Comparative and Experimental Study on Self Curing Concrete

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ABSTRACT

High-performance concrete is defined as concrete that meets special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices. Ever since the term high-performance concrete was introduced into the industry, it had widely used in large-scale concrete construction that demands high strength, high flow ability, and high durability. A high-strength concrete is always a high-performance concrete, but a high-performance concrete is not always a high-strength concrete.

Durable concrete Specifying a high-strength concrete does not ensure that a durable concrete will be achieved. It is very difficult to get a product which simultaneously fulfills all of the properties. So the different pozzolanic materials like Ground Granulated Blast furnace Slag (GGBS), silica fume, Rice husk ash, Fly ash, High Reactive Metakaolin, are some of the pozzolanic materials which can be used in concrete as partial replacement of cement, which are very essential ingredients to produce high performance concrete. So we have performed XRD tests of these above mentioned materials to know the variation of different constituent within it. Also it is very important to maintain the water cement ratio within the minimal range, for that we have to use the water reducing admixture i.e superplasticizer, which plays an important role for the production of high performance concrete. So we herein the project have tested on different materials like rice husk ash, Ground granulated blast furnace slag, silica fume to obtain the desired needs. Also X-ray diffraction test was conducted on different pozzolanic material used to analyse their content ingredients. We used synthetic fiber (i.e Recron fiber) in different percentage i.e 0.0%, 0.1%, 0.2%, 0.3% to that of total weight of concrete and casting was done. Finally we used different percentage of silica fume with the replacement of cement keeping constant fiber content and concrete was casted. In our study it was used two types of cement, Portland slag cement and ordinary Portland cement. We prepared mortar, cubes, cylinder, prism and finally compressive test, splitting test, flexural test are conducted. Finally porosity and permeability test conducted. Also to obtain such performances that cannot be obtained from conventional concrete and by the current method, a large number of trial mixes are required to select the desired combination of materials that meets special performance.

1. INTRODUCTION

1.1 Curing

Curing is the process of controlling the rate and extent of moisture transport from concrete during Cement hydration. It may be either after it has been placed in position (or during the manufacture of concrete products), thereby providing time for the hydration of the cement to occur. Since the hydration of cement does take time in days, and even weeks rather than hours curing must be undertaken for a reasonable period of time, if the concrete is to achieve its potential strength and durability. Curing may also encompass the control of temperature since this affects the rate at which cement hydrates. The curing period may depend on the properties required of the concrete, the purpose for which it is to be used, and the ambient conditions, i.e. the temperature and relative humidity of the surrounding atmosphere. Curing is designed primarily to keep the concrete moist, by preventing the loss of moisture from the concrete during the period in which it is gaining strength.

Conventional Curing Methods

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Methods of curing concrete fall broadly into the following categories:

- Minimise moisture loss from the concrete, for example by covering it with a relatively impermeable membrane.
- Prevent moisture loss by continuously wetting the exposed surface of the concrete.
- Steam curing.
- Ponding or spraying the surface with water.

**Difficulties in conventional curing methods**

- For the vertical member it is not possible to keep the surface moist as in case of the flat surfaces.
- In the places where there is scarcity of water.
- In the places where manual curing is not possible.
- A human error may lead to the cracking in the member and also decreases its strength i.e. when curing water is not provided at the right time.

**1.2 Self Curing**

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. Several investigators explored the possibility of accomplishing self curing concrete. Therefore, the need to develop self-curing agents attracted several researchers. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. It was found that water soluble polymers can be used as self-curing agents in concrete. Concrete incorporating self-curing agents will represent a new trend in the concrete construction in the new millennium. Curing of concrete plays a major role in developing the concrete microstructure and pore structure, and hence improves its durability and performance. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete. The use of self-curing admixtures is very important from the point of view that water resources are getting valuable every day (i.e., each 1cu.m of concrete requires about 3cu.m of water for construction most of which is for curing).

Excessive evaporation of water (internal or external) from fresh concrete should be avoided; otherwise, the degree of cement hydration would get lowered and thereby concrete may develop unsatisfactory properties. Curing operations should ensure that adequate amount of water is available for cement hydration to occur. This investigation discusses different aspects of achieving optimum cure of concrete without the need for applying external curing methods. The effect of curing, particularly new techniques such as "self-curing", on the properties of high performance concrete is of primary importance to the modern concrete industry.

**1.3 Definition of self curing**

Conventionally, curing concrete means creating conditions such that water is not lost from the surface i.e., curing is taken to happen ‘from the outside to inside’. In contrast, ‘internal curing’ is allowing for curing ‘from the inside to outside’ through the internal reservoirs (in the form of saturated lightweight fine aggregates, superabsorbent polymers, or saturated wood fibres) Created. ‘Internal curing’ is often also referred as ‘Self–curing’.

“Self-curing concrete” means that no labour work is required to provide water for concrete, or even no any external curing is required after placing which the properties of this concrete are at least comparable to and even better than those of concrete with traditional curing.

Self-curing is an "internal curing system" where a water- soluble polymer is added to the concrete mix. This method overcomes the difficulty in ensuring that effective curing procedures are employed by the construction personnel as the internal curing composition is a component of the mix.

**1.4 Potential Materials For Self Curing**

The following materials can provide internal water reservoirs:

- Lightweight Aggregate (natural and synthetic, expanded shale),
- LWS Sand (Water absorption =17 %)
- LWA 19mm Coarse (Water absorption = 20%)
- Super-absorbent Polymers (SAP) (60-300 mm size)
- SRA (Shrinkage Reducing Admixture)
- Wood powder.
1.5 Chemicals To Achieve Self-Curing
Some specific water-soluble chemicals added during the mixing can reduce water evaporation from and within the set concrete, making it ‘self-curing.’ The chemicals should have abilities to reduce evaporation from solution and to improve water retention in ordinary Portland cement matrix.

Following are the list of some chemicals which are hydrophilic in nature.

➢ Polyvalent alcohol
➢ Polyethylene glycol (peg)
➢ Poly-acrylic acid
➢ Xylitol, sorbitol
➢ Glycerine
➢ Phytosterols
➢ Hyaluronic acid
➢ Polyxyehylene (poe)
➢ Sodium pyrrolidone carboxylate (pca-na),
➢ Stearyl alcohol
➢ Cetyl alcohol
➢ Thermosetting polymers
➢ Urethanes

1.6 Classification Of Aggregates
For the purpose of this report, the following classifications are adopted.

1.6.1 Natural Aggregate
Construction aggregates produced from natural sources such as gravel and sand, and extractive products such as crushed rock, some of the examples are Crushed rock, Sand and gravel, Crushed river gravel.

1.6.2 Manufactured Aggregate
Aggregates manufactured from selected naturally occurring materials, by-products of industrial processes or a combination of these, some of the examples are Foamed Blast Furnace Slag (FBS), Fly Ash Aggregate, Manufactured Sand, Polystyrene Aggregate (PSA), Expanded Clays, Shale’s and Slates.

1.6.3 Recycled Aggregate
Aggregates derived from the processing of materials previously used in a product and/or in construction, some of the examples are Recycled Concrete Aggregate (RCA), Recycled Concrete and Masonry (RCM), Reclaimed Aggregate (RA), Reclaimed Asphalt Pavement (RAP), Reclaimed Asphalt Aggregate (RAA), Glass Cullet, Scrap Tyres, Used Foundry Sand.

1.6.4 Reused By-product
Aggregates produced from by-products of industrial processes, some of the examples are Air-cooled BF Slag (BFS), Granulated BF Slag (GBS), Electric Arc Furnace Slag (EAF), Steel Furnace Slag (BOS), Fly Ash (FA), Furnace Bottom Ash (FBA), Incinerator Bottom Ash (IBA), Coal Washer Reject (CWR), Organic Materials, Crusher fines, Mine tailings.

1.7 Sources of Recycled Aggregate
Traditionally, Portland concrete aggregate from the demolition construction are used for landfill. But now days, Portland concrete aggregate can be used as a new material for construction usage. According to recycling of Portland Cement Concrete, recycled aggregates are mainly produced from the crushing of Portland concrete pavements and structures building.

The main reason for choosing the structural building as the source for recycled aggregate is because a huge amount of crushed demolition Portland cement concrete can be produced.

1.8 Applications of Recycled Aggregate
General, applications without any processing include:

➢ Many types of general bulk fills
➢ Bank protection
➢ Base or fill for drainage structures
➢ Road construction
➢ Noise barriers and embankments

Most of the unprocessed crushed concrete aggregate is sold as 37.5 mm or 50 mm fraction for pavement sub-bases.

After removal of contaminants through selective demolition, screening, and/or air separation and size reduction in a crusher to aggregate sizes, crushed concrete can be used as:

➢ New concrete for pavements
➢ Shoulders
➢ Median barriers
➢ Sidewalks
➢ Curbs
➢ Gutters
➢ Bridge foundations

1.9 The Use of Recycled Aggregate in Concrete
The use of crushed aggregate from either demolition concrete or from hardened leftover concrete can be regarded as an alternative coarse aggregate, typically blended with natural coarse aggregate for use in new concrete. The use of 100% recycled coarse aggregate in concrete, unless carefully managed and controlled, is likely to have a negative influence on most concrete properties – compressive strength, modulus...
of elasticity, shrinkage and creep, particularly for higher strength concrete. Also the use of fine recycled aggregate below 2 mm is uncommon in recycled aggregate concrete because of the high water demand of the fine material smaller than 150 μm, which lowers the strength and increases the concrete shrinkage significantly. Many overseas guidelines or specifications limit the percentage replacement of natural aggregate by recycled aggregate.

In general leftover concrete aggregate can be used at higher replacement rates than demolition concrete aggregate. With leftover concrete aggregate, information will generally be known about the parent concrete – strength range and aggregate source etc., whereas for demolition concrete very little information may be known about the parent concrete, and the resulting aggregate may be contaminated with chlorides or sulphates and contain small quantities of brick, masonry or timber which may adversely affect the recycled aggregate concrete. Often the sources of material from which a recycled aggregate came (and there could be more than one source), are unknown and the variability and strength of the recycled aggregate concrete could be adversely affected in comparison with a recycled aggregate concrete where the recycled aggregate came from one source with a known history of use and known strength.

Fig: 1.1 Use of Recycled Aggregate in Concrete

It is therefore necessary to distinguish between the properties of recycled aggregate concrete made using demolition concrete aggregate and that using leftover concrete aggregate. Nevertheless, recycled aggregate concrete can be manufactured using recycled aggregate at 100% coarse aggregate replacement where the parent concrete, the processing of the recycled aggregate and the manufacture of the recycled aggregate concrete are all closely controlled. However as target strengths increase, the recycled aggregate can limit the strength, requiring a reduction in recycled aggregate replacement.

1.10 Need of Present Work
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. Several investigators explored the possibility of accomplishing self-curing concrete. Therefore, the need to develop self-curing agents attracted several researchers. The concept of self-curing agents is to reduce the water evaporation from concrete, and hence increase the water retention capacity of the concrete compared to conventional concrete.

A self-curing concrete is provided to absorb water from atmosphere to achieve better hydration of cement in concrete. It solves the problem that the degree of cement hydration is lowered due to no curing or improper curing, and thus unsatisfactory properties of concrete.

It is now widely accepted that there is a significant potential for reclaiming and recycling demolished Debris for use in value added applications to maximize economic and environmental benefits. At present converts low value waste into secondary construction materials such as a variety of aggregate grades, road materials and aggregate fines (dust). Often these materials are used in as road construction, backfill for retaining walls, low-grade concrete production, drainage and brickwork and block work for low-cost housing. Due to issues relating to sustainability and limited natural resources, it is clear that the use of recycled and secondary aggregates (RSA)

1.11 Mechanism of Self-Curing
The mechanism of self-curing can be explained as follows:
Continuous evaporation of moisture takes place from an exposed surface due to the difference in chemical potentials (free energy) between the vapour and liquid phases. The polymers added in the mix mainly
form hydrogen bonds with water molecules and reduce the chemical potential of the molecules which in turn reduces the vapour pressure. This reduces the rate of evaporation from the surface.

1.12 Objectives

- The objective of the investigation is to use the water soluble polymeric glycol, selected from a group consisting of polyethylene glycol (PEG) of average molecular weight (M.W) from 200 to 10000 as self curing agent and to decide the optimum dosage for different curing conditions under arid atmospheric conditions.
- Other objective is to compare the use of different coarse aggregate (i.e. M35, M45 of normal coarse aggregate and recycled aggregate) and to find out optimum strength.
- In this study water retention, compacting factor and compressive strength of concrete containing self-curing agent is investigated and compared with conventional curing. Concrete weight loss with time was carried out in order to evaluate the water retention ability for different dosages of self-curing agent and for different conditions.
- In this study compacting factor and split tensile strength of concrete containing self-curing agent is investigated and compared with conventional curing. Concrete weight loss with time was carried out in order to evaluate the water retention ability for different dosages of self-curing agent and for different conditions.
- In this study compacting factor and flexural strength of concrete containing self-curing agent is investigated and compared with conventional curing. Concrete weight loss with time was carried out in order to evaluate the water retention ability for different dosages of self-curing agent and for different conditions.

2. REVIEW OF LITERATURE


The study investigates using laboratory synthesized water-soluble polymers: polyethylene glycol (PEG) and polyacrylamide (PAM) as self-curing agents and its effect on the degree of hydration, water absorption, permeable pores and microstructural characteristics of Portland cement mixes without and with 8% silica fume replacement. Portland cement mixes including PEG or PEG+PAM as self-curing agents showed a better quality compared to that of the non-cured mixtures. Mixtures incorporating 8% silica fume including a mixture of PEG and PAM as self-curing agent had a better quality compared to that of the mixture including only PEG especially at later ages. Polyethylene-glycol (PEG) was used alone with a dosage of 0.02% by weight of cement. Polyacrylamide (PAM) was used in conjunction with PEG as a second alternative for self-curing agent. The dosage of PEG and PAM was 0.02% by weight of the cement, PEG dosage was 0.013% and that of PAM was 0.007%.

Conclusions

- Effectiveness of the self-curing agents is affected by the cementitious type used (i.e. OPC or OPC+silica fume).
- The use of high molecular weight water-soluble polymers (PAM) together with low molecular weight polymers (PEG) had better performance in retaining water for longer period and releasing it slowly with time than using PEG only.
- Better water retention for self-curing mixtures including silica fume showed the tendency of improving hydration at 28 days of age.
- Water absorption and permeable pores for self-curing mixtures were lower than those of the conventional non-cured mixtures.
- Self-curing mixtures exhibited denser microstructure compared to conventional non-cured mixtures. Silica fume self-curing mixtures suffered less self-desiccation compared to conventional non-cured mixtures.


The objective of the research was to find out the water retention capacity and degree of hydration and moisture transport by using self-curing agent and compare to conventional curing of concrete. The self-curing agent used in this study was water soluble polymeric glycol (polyethylene glycol). The dosage of self curing agent was 0.02% by weight of cement. The dosage was kept constant for all the self curing concrete mixes.
The investigation aimed at studying on concrete with different quantities of cement (350-450kg/m³) at different water-cement ratios (0.3-0.4) both for self, conventional and air-curing concrete and compare the results for different test.

Conclusions

The following could be concluded from the results obtained in this study.

- 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 suffered less self-desiccation under sealed conditions compared to conventional concrete.
- Self-curing concrete resulted in better hydration with time under drying condition compared to conventional concrete.
- Water transport through self-curing concrete is lower than air-cured conventional concrete.
- Water sorptivity and water permeability values for self-curing concrete decreased with age indicating lower permeable pores percentage as a result of the continuation of the cement hydration.

3. MATERIAL AND DIMENSIONS:

The experimental programme was planned as the following-

Total 120 cubes, 120 cylinders.120 prisms were cast which involves different dosages (0%, 0.5%, 1% and 2%) of self-curing agent PEG-6000 for four different mixes (Mix A1,A2 and Mix B1,B2), under different curing conditions (indoor, conventional). The compaction factor test was conducted for all mixes to know the fresh property of concrete. Compressive strength test was conducted at 7 and 28 days of curing and to investigate the water retentivity capacity the cubes were weighed for every three days from the date of casting. The accuracy of the digital weighing machine used is 5 gm. Strength graph is plotted against percentage of self-curing agent; water retentivity graph is plotted for average weight loss versus number of days of curing.

In this investigation the maximum dosage of self-curing agent is restricted to 2% and minimum dosage is of 0.5% is decided as per the literature available.[2]

The flow chart for experimental programme is shown in fig.1.2.

Fig: 1.2: Experimental Programme For Concrete

Fig-1.3: Flow Chart of Experimental Programme for Concrete

Nomenclature for Specimen
MIX B- recycled coarse aggregate (B1-M35, B2-M45 grades)
O-Ordinary Portland cement (OPC)
H-PEG 6000(Higher Molecular Weight)
I-Indoor Curing
W-Wet/Conventional Curing
Self-Curing Agent (SCA)

- For example sample with name A1OW represents Mix A with PEG 6000 and dosage of 0% by weight of cement subjected to wet curing.
- Sample A1OI represents Mix A1 with PEG 6000 and dosage of 0% by weight of cement subjected to indoor curing.
- Sample A1H1 represents Mix A1 with PEG 6000 and dosage of 1% by weight of cement subjected to indoor curing.

3.2 Materials Used

The different materials used in this investigation are:

- Cement
- Fine Aggregate
- Coarse aggregate
- Recycled coarse aggregate
- Water
- Polyethylene glycol (PEG)

Cement

The cement used in the investigation was 53-grade ordinary Portland cement conforming to IS 12269-1987. It was taken from a single lot and stored properly throughout the programme. The physical properties of cement are shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Physical Properties of Cement</th>
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<tbody>
<tr>
<td>Specific gravity</td>
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<tr>
<td>Initial setting time</td>
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<td>Final setting time</td>
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</table>

Fine Aggregate

The fine aggregate that falls in zone-II conforming to IS 383-1970 was used. The fine aggregate used was obtained from a nearby river course. The sand obtained from quarry was sieved through all the sieves (i.e., 2.36mm, 1.18mm, 600µ, 300µ and 150µ). Sand retained on each sieve was filled in different bags and stacked separately for use.

To obtain zone-II sand correctly, sand retained on each sieve is mixed in appropriate proportion.

Coarse Aggregate

The coarse aggregate used is from a local crushing unit having 20mm nominal size. 20mm well-graded aggregate according to IS-383 is used in this investigation. The coarse aggregate procured from quarry was sieved through all the sieves (i.e., 16mm, 12.5mm, 10mm and 4.75mm). The material retained on each sieve was filled in bags and stacked separately. To obtain 20mm well-graded aggregate, coarse aggregate retained on each sieve is mixed in appropriate proportions.

Recycled coarse aggregate

The Recycled coarse aggregate used is from a lab crushing unit having 20mm nominal size. 20mm well-graded aggregate according to IS-383 is used in this investigation. The Recycled coarse aggregate procured from lab was sieved through all the sieves (i.e., 16mm, 12.5mm, 10mm and 4.75mm). The material retained on each sieve was filled in bags and stacked separately. To obtain 20mm well-graded aggregate, recycled coarse aggregate retained on each sieve is mixed in appropriate proportions.

Polyethylene glycol (PEG)

Polyethylene glycol is a condensation polymers 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 low molecular weight members from n=2 to n=4 are diethylene glycol, triethylene glycol and tetraethylene glycol respectively, which are produced as pure compounds. The low molecular weight compounds up to 700 are colourless, odourless viscous liquids with a freezing point from 10°C (diethylene glycols), while polymerized compounds with higher molecular weight than 1,000 are wax like solids with melting point up to 56-61°C for n 180. The abbreviation (PEG) is termed in combination with a numeric suffix which indicates the average molecular weights. One common feature of PEG appears to be water-soluble. The specifications of PEG6000 are shown in table 3.2.8. It is soluble also in many organic solvents including aromatic hydrocarbons (not aliphatic). They are used to make emulsifying agents and
detergents, and as plasticizers, humectants, and water-soluble textile lubricants. The wide range of chain lengths provides identical physical and chemical properties for the proper application selections directly or indirectly in the field.

- Alkyd and polyester resin preparation to enhance water dispersability and water-based coatings.
- Anti dusting agent in agricultural formulations.
- Brightening effect and adhesion enhance in electroplating and electroplating process.
- Cleaners, detergents and soaps with low volatility and low toxicity solvent properties.
- Coupling agent, humectants, solvent and lubricant in cosmetics and personal care bases.
- Dimensional stabilizer in wood working operations.
- Dye carrier in paints and inks.
- Heat transfer fluid formulation and deformer formulations.
- Low volatile, water soluble and noncorrosive lubricant without staining residue in food and package process.
- Paper coating for anti-sticking, colour stabilizing, good gloss.
- Plasticizer to increase lubricant and to impart a humectants property in ceramic mass, adhesives and binders.
- Softener and antistatic agent for textiles.
- Soldering fluxes with good spreading property.

Polyethylene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and no irritating and is used in a variety of pharmaceuticals and in medications as a solvent, dispensing agent, ointment and suppository bases, vehicle, and tablet excipient. Chemical structure of PEG is shown below.

![Chemical structure of PEG](image)

Polyethylene glycol is produced by the interaction of ethylene oxide with water, ethylene glycol or ethylene glycol oligomers.

4. RESULTS AND DISCUSSION

As per Experimental programme results for different experiments were obtained. They are shown in table format or graph, which is to be presented in this chapter.

4.1. Studies on Concrete

4.1.1. Compaction Factor Test

The compaction factor test is performed to calculate the compaction factor, and to know more about workability. The test results are shown in table 4.1. The plot of the compaction factor and different dosage of PEG 6000 is shown in Figure 4.1. The following are the observations on Compaction factor test.

- In case of specimens with PEG 6000 of Mix A it is clear that compaction factor for 0.5% dosage of self curing agent is less when compared to other dosages 1% and 2%.
- In case of specimens with PEG 6000 of Mix B 1% dosage compaction factor is more compared to other dosages (1% and 2%).
- It is also clear that compaction factor is more for Mix B in 1% and 2% when compared to Mix A.
- It is also observed that in Mix A the compaction factor is increased with increase of % of PEG 6000. But in Mix B it is increased from 0.5% to 1% and then it is decreased.

4.2 Water Retentivity Test

4.2.1. Water Retentivity Test Results for Mix A1

Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5gms up to 28 days. The results were recorded in table-2. The analysis of results or average weight loss of individual specimen is shown in table-3. The average weight loss is shown in Fig.1.3. The following are the observations on water retentivity of concrete.

- It is clear that 0% dosage of self curing agent is losing more weight when compared to other dosages (0.5%, 1% and 2% of self curing agent).
- It is also observed that 2% dosage of self curing agent shows lower weight loss when compared to other dosages (0%, .5% and 1% of self curing agent).
4.2.2. Water Retentivity Test Results for Mix A2
Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days. The results were recorded in Table 4. The analysis of results or average weight loss of individual specimen is shown in Table 5. The average weight loss is shown in Figure 1.4. The following are the observations on water retentivity of concrete:

- It is clear that 0% dosage of self curing agent is losing more weight when compared to other dosages (0.5%, 1% and 2% of self curing agent).
- It is also observed that 1% dosage of self curing agent shows lower weight loss when compared to other dosages (0%, .5% and 2% of self curing agent).

4.2.3. Water Retentivity Test Results for Mix B 1
Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days. The results were recorded in Table 6. The average weight loss is shown in Figure 1.6. The analysis of results or percentage weight loss of individual specimen is shown in Table 7. The following are the observation on water retentivity of concrete:

- It is clear that conventional concrete with indoor curing is losing more weight when compared to other dosages 0.5%, 1% and 2% of self curing agent.
- It is also clear that 2% dosage of S.C.A result is almost nearer when compared to the dosages of conventional concrete with indoor curing. But it is not appreciable when compared with 2%.
- It is also observed that 1% dosage of S.C.A shows less weight loss when compared to other dosages.

4.2.4. Water Retentivity Test Results for Mix B 2
Concrete with high molecular weight PEG subjected to indoor curing was studied by weighing the samples at regular intervals of 3 days, with digital weighing machine of accuracy 5 gm up to 28 days. The results were recorded in Table 8. The average weight loss is shown in Figure 1.7. The analysis of results or percentage weight loss of individual specimen are shown in Table 9. The following are the observation on water retentivity of concrete:

- It is clear that conventional concrete with indoor curing is losing more weight when compared to other dosages 0.5%, 1% and 2% of self curing agent.
- It is also clear that 1% dosage of S.C.A result is almost nearer when compared to the dosages of conventional concrete with indoor curing. But it is not appreciable when compared with 2%.
- It is also observed that 1% dosage of S.C.A shows less weight loss when compared to other dosages.

4.3 Comparison of Mix A1 and Mix B1
As per the Figure 1.8 and 1.9 the following are the observations on strength of concrete for indoor curing with different dosages of PEG 6000:

- The compressive strength is more for Mix A1 at 7 and 28 days when compared to Mix B1.
- The compressive strength is more for Mix A1 at 2% of SCA and it is very low at same 0.5% of SCA for Mix B1 at 7 days.
- The compressive strength is nearly same for 0% and 0.5% of SCA for Mix B1 at 7 days.
- The compressive strength is nearly same for Mix B1 at 28 days for 0% and 0.5% of SCA.
- The compressive strength is more for 2% of SCA for Mix A1 at 28 days of age.
- The compressive strength is more for 1% of SCA for Mix B1 at 28 days of age.
- The split tensile strength is nearly same for 0% and 0.5% of SCA for Mix B1 at 7 days.
- The split tensile strength is nearly same for Mix B1 at 28 days for 0% and 0.5% of SCA.
- The split tensile strength is more for 2% of SCA for Mix A1 at 28 days of age.
- The split tensile strength is more for 1% of SCA for Mix B1 at 28 days of age.
- The flexural strength is more for Mix A1 at 7 and 28 days when compared to Mix B1.
- The flexural strength is more for Mix A1 at 2% of SCA and it is very low at same 0.5% of SCA for Mix B1 at 7 days.
- The flexural strength is nearly same for 0% and 0.5% of SCA for Mix B1 at 7 days.
- The flexural strength is nearly same for Mix B1 at 28 days for 0% and 0.5% of SCA.
• The split tensile strength is more for 2% of SCA for Mix A at 28 days of age.
• The split tensile strength is more for 1% of SCA for Mix B1 at 28 days of age.

Variation of 7 & 28 Days Compressive Strength with Different Dosages of PEG6000

Variation of 7&28 Days Split Tensile Strength with Different Dosages Of PEG 6000

Variation of 7&28 Days Flexural Strength with Different Dosages Of PEG 6000

4.3.1 Comparison of Mix A2 and Mix B2

As per the figure 1.8 the following are the observations on strength of concrete for indoor curing with different dosages of PEG 6000.

• The compressive strength is more for Mix A2 at 7 and 28 days when compared to Mix B2.
• The compressive strength is more for Mix A at 2% of SCA and it is very low at same 0.5% of SCA for Mix B at 7 days.
• The compressive strength is nearly same for 0% and 0.5% of SCA for Mix B2 at 7 days.

• The compressive strength is nearly same for Mix B2 at 28 days for 0% and 0.5% of SCA.
• The compressive strength is more for 2% of SCA for Mix A2 at 28 days of age.
• The compressive strength is more for 1% of SCA for Mix B2 at 28 days of age.
• The split tensile strength is more for Mix A2 at 7 and 28 days when compared to Mix B2.
• The split tensile strength is more for Mix A at 2% of SCA and it is very low at same 0.5% of SCA for Mix B at 7 days.
• The split tensile strength is nearly same for 0% and 0.5% of SCA for Mix B2 at 7 days.
• The split tensile strength is nearly same for Mix B2 at 28 days for 0% and 0.5% of SCA.
• The split tensile strength is more for 2% of SCA for Mix A2 at 28 days of age.
• The split tensile strength is more for 1% of SCA for Mix B2 at 28 days of age.
• The flexural strength is more for Mix A2 at 7 and 28 days when compared to Mix B2.
• The split tensile strength is more for 1% of SCA for Mix B2 at 28 days of age.

CONCLUSION

After the analysis of the result of the experimental programme the following conclusions were arrived for self curing agent polyethylene glycol (PEG6000) and comparison of different aggregates are obtained.

5.1 Conclusions

• Due to the use of PEG6000
  ➢ The workability of concrete with low w/c ratio has significant effect due to higher molecular weight polyethylene glycol (PEG6000).
  ➢ Water retention of the concrete with low w/c ratio in conjunction has significant effect due to addition of higher molecular weight polyethylene glycol (PEG6000).
  ➢ The compressive strength of concrete with lower w/c ratio and with lower dosage of polyethylene glycol (PEG6000) is beneficial.
  ➢ The use of higher molecular weight polyethylene glycol (PEG6000) with higher w/c ratio is not beneficial.
• **Conclusions from comparative studies of different coarse aggregate**

  ➢ Effectiveness of self-curing concrete is affected by w/c ratio and percentage dosages of self-curing agent.
  
  ➢ Water retention of concrete mixes incorporating self-curing agent is higher compared to conventional concrete mixes.
  
  ➢ The compressive strength of concrete with low w/c ratio has significant effect due to change in curing regime.
  
  ➢ The mix which shows lower weight loss need not give higher compressive strength.
  
  ➢ Water retention of concrete with lower w/c ratio incorporating higher molecular weight polyethylene glycol (PEG 6000) with lower dosage is more beneficial.

**b) Due to the use of Normal coarse aggregate**

  ➢ Workability of concrete has increased due to PEG 6000 when compared to conventional concrete.
  
  ➢ Water retention of the concrete with low w/c ratio in conjunction has significant effect due to addition of higher molecular weight polyethylene glycol (PEG6000).
  
  ➢ Compressive strength increases from 0.5% to 2% the increases in strength at 2% is maximum then of conventional concrete in both the grades (M35, M45).
  
  ➢ Split tensile strength increased from 0.5% to 1% and then decrease at 2% the increase in strength at 1% is maximum greater then of conventional concrete in both the grades.
  
  ➢ Flexural strength increased from 0.5% to 1%. The increases in strength at 1% is maximum of conventional concrete in both the grades.
  
  ➢ The strength is more for normal coarse aggregate compared to recycled coarse aggregate.

**REFERENCE**


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