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An Experimental Investigation on Self-Curing Concrete Using Different Curing Agents

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Abstract - *In this research, the strength parameters of M20 grade self- curing concrete is compared with that of conventional concrete. Mechanical properties of self-curing concrete and conventional concrete such as compressive strength and split tensile strength are tested and compared. Curing of concrete is used for maintaining satisfactory moisture content in the concrete during its early stages in order to develop the desired properties. However, good curing is often neglected in many cases. The concept of self- curing is used to reduce the evaporation of water from the concrete and to increase the water retaining capacity of the concrete. Self-curing agents such as Paraffin wax and Sodium Polyacrylate are used. These elements prevent the evaporation of water from the concrete. Sodium Polyacrylate also aids in absorption of the moisture to compensate the loss of water due to the heat of hydration Thus, the need for application of additional water is eliminated. It is added at the rate of 0.4% to the weight of cement. Paraffin wax is applied externally after the casting of concrete. River sand is completely replaced by manufactured sand. The experiment focuses on testing the mechanical properties of the self- curing concrete prepared using different methods and compare the results with that of conventional concrete.*

Key Words*: *Self-curing; Sodium Polyacrylate; Paraffin wax

1. INTRODUCTION

Moisture plays a vital role in the curing of concrete. Curing is the procedure used for the hydration of cement. It involves the control of temperature and moisture in the concrete. This is done to ensure continuous hydration of cement and consequently aids in proper gain in strength. The strength gain in concrete stops when curing is stopped. In conventional concrete, curing is done by the application of water after mixing, placing and finishing. In self- curing, this need for external application of water is neglected. Instead, admixtures or membranes are added to prevent the evaporation of moisture from the concrete. The admixtures added also aid in absorption of moisture from the environment. In this paper, two agents are used for promoting self- curing. The materials used are Sodium Polyacrylate and Paraffin wax. Sodium Polyacrylate is a Super Absorbent Polymer(SAP). It has the capacity to hold water manifold to its original volume. This water is dissipated into the concrete when the moisture in the concrete is getting evaporated due to heat of hydration. Paraffin wax is a membrane coating that is applied over the concrete after it has been casted and demoulded. The wax acts as a sealant for the moisture present inside the concrete. Hence, requirement for the further application of water for curing is neglected. The primary objective of this research is to compare the test results of the mechanical properties of self curing concrete produced using the above mentioned two methods with that of conventional methods.

2. OBJECTIVES

- To study the strength parameters of self curing concrete by conducting hardened concrete test.
- To conduct compressive and split tensile strength tests on Sodium Polyacrylate concrete sample and Paraffin waxed concrete sample and compare the test results with that of conventional concrete.

3. MATERIALS USED

3.1. Cement

The cement used is PPC grade 53 confirming to IS 1489- 1 was used. Various tests were performed on the cement. The specific gravity of this cement was found to be 3.15. The initial setting time is 29 minutes. The final setting time was found to be 410 minutes.

3.2. Fine Aggregate

The fine aggregate used is manufactured sand (m sand). The sand was washed and screened in order to remove delirious materials. The specific gravity of the sand was found to be 2.73.

3.3. Coarse Aggregate

The coarse aggregate used is gravel of size 12mm. The specific gravity of the gravel used was found to be 1.67. The water absorption was found to be 0.396.

3.4. Sodium Polyacrylate

Sodium Polyacrylate is a Super Absorbent Polymer (SAP). They have a covalently cross linked structure. SAP has a capacity to hold water 250-300 times its own weight. It is non- toxic and non- corrosive .It has a crystalline structure

when dry but forms a transparent gel when it absorbs water. It has a density of 1.22 g/cm^3. The specific gravity of sodium polyacrylate used in the experiment is 1.2. SAP is used as an addition at the rate of 0.4% to the weight of cement.

3.5. Paraffin Wax

Paraffin wax is used as a membrane coating in the experiment. It is used as a sealant to prevent the loss of water from the concrete. The specific gravity of the wax used is 1.077. It has a density of 1.1258 g/cm^3.

Sodium Polyacrylate Paraffin Wax

Fig -1: Self- Curing Agents

3.6. Water

Water is used for mixing and curing in the experiment. The water used must be potable. It must not have any acidic or alkaline substances, salt compounds, organic materials or sugar compounds or any other material that may cause harmfulness or damage to the concrete. The water used must have a neutral pH level.

4. MIX DESIGN

Table -1: Mix Design

CEMENT (kg/m^3)	FINE AGGREGATE (kg/m^3)	COARSE AGGREGATE (kg/m^3)	WATER (liters)
479.5	884.78	835.99	215.82

5. FRESH CONCRETE TEST

5.1. Slump Cone Test

The concrete slump test is an empirical test that measures the workability of fresh concrete. The test is performed to check the consistency of freshly mixed concrete in a specific batch. Consistency refers to the ease and homogeneity with which the concrete can be mixed, placed, compacted and finished.

5.2. Compaction Factor Test

Compacting factor of fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199 – 1959. This test is used to find the degree of compaction of concrete.

6. MIXING AND CASTING

Mixing of concrete was done by hand. It was compacted using a table vibrator. The dry mix was first mixed thoroughly before the addition of water. After water was added, it was mixed swiftly and casted in cubes and cylinders. The size of the cube used is 150mm X 150mm X 150mm. The cylinders used are of 150 mm in diameter and 300 mm in height. The moulds after filling are placed in a table vibrator so as to compact it thoroughly. The moulds are removed after 24 hours. The self curing specimen is kept outside in normal environment for curing. The conventional concrete is placed in a curing tank with water.

7. HARDENED CONCRETE TEST

7.1. Compression Strength Test

Compressive strength is one of the most important properties of hardened concrete. It is tested using a concrete cube of size 150mmX 150mm X150mm. The specimen is placed in a compression testing machine of 2000KN capacity and the load is applied till the failure is reached. In this experiment, compression test is done on samples after 7 days, 14 days and 28 days.

Fig -2: Compression Strength Test

Table -2: Compression Strength Test

COMPRESSIVE STRENGTH TEST (N/mm^2)			
DAYS	7 DAYS	14 DAYS	28 DAYS
Conventional	14.05	16.25	23.87
Paraffin Wax	11.58	13.02	19.02
Sodium Polyacrylate	15.13	18.05	22.42

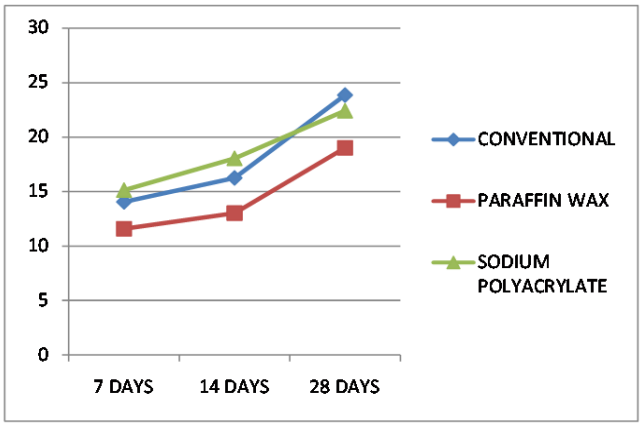

Chart -1: Compression Strength Test Result Comparison

7.2. Split Tensile Strength

Split tensile strength is used to determine the tensile strength of the concrete indirectly. It is done using a cylinder specimen of diameter 150mm and height 300mm. The specimen is placed horizontally in the compression testing machine and loaded. The test is performed for 7 days, 14 days and 28 days.

Fig -3: Split Tensile Strength Test

Table -3: Split Tensile Strength Test

SPLIT TENSILE STRENGTH TEST (N/mm²)			
DAYS	**7 DAYS**	**14 DAYS**	**28 DAYS**
Conventional	1.75	2.10	2.250
Paraffin Wax	1.52	1.825	2.125
Sodium Polyacrylate	1.925	2.345	2.025

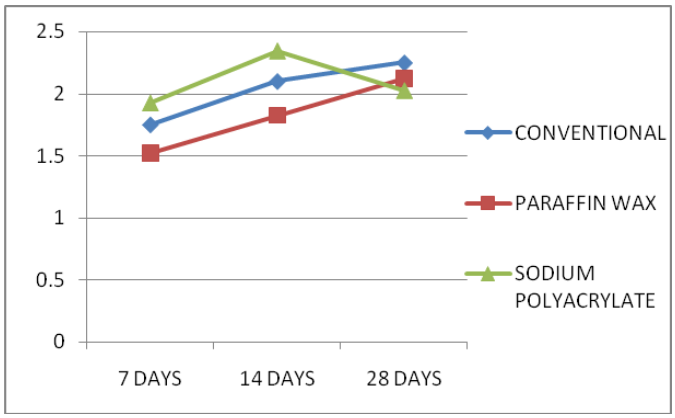

Chart -2: Split Tensile Strength Test Result Comparison

8. CONCLUSIONS

An experimental study on self- curing concrete was done using Paraffin wax and Sodium Polyacrylate and the following conclusions were drawn by conducting compressive strength and split tensile strength tests.

- The concrete with sodium polyacrylate showed 8% more compressive strength than conventional concrete at 7 days and 11% more compressive strength at 14 days.
- The sodium polyacrylate concrete showed 6% lesser compressive strength than conventional concrete at 28 days.
- The concrete with paraffin wax coating had17.5%, 19.6% and 20% lesser compressive strength than conventional concrete at 7, 14 and 28 days respectively.
- The sodium polyacrylate concrete had 10% and 11.6% higher split tensile strength than conventional concrete at 7 days and 14 days but it had 10% lesser split tensile strength at 28 days.
- The paraffin wax coated concrete had 13.1%, 13% and 5.5% lesser split tensile strength than conventional concrete at 7 days, 14 days and 28 days respectively.
- The usage of Sodium Polyacrylate as a self curing agent is more functional than Paraffin wax coating. This is because, although the strength of sodium polyacrylate concrete was lesser than that of conventional concrete, it gained the grade strength, whereas, wax coated concrete failed to achieve the grade strength.

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