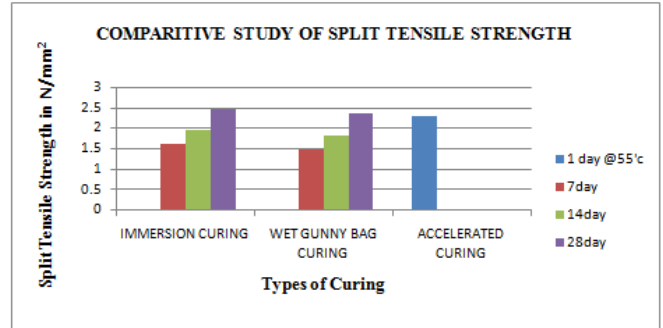


FIG 4: EFFECT OF THREE TYPES OF CURING ON SPLIT TENSILE STRENGTH OF CONCRETE FOR M40 GRADE OF CONCRETE

It was found that 65% of the strength was achieved at 7 days by Immersion curing whereas 63.4% of the strength was achieved at 7 days by Wet gunny bag curing. After 28 days it was seen that the strength achieved by Immersion curing was 1.05% higher than Wet gunny bag curing. The result obtained from Wet gunny bags curing was 1.03% higher than that of accelerated curing as shown in Figure 4.

#### IV. CONCLUSION

From the experimental test results the following conclusions were made,

- The Immersion curing and Wet gunny bag curing attained an average compressive strength of 24.6 N/mm<sup>2</sup> and 23.2 N/mm<sup>2</sup> respectively for M20 grade of concrete at the age of 28 days. At same age, the Immersion curing and Wet gunny bag curing attained an average compressive strength of 43.6 N/mm<sup>2</sup> and 41.3 N/mm<sup>2</sup> respectively for M40 grade of concrete.
- At the age of 28 days by Immersion curing and Wet gunny bag curing attained an average split tensile strength of 1.63 N/mm<sup>2</sup> and 1.54 N/mm<sup>2</sup> respectively for M20 grade of concrete. In case of M40 grade the average split tensile strength of 2.47N/mm<sup>2</sup> by Immersion curing and 2.35 N/mm<sup>2</sup> by Wet gunny bags curing respectively.
- The average compressive strength of concrete cubes with Accelerated warm water curing method equivalent to 28 days was found to be 22.43 N/mm<sup>2</sup> for M20 grade
- The average compressive strength of concrete cubes with Accelerated warm water curing method was 40.7 N/mm<sup>2</sup> for M40 grade of concrete.
- The average split tensile strength of cylinder specimens by Accelerated warm water curing method which is equal to 28 days of curing was calculated as 1.51 N/mm<sup>2</sup> for M20 grade of concrete.

- The average split tensile strength of cylinder specimens by Accelerated warm water curing method was 2.28 N/mm<sup>2</sup> for M40 grade of concrete.
- The variation in average compressive strength of concrete for a normal strength of M20 grade by Immersion curing was observed to be 1.06% higher than Wet gunny bags curing. The results of Accelerated curing was found to be 0.96% lesser than Wet gunny bags curing. The variations in average split tensile strength by Immersion curing was observed to be 1.06% higher and by Accelerated curing 0.98% lesser when compared with Wet gunny bags curing method.
- The variation in average compressive strength of concrete for a medium strength of concrete of M40 by Immersion curing was observed to be 1.06% higher than Wet gunny bags curing and by Accelerated curing it was 0.98% lesser than Wet gunny bags curing. The variations in average split tensile strength by Immersion curing was observed to be 1.05% higher and by Accelerated curing 0.97% lesser when compared with Wet gunny bags curing method.
- From the experimental values it can be concluded that the optimum strength of concrete for compressive and split tensile strength was achieved by adopting immersion curing method for both normal and medium strength concrete.
- But as immersion curing is not practically possible the strength is being compared with Wet gunny bags curing which is practically done in the site.

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