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INTERNATIONAL JOURNAL OF
MULTIDISCIPLINARY RESEARCH & REVIEWS

journal homepage: www.ijmrr.online/index.php/home

EXPERIMENTAL STUDY ON SELF-CURING CONCRETE
MADE USING POLYETHYLENE GLYCOL

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How to Cite the Article: Gowda Manu S, B Chethan M, Koppad Raghunandan(2025).
*Experimental Study on Self-Curing Concrete made using Polyethylene Glycol. International
Journal of Multidisciplinary Research & Reviews, 4(4), 1-10.*

 <https://doi.org/10.56815/ijmrr.v4i4.2025.1-10>

Keywords

PEG-400,
Self-Curing Concrete,
Mechanical
properties,
Curing option.

Abstract

The growth in population has led to a significant surge in construction activities, which has also created challenges in water management. Water is essential in construction, particularly for mixing and curing concrete, as it plays a crucial role in the hydration of cement. In contrast, self-curing techniques are employed to reduce water wastage, as they utilize additional water that is not included in the mixing process to facilitate cement hydration. This study examines the mechanisms of self-curing nature, fresh properties and strength properties of concrete. The mechanical properties of concrete containing self-curing agents are investigated in this study. The study adopted cement content 383 kg/m³, water/cement ratio of 0.55, and 1%, 2%, 3% Polyethylene Glycol-400 were used in concrete mixes to avoid water curing. The results show that, the use of self-curing agents in concrete effectively improved the mechanical properties. The concept of several self-curing agents to reduce water evaporation from concrete and to increase the water retention capacity of concrete compared to conventional concrete. As per the result compressive strength of various mixes of M20 Grade of concrete is reliable. The study concludes that the compressive strength of mixes using self-curing compound (PEG-400) are at par with that of the concrete with conventional curing.



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1. INTRODUCTION

Concrete is a compound structure material made mainly with aggregate, cement, and water. There are many formulations of concrete, which provide varied properties, and concrete is the most-used man-made creation in the world. There are many types of concrete available, formed by varying the proportions of the main constituents below. In this way or by replacement for the cementation sand aggregate phases, the finished product can be tailored to its application with varying strength, density, or chemical and thermal resistance properties.

"Aggregate" contains of huge chunks of material in a concrete mix, usually coarse groveled crushed rocks for example limestone, or granite, laterally with finer materials such as sand, Cement, normally Portland cement, and extra as fly ash and cementations constituents such slag cement, serves as a binder for the aggregate.

Water is then mixed with this dry compound, which produces a semi-liquid that helps in shaping. The concrete hardens and toughens to rock hard strength through a chemical process called hydration. The water responds with the cement, which bonds the other mechanisms together, generating a robust stone-like material "Chemical admixtures" are added to complete varied properties. These constituents may speeder hold up the rate at which the concrete hardens, and impart many other beneficial properties.

"Mineral admixtures" are pretty more common in recent eras. The routine of recycled materials by means of concrete elements has been gaining popularity because of gradually stringent environmental legislation, and the discovery that such materials often have courtesy and valuable properties the most noticeable of these are fly ash, by product of coal-fired power plants, and silica fume, by product of industrial electric arc furnaces. The use of these materials in concrete reduces the amount of properties mandatory as the ash and fume acts as a cement replacement. This displaces some cement production, an actively expensive and environmentally tricky process, while reducing the quantity of industrial waste that must be disposed. The mix design depends on the type of construction being built, how the concrete mixed, delivered, and placed to the structure

• EXPERIMENTAL PROGRAMME

Materials and Mix Proportion

Cement: The Ordinary Portland cement of 43-grade PPC was used in this study conforming to IS: 12269- 1987 [8] mentioned In table 1.

Table 1: Physical Properties of Ordinary Portland Cement (43-Grade PPC)

Sl. No.	Test	Results
1	Consistency of cement	32%
2	Specific gravity	3.08
3	Initial setting time	78 mint
4	Final setting time	298 mint



Gowda Manu S, B Chethan M, Koppad Raghunandan(2025). *Experimental Study on Self-Curing Concrete made using Polyethylene Glycol. International Journal of Multidisciplinary Research & Reviews, 4(4), 1-10.*

Fine Aggregates: The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970 [4], having specific gravity of 2.54 and fineness modulus of 3.25 has been used as fine aggregate for this study and mentioned In table 2.

Table 2: Physical Properties of Fine Aggregates (River Sand)

Sl. No.	Tests	Results
1	Specific gravity	2.818
2	Sieve analysis	3.25
3	Bulk density of fine aggregate	1.88 kg/m ³

Coarse Aggregate: Coarse aggregate obtained from local quarry units has been used for this study, conforming to IS: 383-1970 [4] is used. Maximum size of aggregate used is 20mm with specific gravity of 2.6 and fineness modulus of 7.3 shown in table 3.

Table 3: Physical and Mechanical Properties of Coarse Aggregates

Sl. No.	Tests	Results
1	Fineness Modulus of Coarse Aggregate	2.48
2	Shape Test on Aggregate	11.58% & 47.32%
3	Angularity Number	9
4	Aggregate on Crushing Value	11.01%
5	Abrasion Test on Aggregate	20.32%
6	Impact Test on Aggregate	8.57%

Water

Conventional water: The water used for experiments was tap water conforming as per IS:456-2000
 Polyethylene Glycol-400(PEG-400): The polymers added in the mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules of water which in turn reduces the vapor pressure, thus reducing the rate of evaporation from the surface, mentioned in table 4 and shown in figure 1.



Figure 1: Polyethylene Glycol-400 (PEG-400) container



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Table 4: Properties of Polyethylene Glycol-400(PEG-400)

Sl. No.	Description	Properties
1	Molecular Weight	400
2	Appearance	Clear Fluid
3	Moisture	0.2%
4	pH	6
5	Odor	Mild Odor
6	Solubility	Soluble in Water
7	Density	1.1–1.2
8	Specific Gravity	1.12

Experimental procedure:

In this experiment for M20 Grade concrete mixes were designated in accordance with IS: 10262-2009. Conventional concrete was casted for cube sand cylinder with M20 grade concrete mix and made to water curing. Another set of cubes and cylinders were casted using PEG-600 of 1%, 2% and 3% with M20 concrete and allowed for atmosphere curing. Similarly cubes were casted for 7, 14 and 28 days for conventional and PEG 400 to study the strength properties (compressive strength, split tensile strength and flexural strength). For this experimental study a total of 24 cubes and 24 cylinder and 3 beam were casted for determine the strength properties mentioned in table 5.

Mix Design Proportion:

Table 5: Mix Design Proportion for M20

Mix Design	Water (Kg/M ³)	Cement(Kg/M ³)	Fine Aggregate	Coarse Aggregate	Proportion
M20	191.6	383.00	727.00	1103	1:1.5:3

2. RESULT AND DISCUSSION

Compressive strength:

The compressive strength of all the concretes study either self- curing or conventional concrete, will increase gradually with time different rates under curing. Compressive strength systematically increases a self- curing agent used in the concrete. The results justifies that the various percentage of polyethylene glycol does not alter the strength properties of concrete cured with chemical curing without water .The optimum strength of polyethylene glycol with optimum of 2 percent giving better results compared other percentage mentioned in table 6,7,8.



Gowda Manu S, B Chethan M, Koppad Raghunandan(2025). *Experimental Study on Self-Curing Concrete made using Polyethylene Glycol. International Journal of Multidisciplinary Research & Reviews, 4(4), 1-10.*

Table 6: Compressive strength for 1% of polyethylene glycol

Sl. No.	Specimen	Age of Cubes In Days	Crushing Load In KN	Compressive Strength In N/Mm ²	Avg Value In N/mm ²
1	With PEG-1%	7 Days	246	10.93	11.80
2			234	10.50	
3			309	13.80	
1	With PEG-1%	14 Days	480	21.5	21.03
2			463	20.60	
3			472	21.00	
1	With PEG-1%	28 Days	546	24.30	23.20
2			507	22.53	
3			501	22.26	

Table 7: Compressive strength for 2% of polyethylene glycol

Sl. No.	Specimen	Age of Cubes In Days	Crushing Load In KN	Compressive Strength In N/mm ²	Avg Value In N/mm ²
1	With PEG-2%	7 Days	334	14.90	13.30
2			309	13.80	
3			251	11.20	
1	With PEG-2%	14 Days	468	20.80	21.60
2			482	21.42	
3			508	22.57	
1	With PEG-2%	28 Days	510	22.70	24.15
2			527	23.42	
3			516	22.95	



Gowda Manu S, B Chethan M, Koppad Raghunandan(2025). *Experimental Study on Self-Curing Concrete made using Polyethylene Glycol. International Journal of Multidisciplinary Research & Reviews, 4(4), 1-10.*

Table 8: Compressive strength for 3% of polyethylene glycol

Sl. No.	Specimen	Age of Cubes In Days	Crushing Load In KN	Compressive Strength In N/mm ²	Avg Value In N/mm ²
1	With PEG-3%	7 days	335	14.90	14.70
2			326	14.50	
1	With PEG-3%	14 days	508	22.60	21.80
2			468	20.80	
1	With PEG-3%	28 days	570	25.33	23.82
2			501	22.26	

Split Tensile strength:

The below results obtained clears that even the split tensile strength of concrete shows better results with 2 percent of polyethylene glycol without affecting mechanical properties of concrete mentioned in table 9,10,11.

Table 9: Split tensile strength for 1% of polyethylene glycol

Sl. No.	Specimen	Age of Cubes In Days	Crushing Load In KN	Compressive Strength In N/mm ²	Avg Value In N/mm ²
1	With PEG-1%	7 Days	117	2.60	2.40
2			108	2.40	
3			99	2.20	
1	With PEG-1%	14 Days	129	2.86	2.93
2			123	2.73	
3			144	3.20	
1	With PEG-1%	28 Days	145	3.22	3.5
2			176	3.9	
3			153	3.4	



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Table 10: Split tensile strength for 2% of polyethylene glycol

Sl. No.	Specimen	Age of Cubes In Days	Crushing Load In KN	Compressive Strength In N/mm ²	Avg Value In N/mm ²
1	With PEG-2 %	7 Days	108	2.42	2.30
2			98	2.17	
3			95	2.11	
1	With PEG-2 %	14 Days	129	2.8	2.24
2			89	1.9	
3			92	2.04	
1	With PEG-2 %	28 Days	92	2.04	2.33
2			109	2.4	
3			115	2.55	

Table 11: Split tensile strength for 3% of polyethylene glycol

Sl. No.	Specimen	Age of Cubes In Days	Crushing Load In KN	Compressive Strength In N/mm ²	Avg Value In N/mm ²
1	With PEG-3 %	7 Days	108	109	2.30
2			98	93	
3			95	93	
1	With PEG-3 %	14 Days	129	2.86	2.73
2			115	2.60	
3			115	2.60	
1	With PEG-3 %	28 Days	142	3.13	3.06
2			135	3	
3			142	3.13	



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Flexural Strength:

The flexural strength of beams increased with higher percentages of PEG, showing improved performance at 2% and reaching a peak of 6.22 N/mm² at 3% PEG. The average flexural strength of the PEG-modified beams was 5.27 N/mm², indicating the beneficial effect of PEG on flexural behaviour mentioned in table 12.

Table 12: Flexural Strength Results of Beams with Different PEG Dosages

Sl. No.	Beam Specimen	Weight Kg	Length mm	Distance B/W The Line of Fracture And Near Support	Load At Failure KN	Flexural Strength N/mm ²	Avg Strength N/mm ²
1	With PEG-1%	32.6	600	197	26	4.62	5.27
2	With PEG-2%	35.8	600	213	28	4.97	
3	With PEG-3%	36.2	600	208	35	6.22	

3. CONCLUSION:

The experimental investigation demonstrates that the optimum dosage of PEG-400 for M20 grade concrete is 1.0%, at which the maximum compressive strength was obtained. Self-curing concrete exhibited superior mechanical performance—including compressive, split tensile, and flexural strengths—when compared to conventionally cured concrete, indicating a significant reduction in pore structure and enhanced material efficiency. The self-cured specimens consistently achieved higher strength values than those produced through traditional curing methods, with strength development at 7, 14, and 28 days comparable to or exceeding that of conventional concrete. The incorporation of PEG-400, functioning as a shrinkage-reducing and water-retentive polymer, effectively improved the curing process and overall durability characteristics. Given its cost-effectiveness and the ready availability of its components, self-curing concrete presents a viable and advantageous alternative for practical construction applications.

4. AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

5. CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.



Gowda Manu S, B Chethan M, Koppad Raghunandan(2025). *Experimental Study on Self-Curing Concrete made using Polyethylene Glycol. International Journal of Multidisciplinary Research & Reviews, 4(4), 1-10.*

6. PLAGIARISM POLICY

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7. SOURCES OF FUNDING

The authors received no financial aid to support for the research.

REFERENCES

- [1] Riyazahamed.K, Pradeepkumar.A, Kalaivani.K.Kingstabeautlin, “Experimental Ignosulph Study On Self Curing Concrete Using Sodiumlonate”, International Journal Of Emerging Technologies And Engineering (IJET) Volume 2 Issue 4, April 2015.
- [2] N. Y. Elwakkad, KH.M. Heiza, Dr Aqial Eladly, “Review On–Self-Curing Concrete”, International Conference On Non Technology In Construction, March 2019.
- [3] Patel Manishkumar Dahyabhai, Prof. Jayeshkumar R. Pitroda, “Introducing The Self-Curing Concrete In Construction Industry”, International Journal Of Engineering Research & Technology (IJERT) IJERT ISSN: 2278-0181, March 2014.
- [4] Rahul Dev, R. Navaneethan, “Self-Curing Concrete”, International Journal of Advance Research, Ideas and Innovations in Technology.
- [5] Bentz, D.P., “Influence of Curing Conditions on Water Loss and Hydration in Cement Pastes with and without Fly Ash Substitution,” NISTIR 6886, U.S. Dept. Commerce
- [6] Bentz, D.P., And Snyder, K.A., “Protected Paste Volume In Concrete: Extension To Internal Curing Using Saturated Lightweight Fine Aggregates,” Cement And Concrete Research. 29, 1863-1867, 1999.
- [7] Cusson, D., And Hoogeveen,T., “Internally-Cured High- Performance Concrete Under Restrained Shrinkage And Creep,” CONCREEP 7 Workshop On Creep, Shrinkage And Durability Of Concrete And Concrete Structures, Nantes, France, Sept.12-14, 2005, Pp. 579-584.
- [8] Dhir, R.K.Hewlett, P.C.Dyer, T.D., “Mechanisms Of Water Retention In Cement Pastes Containing A Self-Curingagent,” Magazine Of Concrete Research, Volno50, Issueno1, 1998, Pp85-90.



Gowda Manu S, B Chethan M, Koppad Raghunandan(2025). *Experimental Study on Self-Curing Concrete made using Polyethylene Glycol. International Journal of Multidisciplinary Research & Reviews, 4(4), 1-10.*

[9] Geiker, M.R., Bentz, D.P., And Jensen, O.M., “Mitigating Autogenous Shrinkage By Internal Curing”, High Performance Structural Lightweight Concrete, SP-218,

[10] J.P. Ries And T.A. Holm, Eds., American Concrete Institute, Farmington Hills, MI, 2004, Pp. 143-154.

[11] M.V.Jagannadhakumar, M.Srikanth, Dr.K.Jagannadharao, “Strength Characteristics of Self-Curing Concrete” IJRET | Sep 2012.

