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RESEARCH ARTICLE

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INVESTIGATIONS ON CONCRETE STRENGTH BY VARIOUS CURING

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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 M20and medium strength M40 grade concrete by adopting various types of curing methods as per 10262:2009, IS 9031:1978. 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.

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.

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± 2°C 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± 2°C 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± 2°C 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.

RESULT AND DISCUSSION

In this study a total of 114 cubes and 78 cylinders were cast and tested. Out of which for each method of curing 9 cubes and 6 cylinders were being cast and tested. For Accelerated curing 6 cubes and 6 cylinders were cast and results were taken. For M20 grade a total of

TABLE 1: COMPRESSIVE STRENGTH RESULTS

GRADE OF CONCRETE	M20			M40		
CURING (in days)	3 (days)	7 (days)	28 (days)	3 (days)	7 (days)	28 (days)
Immersion Curing(N/mm^2)	7.7	13.25	24.14	15.26	27.40	43.25
Wet Gunny Bags Curing(N/mm^2)	7.18	11.93	22.51	13.77	25.48	41.55
Coir Mat Curing(N/mm^2)	7.10	11.62	22.07	12.59	25.11	41.10
Sprinkler Curing(N/mm^2)	6.66	10.88	20.59	10.74	22.74	39.70
Moist Sand Curing(N/mm^2)	7.25	11.55	21.62	11.33	23.63	40.14
Plastic Sheeting(N/mm^2)	7.25	11.92	22.12	13.62	27.03	42.81
Accelerated Curing(N/mm^2)	20.88 (@ 55°C for 1 day)			40.95 (@ 55°C for 1 day)		

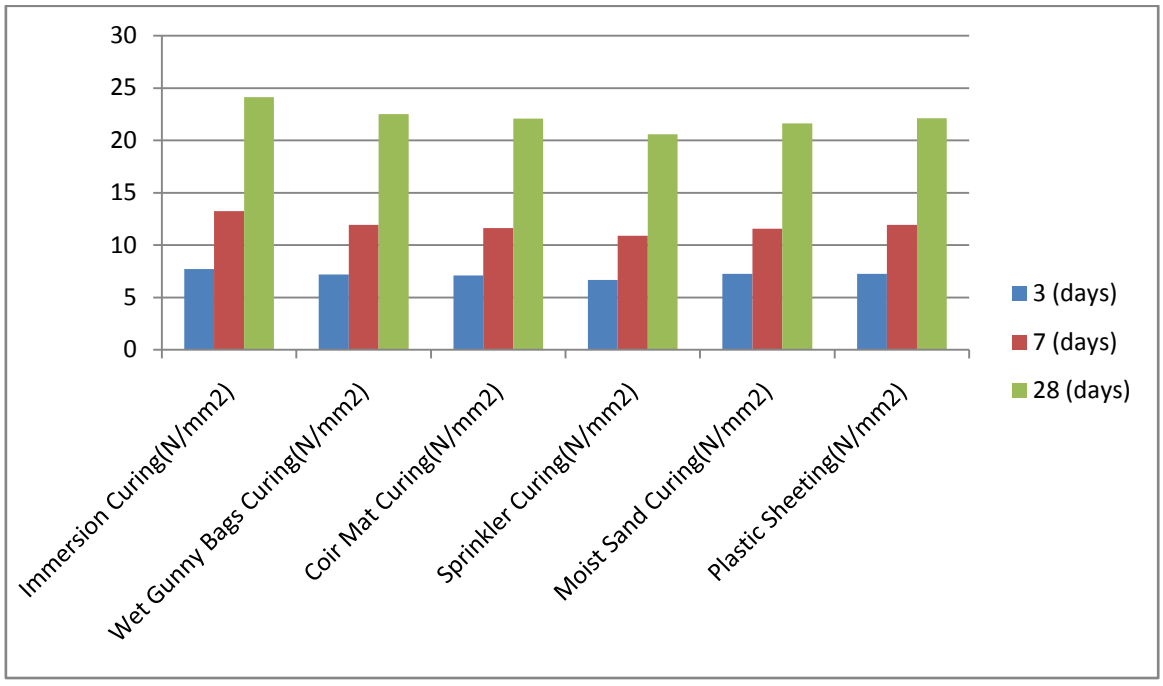

FIG 1: EFFECT OF COMPRESSIVE STRENGTH OF M20 GRADE CONCRETE BY DIFFERENT CURING METHODS

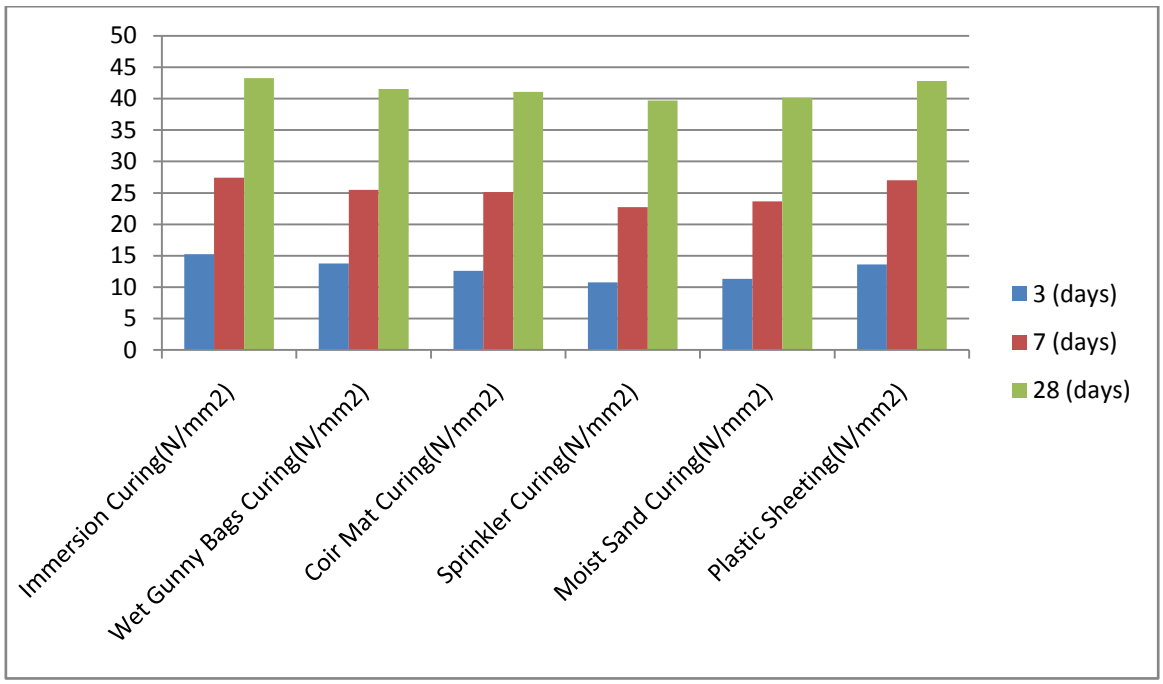

FIG 2: EFFECT OF COMPRESSIVE STRENGTH OF M40 GRADE CONCRETE BY DIFFERENT CURING METHODS

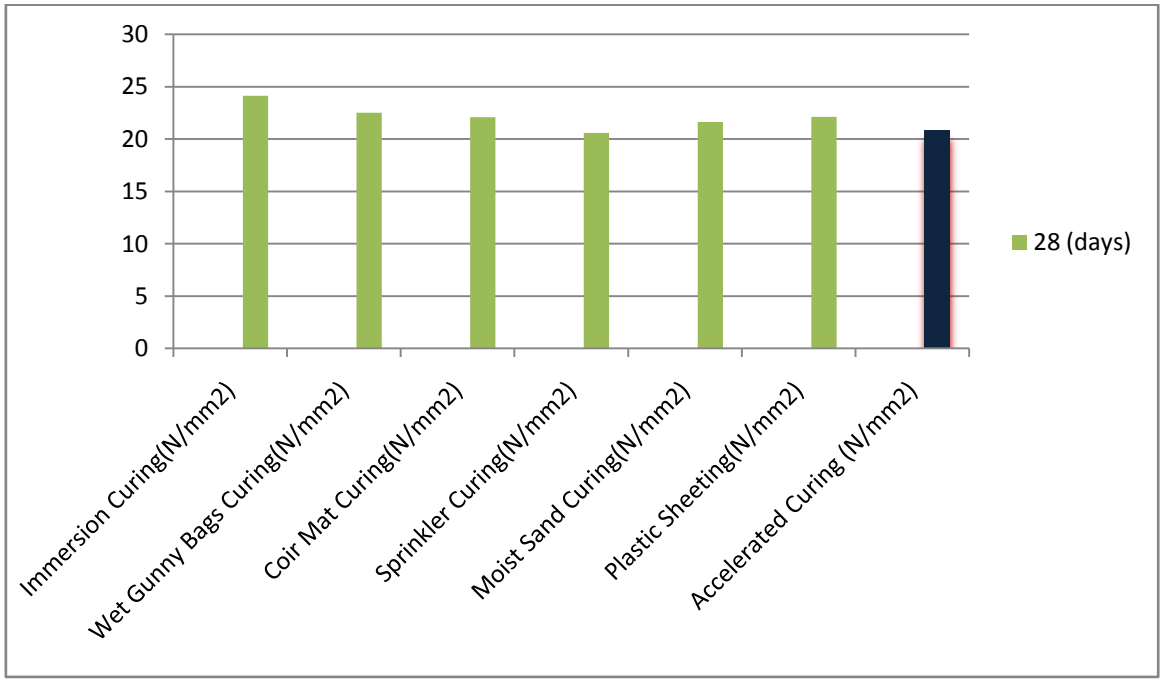

FIG 3: EFFECT ON COMPRESSIVE STRENGTH OF M20 GRADE CONCRETE BY VARIOUS CURING METHODS

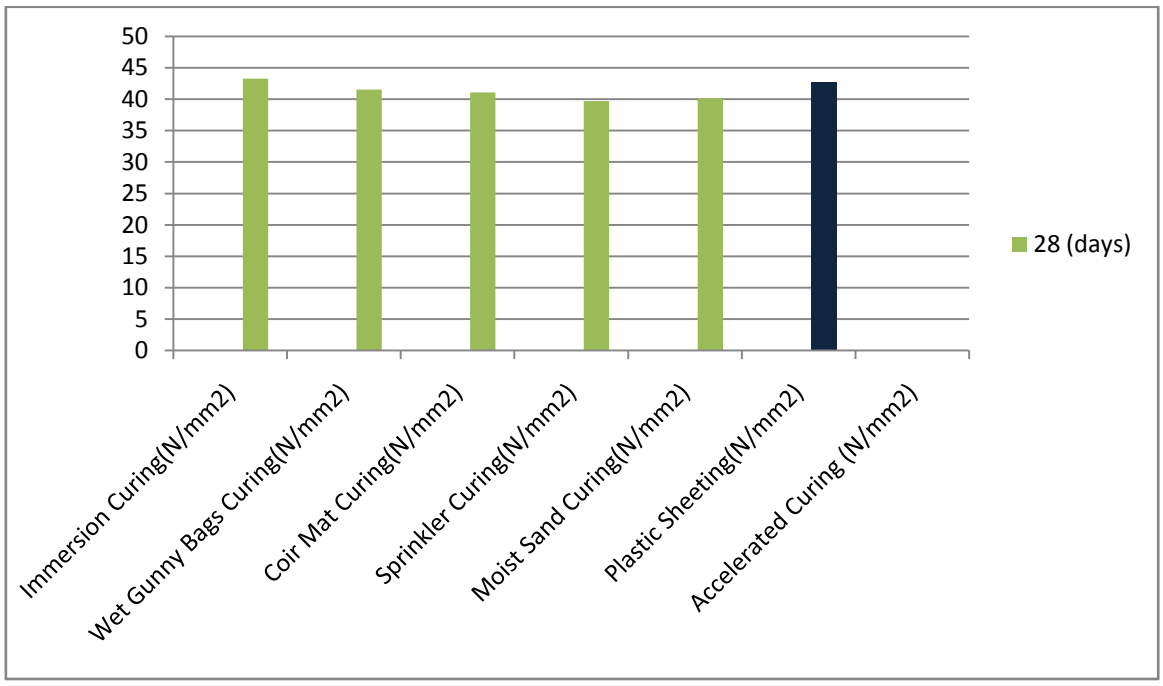

FIG 4: EFFECT ON COMPRESSIVE STRENGTH OF M40 GRADE CONCRETE BY VARIOUS CURING METHODS

TABLE 2: SPLIT TENSILE STRENGTH RESULTS

GRADE OF CONCRTE	M20		M40	
CURING (in days)	3 (days)	28 (days)	3 (days)	28 (days)
Immersion Curing(N/mm^2)	0.52	2.18	0.79	3.26
Wet Gunny Bags Curing(N/mm^2)	0.44	2.10	0.73	3.18
Coir Mat Curing(N/mm^2)	0.52	2.00	0.79	3.19
Sprinkler Curing(N/mm^2)	0.43	1.88	0.71	3.00
Moist Sand Curing(N/mm^2)	0.48	2.00	0.70	3.17
Plastic Sheeting(N/mm^2)	0.50	2.12	0.79	3.29
Accelerated Curing(N/mm^2)	2.12 (@ 55^{o}C for 1 day)		3.10 (@ 55^{o}C for 1 day)	

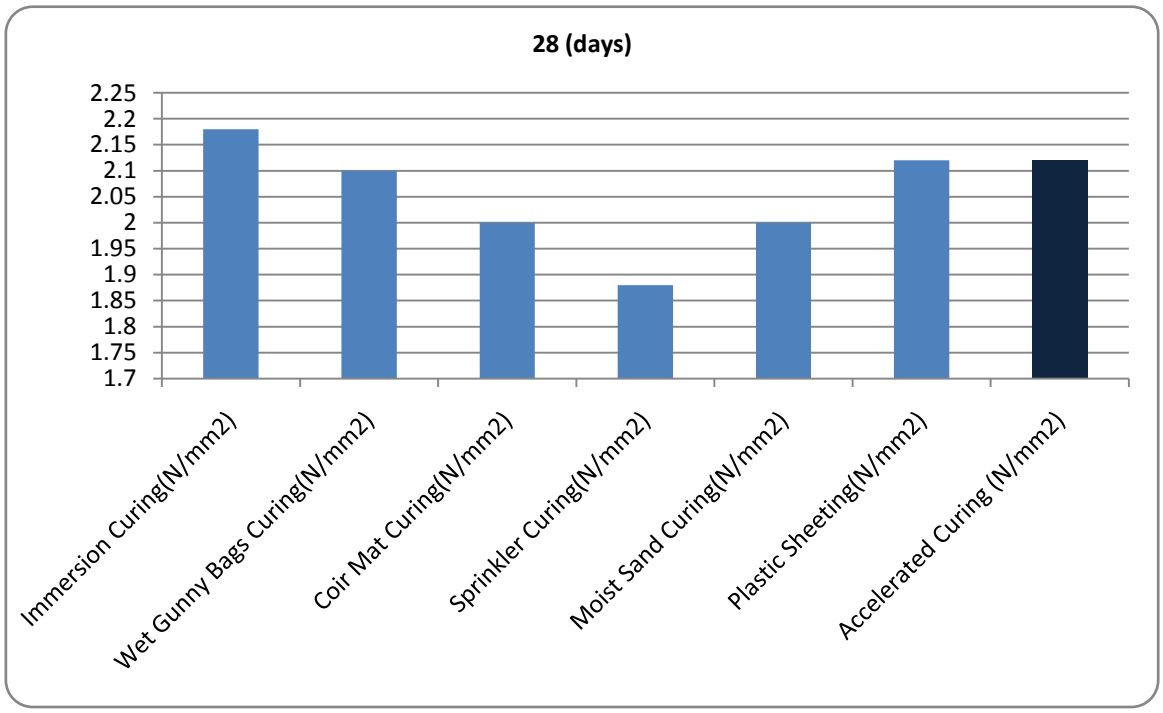

FIG 5: SPLIT TENSILE STRENGTH RESULTS FOR M20 GRADE CONCRETE BY VARIOUS CURING METHODS

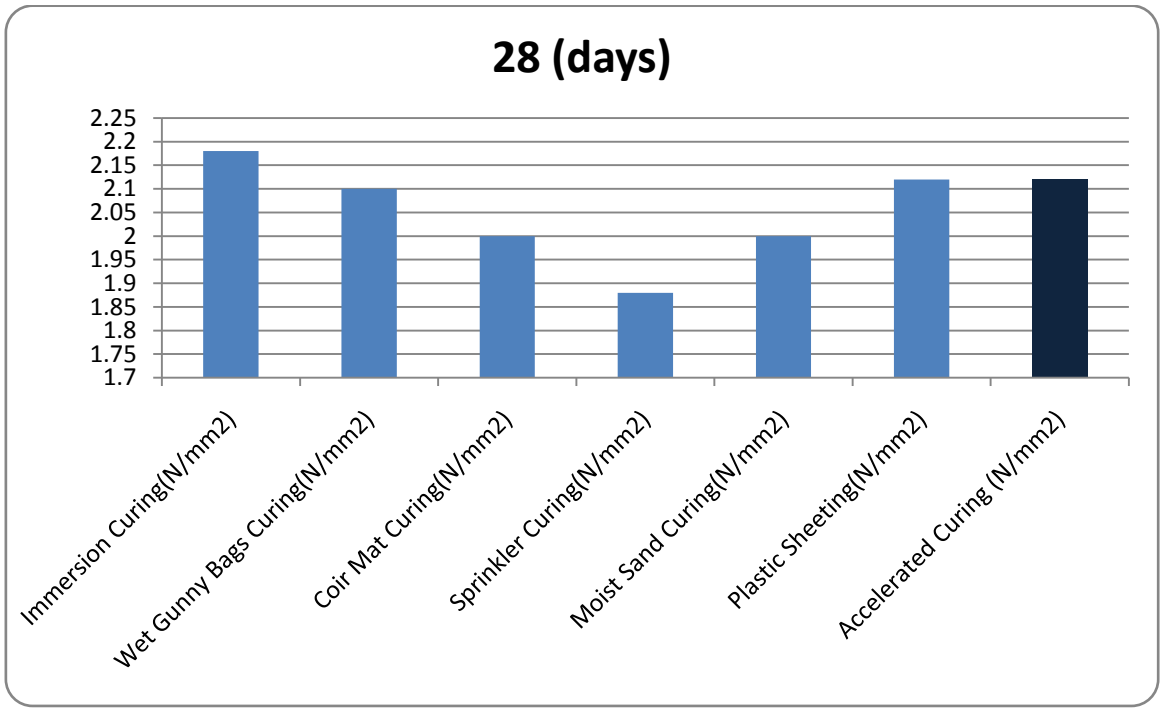

FIG 6: SPLIT TENSILE STRENGTH RESULTS FOR M40 GRADE CONCRETE BY VARIOUS CURING METHODS

CONCLUSION

From the experimental test results the following conclusions were made,

1. The Immersion curing and wet gunny bag curing attained an average compressive strength of 24.14 N/mm^2 and 22.51 N/mm^2 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 43.25 N/mm^2 and 41.55 N/mm^2 respectively for M40 grade of concrete.
2. At the age of 28 days by Immersion curing and Wet gunny bag curing attained an average split tensile strength of 2.18 N/mm^2 and 2.10 N/mm^2 respectively for M20 grade of concrete.In case of M40 grade the average split tensile strength of 3.26 N/mm^2 by Immersion curing and 3.18N/mm^2 by Wet gunny bags curing respectively.
3. The average compressive strength of concrete cubes with Accelerated warm water curing method equivalent to 28 days was found to be 20.88 N/mm^{2}and 40.95 N/mm^{2}for M20 and M40 grade of concrete.
4. 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 2.12 N/mm^{2}and 3.10 N/mm^{2}for M20 and M40 grade of concrete.
5. 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.
6. From the test result it is recommended that the accelerated curing can be adopted as a time consuming curing method in construction industry though it has around 1% of lesser compressive strength than the wet gunny bags curing system.

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