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Self Curing Concrete with Light Weight Aggregate

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Abstract: ***As water is becoming a scarce material day-by-day, there is an urgent need to do research work pertaining to saving of water in making concrete and in constructions. Curing of concrete is maintaining satisfactory moisture content in concrete during its early stages in order to develop the desired properties. However, good curing is not always practical in many cases. Curing of concrete plays a major role in developing the concrete microstructure and pore structure and hence improves its durability and performance. Keeping importance to this, an attempt has been made to develop self curing concrete by using water-soluble Polyethylene Glycol as self-curing agent and light weight aggregate as Granite. The aim of this investigation is to study the strength and durability properties of concrete using water-soluble Polyethylene Glycol as self-curing agent. The function of self-curing agent is to reduce the water evaporation from concrete, and hence they increase the water retention capacity of concrete compared to the conventionally cured concrete. The use of self-curing admixtures is very important from the point of view that saving of water is a necessity everyday (each one cubic meter of concrete requires 3m3 of water in a construction, most of which is used for curing).In this study, compressive strength and split tensile strength of concrete containing self-curing agent is investigated and compared with those of conventionally cured concrete. It is found through this experimental study that concrete cast with Polyethylene Glycol as self-curing agent is stronger than that obtained by sprinkler curing as well as by immersion curing. In the present study, the affect of admixture (PEG 400) on compressive strength, split tensile strength and modulus of rupture by varying the percentage of PEG by weight of cement from 0% to 0.2% were studied for M20. It was found that PEG 400 could help in self curing by giving strength on par with conventional curing. It was also found that 0.1% of PEG 400 by weight of cement was optimum for M20 grade concretes for achieving maximum strength without compromising workability. Concrete derives its strength by the hydration of cement particles. Hydration isn't a momentary action but a long time process. Even if higher w/c ratio is used, water gets evaporated into the atmosphere leading to insufficient hydration especially in the top layer. Hence extra water needs to be added i.e., curing. Each 1m^3 of concrete requires about 3m^3 of water for construction most of which is for curing (conventional). If curing is neglected, the quality of concrete will experience a sort of irreparable loss. A self-curing concrete primarily comprising coarse aggregates, fine aggregates, cement, and mixing water, and further comprising a self-curing agent added during mixing, wherein the self-curing agent absorbs moisture from air and then releases it into the concrete, thereby achieving self-curing without external curing method after placing, wherein a specific amount of the self-curing agent is added to the concrete such that a 10% higher compressive strength than that of concrete without curing is achieved, wherein the added solid amount of the self-curing agent is about 0.1%- 0.2 wt. % of cement weight of the concrete, wherein the added self curing agent comprises polyvalent alcohol selected from the group consisting of xylitol, sorbitol, phytosterols and butylene glycol.***

Keywords: Self Curing Concrete, Light Weight Aggregate

1. Potential Materials

- Cement of 53 Grade
- Fine Aggregate
- Coarse Aggregate
- Waste Granite As Coarse Aggregate Replacement
- Peg 400

Polyethylene Glycol, Paraffin Wax, Acrylic acid are some of the commonly available hydrophilic materials in market.

2. Results

- Water retention for the concrete mixes incorporating self-curing agent is higher compared to conventional concrete mixes, as found by the weight loss with time.
- Self-curing concrete resulted in better hydration with time under drying condition compared to conventional concrete.
- Performance of the self-curing agent will be affected by the mix proportions mainly the cement content and the w/c ratio.
- Use of Polyvinyl alcohol (0.48% by the weight of cement) as self-curing agent Provides higher compressive, tensile as well as flexural strength than the Strengths of conventional mix.
- Increase in the Percentage of polyvinyl alcohol results in the reduction of weight loss.
- Durability of self-curing concrete to sulphate salts and chloride induced corrosion is needed to be evaluated.
- The result also showed that compressive, tensile and flexural strength of self-curing concrete is found to be higher than conventional concrete.
- The self-curing concrete is a self-consolidating concrete and a high performance concrete.

3. Applications

- Water scarcity
- Labor cost is high
- Water contains high fluoride content
- Inaccessible structures in difficult terrains

4. Self-Curing Concrete

4.1 Introduction

Most of the concrete that is produced and placed each year all over the world already does self-cure to some extent. Some of it is not intended to have anything done to its exterior surface, except perhaps surface finishing. Yet the concrete's ability to serve its intended purpose is not significantly reduced.

Curing is the maintaining of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties (of concrete) may develop. Curing is essential in the production of concrete that will have the desired properties. The strength and durability of concrete will be fully developed only if it is cured. No action to this end is required, however, when ambient conditions of moisture, humidity, and temperature are sufficiently favorable to curing. Otherwise, specified curing measures shall start as soon as required.

Most of the concrete in the world is placed in quantities that are of sufficient thickness such that most of the material will remain in satisfactory conditions of temperature and moisture during its early stages. Also, there are cases in which concrete has been greatly assisted in moving toward a self-curing status either inadvertently or deliberately through actions taken in the selection and use of materials.

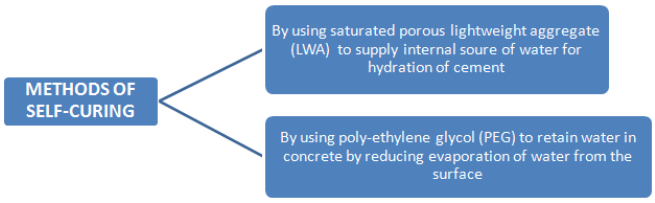
To achieve good cure, excessive evaporation of water from a freshly cast concrete surface should be prevented. Failure to do this will lead to the degree of cement hydration being lowered and the concrete developing unsatisfactory properties. Curing can be performed in a number of ways to ensure that an adequate amount of water is available for cement hydration to occur. However, it is not always possible to cure concrete without the need for applying external curing methods.

5. Self Curing

The ACI-308 code states that "Internal curing refers to the process by which the hydration of cement occurs because of the availability of additional internal water that is not part of the mixing water." "Internal curing" is often also referred as Self–curing. Self Curing Concrete can be achieved byadding self curing agents. The concept of self-curing agents is to reduce the water evaporation from concrete and hence increase the water retention capacity of the concrete. It was found that water soluble polymers can be used as self-curing agents in concrete. Curing of concrete plays a major role in developing the concrete microstructure and pore structure and hence improves its durability and performance.

Currently, there are two major methods available for internal curing of concrete. The first method uses saturated porous lightweight aggregate (LWA) in order to supply an internal source of water, which can replace the water consumed by chemical shrinkage during cement hydration. The second method uses poly-ethylene glycol (PEG) which reduces the evaporation of water from the surface of concrete and also helps in water retention.

Most paving mixtures contain adequate mixing water to hydrate the cement if the moisture is not allowed to evaporate. It should be possible to develop an oil, polymer, or other compound that would rise to the finished concrete surface and effectively seal the surface against evaporation.



6. Methods of Internal Curing in Concrete

Polyethylene Glycol

Polyethylene glycol is a condensation polymer of ethylene oxide and water with the general formula H(OCH2CH2)nOH, where n is the average number of repeating oxyethylene groups typically from 4 to about 180. The abbreviation (PEG) is termed in combination with anumeric suffix which indicates the average molecular weights. One common feature of PEG appears to be the water-soluble nature. Polyethylene glycol is non-toxic, odorless, neutral, lubricating, non-volatile and non-irritating and is used in a variety of pharmaceuticals.

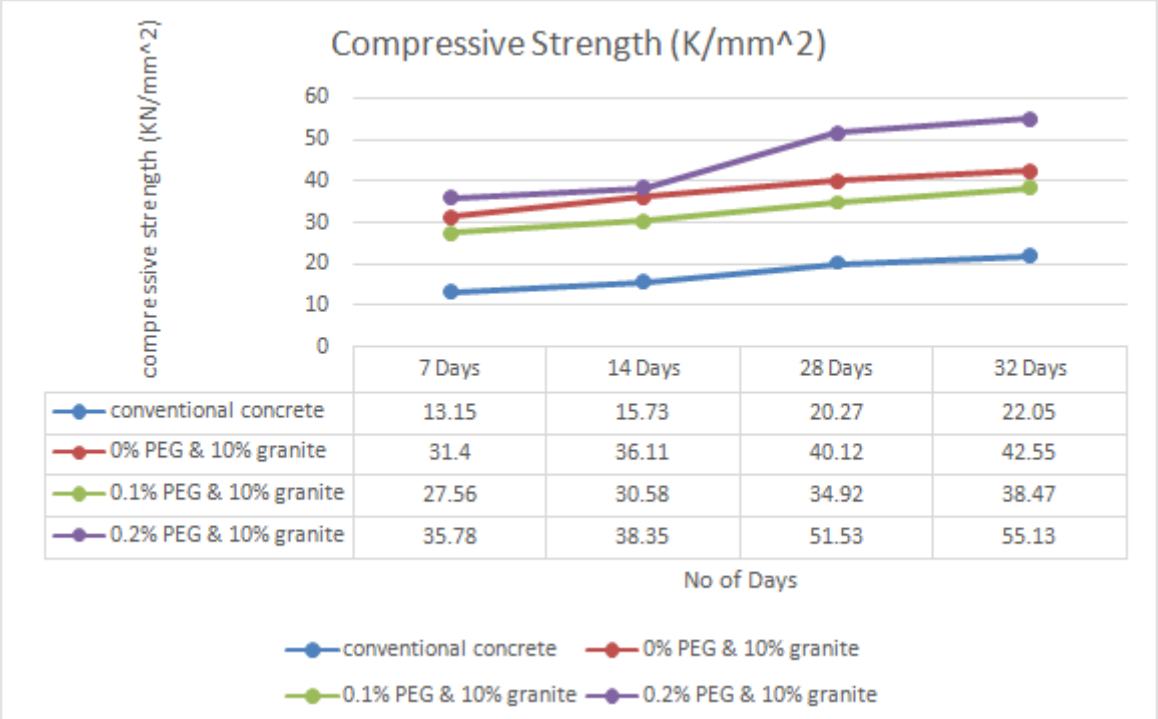
7. Experiment and Result

Compressive Strength

Overall Result of Compressive Strength

Following table gives the overall results of compressive strength concrete produced with different percentages of PEG and replacement of CA. The variation of compressive

Mix Designation	Compressive strength 7 DAYS (PC)	Compressive strength 14 DAYS (PC)	Compressive strength 28 DAYS (PC)	Compressive strength 32 DAYS (PC)
M20 **Conventional Concrete**	13.15	15.73	20.27	22.05
M20 **0% PEG & 10% Granit**	31.40	36.11	40.12	42.55
M20 **0.1% PEG & 10% Granite**	27.56	30.38	34.92	38.47
M20 **0.2% PEG & 10% Granit**	35.78	38.35	51.53	55.13

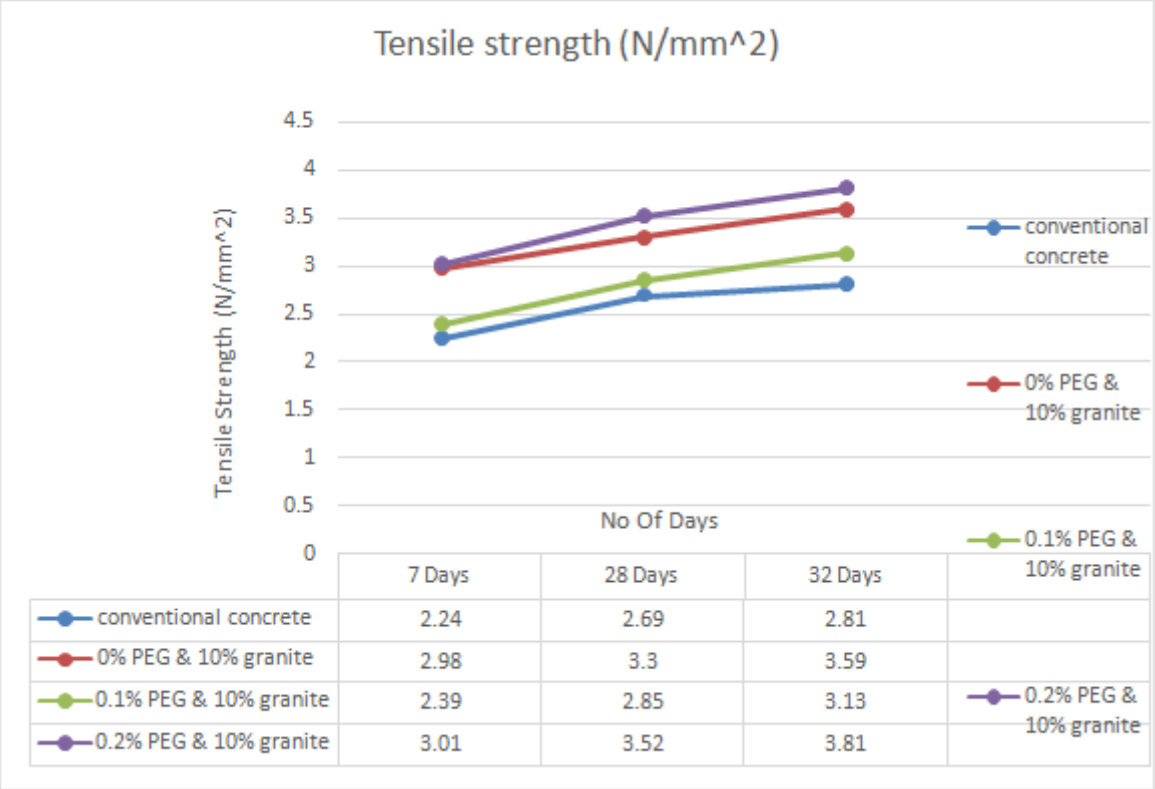


8. Graph Representation of Compressive Strength

Split Tensile Strength

Mix Designation	*Tensile Strength*	*Tensile Strength*	*Tensile Strength*
	7 DAYS (PC)	**28 DAYS (PC)**	**32 DAYS (PC)**
M20 **Conventional Concrete**	2.24	2.69	2.81
M20 **0% PEG & 10% Granit**	2.98	3.30	3.59
M20 **0.1% PEG & 10% Granite**	2.39	2.85	3.13
M20 **0.2% PEG & 10% Granit**	3.01	3.52	3.81

9. Graphical Representation of Tensile Strength



	7 Days	28 Days	32 Days
conventional concrete	2.24	2.69	2.81
0% PEG & 10% granite	2.98	3.3	3.59
0.1% PEG & 10% granite	2.39	2.85	3.13
0.2% PEG & 10% granite	3.01	3.52	3.81

10. Literature Review

Wen-Chen Jau stated that "self-curing concrete is provided to absorb water from moisture from air to achieve better hydration of cement in concrete. It solves the problem when the degree of cement hydration is lowered due to no curing or improper curing by using a self-curing agent like poly-acrylic acid which has strong capability of absorbing moisture from the atmosphere and providing water required for curing concrete".

Tarun R. Naik in 2014 stated that Most of the concrete that is produced and placed each year all over the world already does self-cure to some extent. Some of it is not intended to have anything done to its exterior surface, except perhaps surface finishing. Yet the concrete's ability to serve its intended purpose is not significantly reduced.—Curing is the maintaining of a satisfactory moisture content and temperature in concrete during its early stages so that desired properties (of concrete) may develop. Curing is essential in the production of concrete that will have the desired properties. The strength and durability of concrete will be fully developed only if it is cured. No action to this end is required, however, when ambient conditions of moisture, humidity, and temperature are sufficiently favorable to curing. Otherwise, specified curing measures shall start as soon as required. Most of the concrete in the world is placed in quantities that are of sufficient thickness such that most of the material will remain in satisfactory conditions of temperature and moisture during its early stages. Also, there are cases in which concrete has been greatly assisted in moving toward a self-curing status either inadvertently or deliberately through actions taken in the selection and use of materials. To achieve good cure, excessive evaporation of water from a freshly cast concrete surface should be prevented. Failure to do this will lead to the degree of cement hydration being lowered and the concrete developing unsatisfactory properties. However, it is not always possible to cure concrete without the need for applying external curing methods. Most paving mixtures contain adequate mixing water to hydrate the cement if the moisture is not allowed to evaporate. It should be possible to develop oil, polymer, or other compound that would rise to the finished concrete surface and effectively seal the surface against evaporation new developments in curing of concrete are on the horizon as well. In the next century, mechanization of the placement, maintenance, and removal of curing mats and covers will advance as performance-based specifications quantify curing for acceptance and payment.

11. Conclusion

1. The optimum dosage of PEG4000 for maximum Compressive strength was found to be 0.1% for grades of concrete.
2. As percentage of PEG4000 increased slump increased for M20 grade of concrete.
3. Strength of self-curing concrete is better than with conventional concrete.
4. Self-curing concrete is the answer to many problems faced due to lack of proper curing.
5. Wrapped curing is less efficient than Membrane curing and Self-Curing it can be applied to simple as well as complex shapes.
6. It is concluded from above study that method of curing has considerable effect on the compressive strength of SCC.
7. Self-curing offers a compressive strength significantly greater than uncured or dry cured SCC.

8. The experimental study shows that the use of water soluble Polyethylene Glycols is possible as a self-curing agent.

References

[1] Nirav R Kholia, Prof. Binita A Vyas, Effect on concrete by different curing method and efficiency of curing compounds International Journal of Advanced Engineering Technology, pp: 57-60, 20136. IS 456-2000, "Plain & Reinforced concrete-Code of Practice", Bureau of Indian Standards, New-Delhi, India, 4th revision, page 27
[2] IS: 516-1959, "Methods of tests for strength of concrete", Bureau of Indian Standards, New-Delhi, India.
[3] Jagannadha Kumar M.V., Srikanth M., Dr. Rao K. Jagannadha, "Strength characteristics of self-curing concrete", International Journal Of Research Engineering & Technology (IJRET), 2012, pp. 51-57.
[4] Lura, P., "Autogenous Deformation and Internal Curing of Concrete," Ph.D. Thesis, Technical University Delft, Delft, The Netherlands, 2003.
[5] C. Selvamony, M. S. Ravikumar,S ,Investigations on self-compacted self-curing concrete using limestone powder and clinkers, Vol.5,No.3 ARPN Journal of Engineering and Applied , 2010