An Experimental Study on Self-curing concrete Incorporated with Bagasse Ash and Polyethylene Glycol 600

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Abstract **- The aim of this study is to find out the compressive strength of concrete using water soluble polyethylene glycol 600 as self-curing agent in M40 grade mix. The function of self-curing agent is to reduce the water evaporation from concrete. The use of self-curing admixtures is very important from the point of view that water resources are getting valuable every day. Bagasse ash in 5,10,15and 20% is replaced to cement in self-curing concrete and for each % of Bagasse ash 1, 1.5 and 2% of polyethylene glycol 600 is added. The average compressive strength at the end of 7,14 and 28 days is found out for various % of Bagasse ash and Polyethylene glycol600. The compressive strength is compared with conventional self-curing concrete. The study reveals that the addition of 20% of Bagasse ash to cement and 1% of polyethylene glycol600 shows a better compressive strength then the other concrete mix studied.**

Index Terms **- Self-Curing Concrete, PEG600, Bagasse Ash, Compressive Strength.**

I.INTRODUCTION

Proper curing of concrete structures is important to meet the performance and durability requirements. In conventional curing this is achieved by external curing applied after mixing, placing and finishing. Self-curing or internal curing is a technique that can be used to provide additional moisture in concrete for more effective hydration of cement and reduced self-desiccation. Methods of Self-Curing (Internal Curing). 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. Contrivance of Self-Curing: Due to difference in chemical potential between the vapor and liquid phases, continuous evaporation of moisture takes place from external surface of concrete. The polymers added to the concrete mix mainly form hydrogen bonds with water molecules and reduce the chemical potential of the molecules which results in reduction of the vapor pressure, thus reducing the rate of evaporation from the surface. Potential Materials for Self-Curing (Internal) Curing: The following materials can provide internal water retention: • Lightweight Aggregate (natural and synthetic, expanded shale) • Super-absorbent Polymers (SAP) (60-300 nm size) • SRA (Shrinkage Reducing Admixture) (propylene glycol type i.e., Polyethylene-glycol) D. Advantages of Self-Curing (Internal) Curing: • It is the alternate of construction in desert regions where major scarcity of water is there. • Self-Curing (Internal Curing) is a method to provide the water to hydrate all the cement, accomplishing what the mixing water alone cannot do. • Provides water to keep the relative humidity (RH) high, keeping self-desiccation from occurring. • Eliminates largely autogenous shrinkage. • Can make up for some of the deficiencies of external curing, both human related (critical period when curing is required in the first 12 to 72 hours) and hydration. • Increases the strength of concrete in some extent.

II. MATERIALS

A) Cement

Ordinary Portland cement (OPC) – 53 grades of cement and refer IS: 12269-1987 as shown in the Fig 1, is used for entire experimental investigation. The physical properties of the cement are Table 1

Table 1 Properties of Cement

S.NO	PROPERTIES	VALUES
1.	Finess Test	31%
2.	Initial Setting Time	45 Mins
3.	Final Setting Time	380
4.	Specific Gravity	3.125

B) Fine Aggregate

Manufactured sand (M-sand) is quarry dust produced from rock quarry; it is the replacement of river sand. M-Sand less damage to the environment as compared to natural sand. Manufactured sand (M sand) is artificial sand produced from crushing hard stones into small sand sized angular shaped particles, washed and finely graded to be used as construction aggregate. M- sand is a substitute of river sand used in construction industries mainly for concrete production and mortar mix. It is an eco-friendly material which made from rock pieces by artificial processes. The specific gravity and bulk density were found to be 2.70 and 1860kg/m^3 respectively as shown in the Table 2 M-Sand has balanced physical and chemical properties that can withstand any aggressive environmental and climatic conditions as it has enhanced durability, greater strength and overall economy. M- sand is free from silt and clay particles which offer better abrasion resistance, higher unit weight and lower permeability as shown in the Fig 1.

Table 2 Properties of M-Sand

S.NO	PROPERTIES	VALUES
1	Specific gravity	3.125
2	Initial setting time	45min
3	Final setting time	380 min
4	Fineness test	3.4%
5	Bulk density	1440Kg/m^3

Fig 1. M-Sand

c) Polyethylene Glycol-600

Polyethylene glycol-600 as shown in Fig 3 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 a numeric suffix which indicates the average molecular weight. One common feature of PEGs appears to be the water-soluble nature shown Fig 2.

Fig 2. PEG 600

d)Water

Ordinary clean portable water free from suspended particles was used both for mixing and curing the concrete specimens. Water used as per IS: 10500-2012.

E) Bagasse Ash

Bagasse ash was collected from a sugar mill situated at Nellikuppam in Tamil Nadu India as shown in Fig 3. The Specific gravity of Bagasse ash was found to be 2.16.

Fig 3. Bagasse ash

F) Coarse Aggregate

The coarse aggregate used was the locally available gravel which was passed through 20 mm IS sieve. The coarse aggregate is tested as per Indian Standard specification IS 383. with the use of pycnometer, the specific gravity of the 20mm gravel was found to be 2.75.

III. METHODOLOGY

Bagasse ash is chosen as an alternative to cement in self-curing concrete, Materials required for self-curing concrete is collected and its initial properties are tested with various percentage of bagasse ash (5, 10,15,20 %) and to it 1, 1.5 and 2% of polyethylene glycol 600 is added. With 5% of bagasse ash 1, 1.5 and 2% of polyethylene glycol 600 is added and its compressive strength is studied. Similarly, for other % of bagasse ash (10,15,20%). 1,1.5 and 2% of polyethylene glycol 600 is added and its corresponding compressive strength at the end of 28 days is found out. Cube of 150 x 150 mm is captured for various percentage of Bagasse ash and polyethylene Glycol 600 and the compressive strength found out for 7, 14and 28 days. conventional self-curing concrete is captured and it compressive strength at the end of 7 ,14 and 28 days is also found out. With the conventional strength of self-curing concrete, the bagasse ash replaced self-curing concrete is compared and optimum % of bagasse ash and polyethylene glycol 600 is found out.

IV RESULTS AND DISCUSSIONS

For 5% of Bagasse Ash replaced the Compressive Strength at the end of 28 days with 1% of PEG600 added Shows a value of 39.21 N/mm^2. This Compressive Strength shows an increasing strength to 44.45 N/mm^2 at the end of 28 days when 1.5% PEG 600 is added as shown table 3. A sharp decline in the Compressive Strength is observed when 2% of PEG 600 is added to 5% of Bagasse ash and the value obtained is 40.31 N/mm^2. The decrease in the compressive strength is observed when the % of PEG 600 is increased to 2% as shown in Table 3

When the Bagasse Ash is increased to 10% for cement the compressive strength shows a value of 39.91 N/mm^2 for 1% of PEG600 added. A higher Compressive Strength is observed when the PEG 600 is increased to 1.5% with a value of 45.11 N/mm^2. when 2% of PEG 600 is added to 10% of Bagasse Ash replaced to cement in Self-Curing Concrete, the compressive strength decreases to a value of 40.73 N/mm^2.

With the Bagasse ash are increase to 15% and 1% added of PEG 600 added a Compressive Strength of 40.21N/mm^2 is obtained at the end of 28 Days. A similar increasing strength is observed when the PEG 600 is increased to 1.5% as the previous cases. A value of 45.87 N/mm^2 is observed at the end of 28 days and a decrease in Compressive Strength is found out when PEG 600 is increased to 2% with the value of 40.92 N/mm^2 as shown in Fig .4

An increased compressive strength of 41.35 N/mm^2 is achieved for 20 % replacement of Bagasse Ash and adding 1% of PEG 600. The compressive strength increases to 44.45 N/mm^2 at the end of 28 days when PEG 600 is increased to 1.5%. The Compressive Strength decreases to a value of 38.45 N/mm^2 When PEG 600 is increased to 2 % as shown in Table 3.

The above discussion establishes that the increase in PEG 600 above 1.5 % shows a decreasing value in the Compressive Strength for various % of Bagasse Ash replaced to the cement in self-curing concrete. The Compressive Strength shows an increasing value from 39.21 N/mm^2 to 41.35 N/mm^2 when the Bagasse Ash is increased from 5% to 20 %. But for 1.5% and 2% of PEG 600 added to Various % of Bagasse Ash shows a decrease in Compressive Strength when the Bagasse Ash is increased from 5% to 20% as shown in Table 3

Table 3 Compressive strength for various % of Bagasse Ash with various % of Polyethylene Glycol 600

Bagasse Ash	Compressive Strength at the end of 28 days (MPa)		
(%)	PEG 600 1%	PEG 600 1.5%	PEG 600 2 %
5	39.21	44.45	40.31
10	39.91	45.11	40.73
15	40.21	45.87	40.92
20	41.35	44.45	38.45

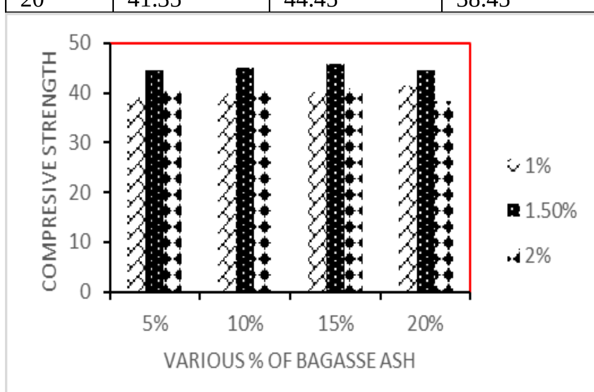

Fig.4 Compressive strength of SCC for various % of Bagasse Ash with various % Polyethylene Glycol 600

V CONCLUSION

- The compressive strength decreases when the percentage of PEG 600 is increased from 1 to 2% for various percentage of Bagasse ash replacement to cement in self-curing concrete.
- The compressive strength increases for various percentage of Bagasse ash with 1% of Polyethylene Glycol 600 added.
- For the chosen M40 grade Self curing concrete a value of 40.21N/mm^2 and 41.35 N/mm^2 compressive strength is achieved at the end of 28 days when 15% and 20% of Bagasse Ash is replaced to cement with 1% polyethylene Glycol 600 added respectively.
- From the above discussion it can be established that the increase in 20% of Bagasse ash replace to cement in self-curing concrete with 1% of Polyethylene glycol 600 shows a better compressive strength
- Hence 20% Bagasse ash can be used as an alternative to cement in the Production of self-curing concrete with 1% of polyethylene glycol 600.

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