TO STUDY ON PARTIAL REPLACEMENT OF CEMENT BY FLYASH AND KNOW THE COMPARATIVE STUDY BY USING POLYETHYLENE GLYCOL (PEG 400) FOR ECO-FRIENDLY SELF-CURING CONCRETE

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Intruduction:

Concrete is a mixture of cement, fine aggregate coarse aggregate and water with or without admixtures. To attain desirable strength and durability properties, curing becomes necessary. Curing is the process in which the concrete is protected from loss of moisture and kept within a reasonable temperature range. This process results in concrete with increased strength and decreased permeability. Large quantity of good quality water is needed for curing concrete and labor has to be conscious while curing. Curing is difficult when works carried out at heights. Curing can be done both internally and externally. For external curing ponding, wet covering, fogging, sprinkling, etc., can be adopted. Internal curing / self-curing can be done by adding admixtures in the concrete. In self curing concrete various additives such as poly ethylene glycol (PEG-400, PEG-600, PEG- 4000, PEG-6000).

A survey had been undertaken to study the effect of using various self-curing agents in producing concrete equivalent to the conventionally cured concrete and presented.

Definition of internal curing:- The Code ACI-308 states “interior curing refer to procedure by which hydration of cement occur for the reason that of the accessibility of extra interior water that is not a part of integrated Water.” conservatively, curing concrete mean create circumstances that water is not absent from the exterior i.e., curing taken to go on ‘from outside to inside’. In compare, internal curing is allowing to cure ‘from within to outside’ through inner reservoirs Created. ‘Internal curing’ is regularly also referred as ‘Self–curing’.

Need of self curing:-When mineral admixtures respond totally in blend system, their require for curing can be lot larger than that in a conservative normal cement concrete. When this water do not willingly obtainable, due to de-percolation of capillary porosity.

Due to contraction happening throughout cement hydration, vacant pores are formed inside cement paste, most important to a diminish in its interior relative dampness and also to contraction which may reason early-age crack. This state is intensified in HPC due to normally advanced cement content, abridged water/cement (w/c) percentage (fly ash, silica fume). The unfilled pores formed during self-desiccation bring contraction stresses and also control the kinetics of cement hydration procedure, restraining the last degree of hydration. The strength achieve by IC might be additional than that probable under soaked curing circumstances. frequently especially in HPC, it is not simply achievable to offer curing water from the top face at the rate necessary to gratify the current chemical contraction, due to the particularly low permeability's frequently achieved.

Significance of self curing:- When mineral admixtures reply entirely in a combine cement structure, their order for curing water can be a lot better than that in a conservative ordinary cement concrete. When this water is not willingly obtainable, important autogenously bend and cracking may consequence. Due to chemical contraction taking place throughout cement hydration, vacant pores are created inside the cement adhesive, chief to a decrease in its inner relative dampness and to contraction which can reason early-age cracking.

Objectives:

- To study the comparative study on flyash and PEG-400 to know the compressive strength of concrete in curing process
- Finding the optimum dosage of shrinkage reducing admixtures of flyash and PEG-400 for M20 grade concrete
- To check the workability of concrete and to study the effect of two different curing agent
  - Conventional Concrete
  - Conventional Concrete + Partial replacement of flyash
  - Conventional Concrete + PEG-400 + Partial replacement of flyash
- To reduce the water quantity in curing period

Methodology:

Collection of Raw Materials:_The materials used in this project are Ordinary Portland cement (OPC), Coarse aggregate, Fine aggregate, PEG-400(polyethylene glycol), Flyash (coal burning product) are easily available in market where as flyash is available in online.

- Ordinary Portland Cement (OPC): Ordinary Portland Cement (OPC) is the most commonly and widely used cement in all over the world. It is manufacture as a powder by mixing limestone and other raw materials which consist of argillaceous, calcareous and gypsum. In this experiment 43 grade of OPC is used.

Ordinary portland cement

Sl No	Tests	Results
01	Consistency of cement	34%
02	Specific gravity	3.15
03	Initial setting time	30min
04	Final setting time	600min

- Fine Aggregate: It is a granular material which is used to produce concrete or mortar and when the particles of the granular material are so fine that they pass through a 4.75mm IS sieve, it is called fine aggregate.

Fine Aggregate

Sl No	Tests	Results
01	Specific gravity	2.63 kg/m^3
02	Sieve analysis	3.17%

- Coarse aggregate: Aggregates which passes through 20mm IS sieve and retained on 4.75mm IS sieve are known as coarse aggregate. In this project, 20mm size of coarse aggregate is used.

Coarse Aggregate

Sl No	Tests	Results
01	Specific gravity	2.80 kg/m^3
02	Fineness modulus of coarse aggregate	4.42%

PEG-400 (polyethylene glycol): Polyethylene glycol is a condensation polymer of ethylene oxide and water with general formula H(OCH2CH2)nOH, where ‘n’ is the average number of repeating of oxy-ethylene groups typically from 4 to about 180. The abbreviation (PEG) is term in combination with a numeric suffix which indicates the average molecular weight. One common feathers of PEG appears to be the water-soluble nature. Polyethylene glycol is non-toxic, odourless, neutral, lubricating, non-volatile and non-irritating is used in a variety of pharmaceuticals.

Polyethylene glycol

Sl No	Tests	Results
01	Appearance	Clear liquid
02	Odor	Mild odor
03	Solubility	Soluble in water
04	Density range	1.126-1.128

- Flyash: Fly ash is a fine grey powder consisting mostly of spherical, particles that are produced as a by-product in coal-fired power stations. Fly ash has pozzolanic properties, meaning that it reacts with lime to from cementitious compounds. It is commonly known as a supplementary cementitious material

- Water: Water plays an important role in mixing, laying, compaction, setting and hardening of concrete. The strength of concrete depends on the quality and quantity of water used in the mix. The water inside the college campus is used in this project.
- Mix proportion for M20 grade:

Sl no	Material used	Quantity
01	Cement	403.2 kg/m^3
02	Coarse aggregate	1275 kg/m^3
03	Fine aggregate	620 kg/m^3
04	PEG-400(2% of Cement weight)	8.06 kg/m^3
05	Flyash(10% of Cement weight)	40.32 kg/m^3
06	Water	201.6 lit/m^3

- Workability Test: Workability test results of various experimental investigation carried out on various percentage of PEG-400(Self-curing concrete) and also normal curing concrete mixes for M_{20}

Slump Test

Sl No	Polyethylene Glycol (PEG) dosage(Percentage by weight of cement)	Slump in mm
01	Conventional Concrete	0mm
02	Conventional Concrete + Flyash	0mm
03	0%	0mm
04	0.5%	91mm
05	1.0%	105mm
06	1.5%	109mm
07	2.0%	117mm

- Experimental analysis:
- Compressive Strength: The cube specimens were tested on compression tested machine of capacity 3000KN, bearing surface of the machine was wiped off clean and sand or other material removed from the surface of the specimen. This specimen was placed in machine in such a manner that the load was applied to the opposite sides of the cubes as casted That is, not top and bottom. the axis of the specimen was carefully aligned at the centre of the loading frame. the load applied was increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained. The maximum load applied on specimen was record.

F_C = P/A Where, P is load ,A is area

	Compressive strength in Mpa,			
Days	7 days	14 days	21 days	28 days
Conventional Concrete	20.76	27.15	28.74	31.94
Conventional Concrete + Flyash	7.28	9.52	10.64	11.20

Percentage varying of PEG-400	**Compressive strength in Mpa,**			
	7 Days	14 Days	21 Days	28 Days
0%	7.54	10.38	18.73	21.96
0.5%	21.26	27.80	29.44	32.71
1.0%	22.66	29.63	31.38	34.86
1.5%	16.23	21.22	22.50	24.97
2.0%	15.49	20.26	21.45	23.83

- Split Tensile Strength: The cylinder specimen were tested on compression testing machine of capacity 3000KN. The bearing surface of machine was wipe off clean and loses other sand or other material removed from the surface of the specimen. the load applied was increased continuously at a constant rate until the resistance of the specimen to the increasing load breaks down and no longer can be sustained. The maximum load applied on specimen was recorded. f split = 2P /3.14D where p = load, D = diameter of the cylinder

Table 2: <u>Split Tensile Strength:</u>

	Split Tensile Strength in Mpa,			
Days	7 days	14 days	21 days	28 days
Conventional Concrete	1.42	1.86	1.97	2.18
Conventional Concrete + Flyash	1.13	1.48	1.56	1.74

Percentage varying of PEG-400	**Split Tensile Strength in Mpa,**			
	7 Days	14 Days	21 Days	28 Days
0%	1.09	1.34	1.76	2.11
0.5%	1.25	1.53	1.82	2.39
1.0%	1.52	2.10	2.81	3.66
1.5%	1.41	1.74	2.23	2.81
2.0%	1.32	1.72	2.13	2.67

Results and conclusions:

- The optimum dosage of PEG-400 for maximum strengths (Compressive, Tensile) was found to be 1% for M_{20} grade concrete,
- The percentage of PEG-400 also gets increased slump value.
- Strength of Self-curing concrete is relatively high when compared with conventional concrete.
- It's fully controls the water evaporation during the hydration of concrete. It gives more strength when it is compared to conventional concrete to save the water and to save the world.
- The cost requirement is also low in internal curing when compared with external curing.
- The strength and durability properties of internally cured concrete with PEG-400 gives better result compared with external cured concrete.
- Combination of partial replacement of flyash by the 10% weight of the cement plus conventional concrete gives the less strength when it compared with conventional concrete and also conventional concrete plus flyash plus PEG-400 mix concrete.
- Self curing concrete is the answer to many problems faced due to lack of proper curing.
- The self-curing concrete improved the workability.
- To study the workability property of concrete by slump cone test with various percentage addition of PEG-400.

Scope for future work:

- Further study can analysis beyond the 2% dosage of PEG-400 as self-curing agent in various concrete mix.
- Effect of natural climate factor such as sunlight, Room temperature and huminity duration self-curing on the properties may be studied.
- Use partial replacement of flyash increases the ultimate concrete strength and durability of concrete,
- Effect of change of molecular weight of PEG's on self-curing capacity may be studied,
- Some specific water soluble chemical such as polyethylene glycol-400 is added during the mixing can reduce water evaporation from and within the set concrete make it self-curing.
- Use of flyash reduce concrete shrinkage during the curing period and also prevent the cracks in buildings.
- The scope of the work to study the effect of polyethylene glycol-400 on strength characteristics of the self-curing concrete.
- Use of flyash reduce the amount of water required in mixture.
- In future the availability of flyash as the replacement for cement can be used.
- To reduce the green das emission and to safe the land.
- To reduce the construction time in the project.
- Flyash increases the resistance to sulphate attack in the concrete.