AN EXPERIMENTAL STUDY ON MECHANICAL PROPERTIES OF M25 GRADE SELF CURING CONCRETE WITH FLYASH AS PARTIAL REPLACEMENT OF CEMENT

V Chaitanya[1], K Deepthi[2]

M.Tech, Structural Engineering[1], Assistant Professor[2]
[1,2]Sri Sunflower College of Engineering and Technology, Lankapalli, Andhra Pradesh[1, 2]

Abstract:- Today concrete is most widely used construction material due to its good compressive strength and durability. Curing plays a major role in the development of concrete properties during construction. Construction industry use lot of water in name of curing. This Self-curing concrete helps to reduce the use of water. Self-curing concrete is a type of concrete in which hydrophilic materials viz., Poly Ethylene glycol, Poly Vinyl Alcohol, Poly vinyl Acetate, Sodium Poly Acrolyte etc. are used as admixtures. These hydrophilic materials help to minimize the loss of water and also absorb the moisture from the atmosphere which helps in continuous curing of concrete. In this study, an attempt has been made to develop self-curing concrete by using different curing agents viz., Poly Ethylene Glycol-400 and Poly Vinyl Alcohol and partial replacement of cement with Fly Ash at 10%,20%,30%.The self-curing agents are added at 0.2,0.4,0.6,0.8,1.0 percentages by weight of cementitious material. The individual effects of these agents on mechanical properties of cement at 7,14,28 days are analyzed, tested, and compared with conventional concrete of similar mix design were studied for M25 grade.

Keywords: Self curing concrete, PEG-400, Poly Vinyl Alcohol, Fly Ash

I. INTRODUCTION

Curing is the name given to the procedures used for promoting the hydration of the cement, and consists of a control of temperature and of moisture movement from and into the concrete. Proper moisture conditions are critical because the hydration of the cement virtually ceases when the relative humidity within the capillaries drops below 80%. Proper curing of concrete structures is important to meet 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. When concrete is exposed to the environment, evaporation of water takes place and loss of moisture will reduce the initial water-cement ratio which will result in the incomplete hydration of the cement and hence lowering the quality of the concrete. Evaporation in the initial stage leads to plastic shrinkage cracking and at the final stage of setting it leads to drying shrinkage cracking.

II. MATERIAL PROPERTIES

A. *Cement*: Cement used in this project is an Ordinary Portland cement of 53- grade conforming to IS 12269-1987. The cement used in the project should be fresh and should have of uniform consistency. The specific gravity of the cement is 3.065.

Table 1: Physical Properties Of Cement

S NO	PROPERTY	RESULTS
1	Normal Consistency	30%
2	Fineness Of Cement	8%
3	Initial Setting Time Final Setting Time	45min 370min
4	Specific gravity	3.065

B. *Fine Aggregate*:

Fine aggregates conforming to grading zone III with particles greater than 2.36 mm and smaller than 150 mm removed are suitable.

Table2: Properties of Fine Aggregate

S NO	PROPERTY	RESULTS
1	Specific gravity	2.58
2	Fineness modulus of Fine Aggregate	2.83
3	Water absorption	0.25%
4	Grading Zone	III

C. *Coarse Aggregate:*

The coarse aggregates are granular materials obtained from rocks and crushed stones. They may be also obtained from synthetic material like slag, shale, fly ash and clay for use in light-weight concrete. In this project coarse aggregate of sizes 20mm(70%) and 12.5mm(30%) are used.

Table 3:Physical Properties Of Coarse Aggregate

SNO	Property	Value for 12.5mm	Valuefor 20mm
1	Type	Crushed	Crushed
2	Specific gravity	2.85	2.72
3	Water absorption	0.20	0.19

D. *Flyash:*

Fly ash is a residual material of energy production using coal, which has been found to have numerous advantage for use in concrete. Some of the advantages include improved workability, reduced permeability, increased ultimate strength, reduced bleeding, better surface and reduced heat of hydration. The Specific Gravity of Fly Ash is 2.18.

Figure 1: Flyash

E. *Water:*

Water to be used in the concrete work should have following properties:

- It should be free from injurious amount of oil, acids, alkalis or other organic or inorganic impurities.
- It should be free from iron, vegetable matter or other any type of substances, which likely to have adverse effect on concrete or reinforcement.
- It should be quite satisfactory for drinking purpose, which is used in mixing of concrete.

Figure 2: Poly Ethylene Glycol-400

Figure 3:Poly vinyl Alcohol

III. EXPERIMENTAL PROGRAMME

To investigate the behavior of self-compacting concrete in which cement is partially replaced with fly ash and with self-curing chemicals namely PEG-400 and PVA and it is compared with the regular mix. The mix design was calculated by using IS: 10262:2009.The mix design obtained is 1:1.75:3.32 with a water/cement ratio of 0.47

Figure 4: Specimens

IV. TESTS AND RESULTS

Concrete specimens viz., Cubes, Cylinders, Prisms are casted by partially replacing the weight of cement with Fly ash at different percentages (at 10%, at 20%, at 30%). Concrete specimens are tested at 7 days, 14 days, 28 days to calculate the mechanical properties viz.,

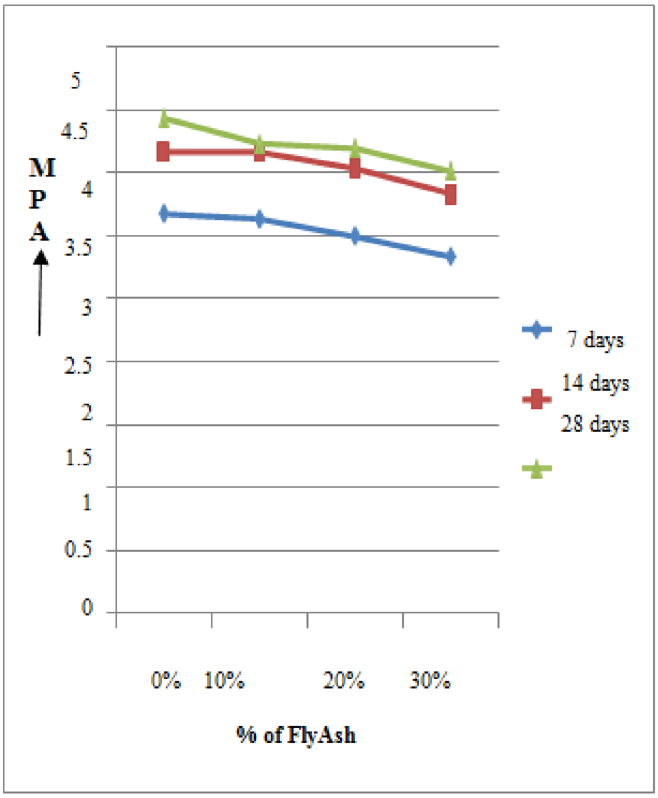
- Compressive strength of cubes,
- Split- Tensile strength of cylinders,
- Flexural strength of prisms.

Conventional Concrete:

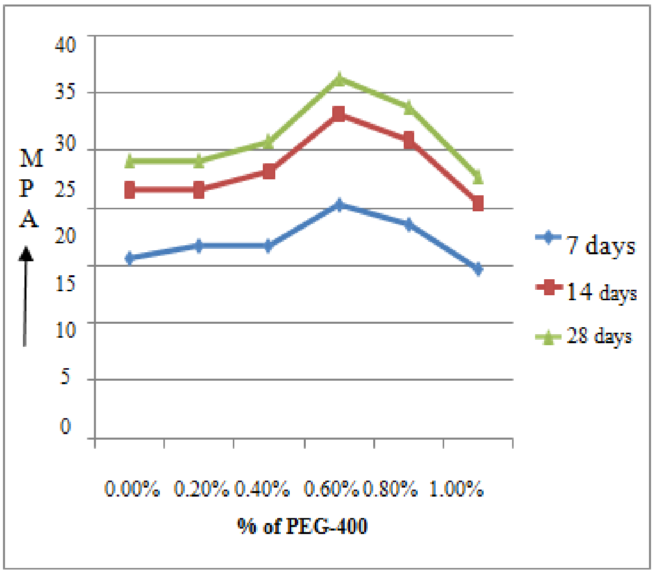
Concrete is tested without replacing cement with Fly Ash. The mechanical properties viz., Compressive Strength, Split tensile strength, Flexural strength of the nominal concrete is calculated at 7 days, 14 days,28 days. The results obtained are as follows:

Compressive strength(MPA)			Split tensile strength(MPA)			Flexural strength(MPA)		
7 days	14 days	28 days	7 days	14 days	28 days	7 days	14 days	28 days
20.5	27.5	31.5	2.03	2.65	3.15	3.17	3.66	3.93

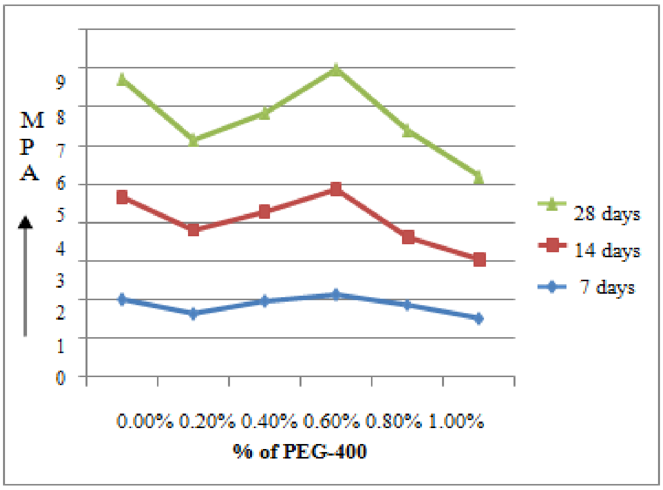
FlyAsh:



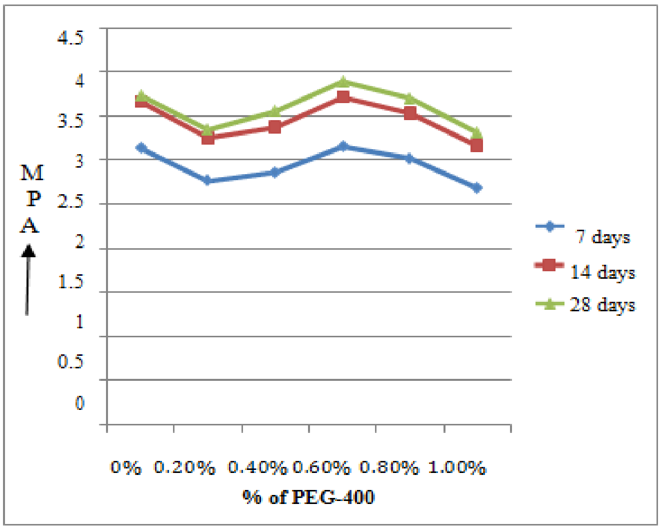
Graph 1: showing the Split-Tensile Strength of concrete with partial replacement of cement by FlyAsh



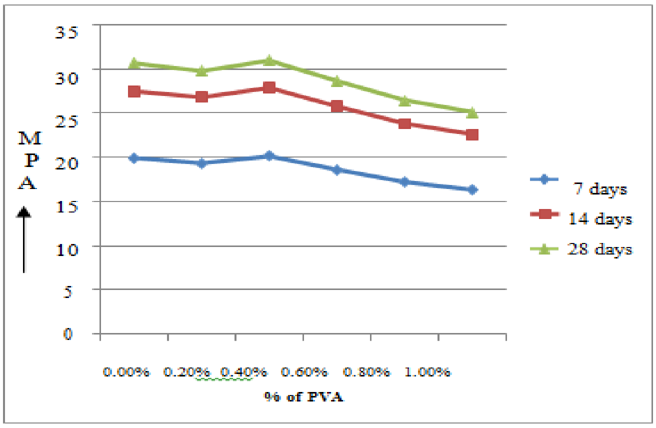
Graph 2: showing Compressive strength of concrete partially replaced by Fly Ash at 10% and PEG-400 with cement



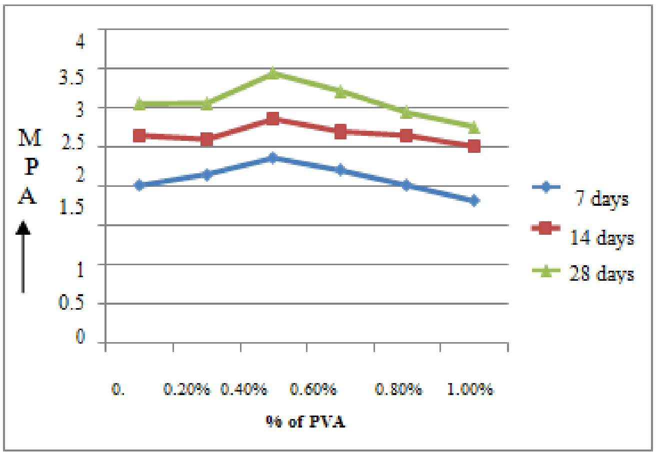
Graph 3: showing Split-Tensile strength of concrete partially replaced by FlyAsh at 10% and PEG-400 with cement



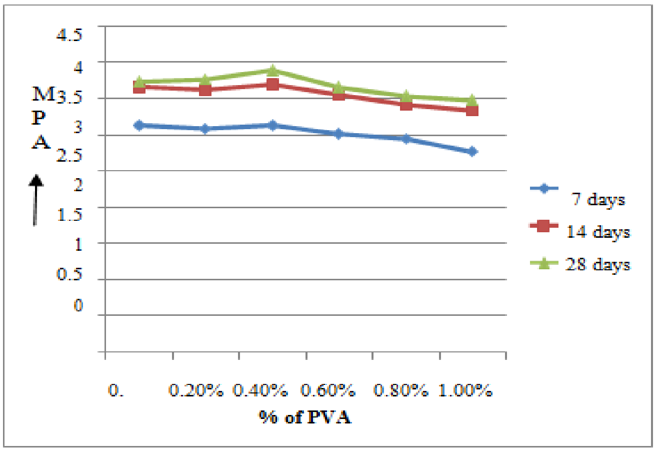
Graph 4: showing Flexural strength of concrete partially replaced by Fly Ash at 10% and PEG-400 with cement



Graph 5: showing Compressive strength of concrete partially replaced by Fly Ash at 10% and PVA with cement

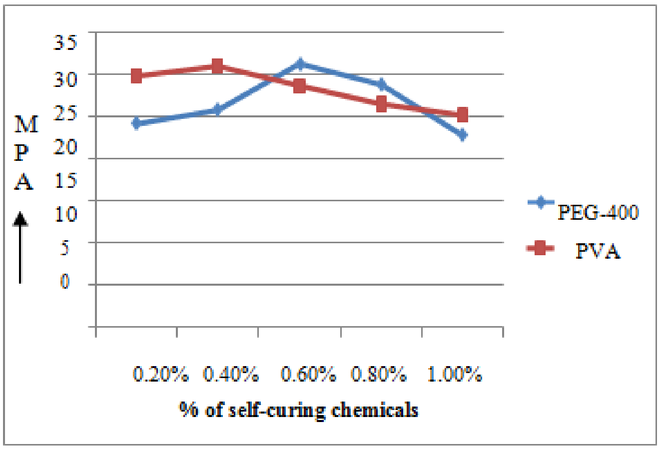


Graph 6: showing Split-Tensile strength of concrete partially replaced by Fly Ash at 10% and PVA with cement

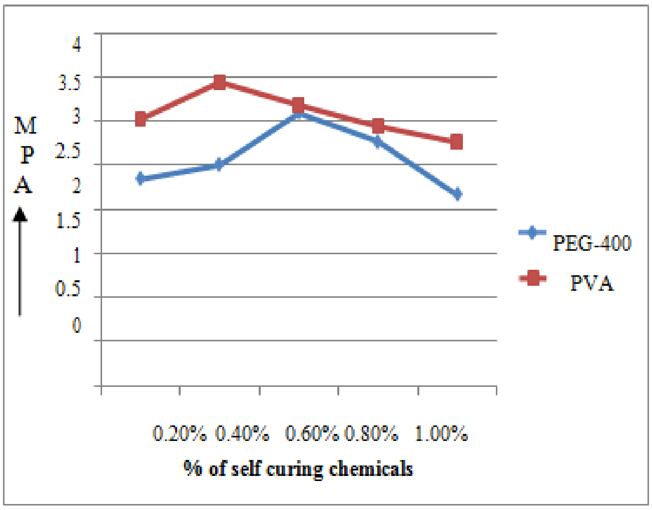


Graph 7: showing Flexural strength of concrete partially replaced by Fly Ash at 10% and PVA with cement

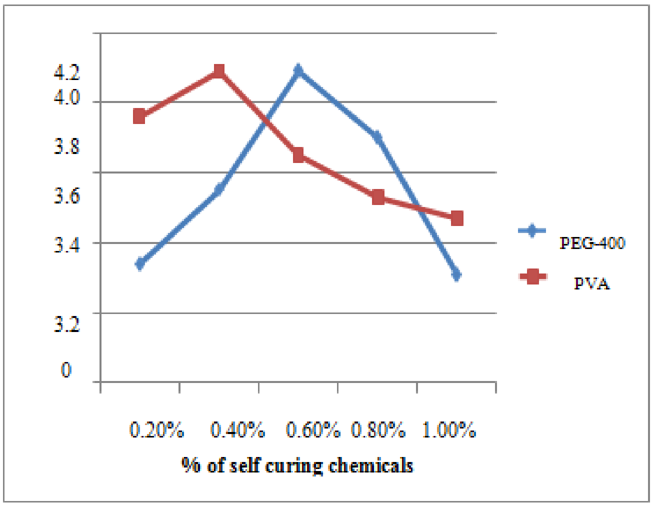
COMPARISON OF STRENGTHS BETWEEN PEG-400 AND PVA at 28 DAYS:



Graph 8: showing the comparison of Compressive strength of PEG-400 and PVA



Graph 9: showing the comparison of Split-Tensile strength of PEG-400 and PVA



Graph 10: showing the comparison of flexural strength of PEG-400 And PVA

V. CONCLUSIONS

- Concrete with **10%** replacement of cement with FlyAsh shows good mechanical properties (Compressive Strength, Split-Tensile Strength and Flexural Strength).
- The Optimum dosage of PEG-400 is found to be **0.6%.**
- The Compressive strength attained by self curing concrete at 0.6% of PEG-400 is nearly equal to that of conventional concrete
- The split tensile strength attained by self curing concrete at 0.6% of PEG-400 is 18.8% less than that of conventional concrete
- The Flexural Strength obtained by self-curing concrete at 0.6% of PEG-400 is nearly equal to that of conventional concrete
- Comparing the Compressive strengths, the self-curing concrete using PEG-400(at 0.6%) is attaining nearly equal strength to that of

conventional concrete (10% replacement of Fly Ash)

- Comparing the Split-Tensile strengths, the self-curing concrete using PEG-400 (at 0.6%) is showing 16.1% less strength than that of conventional concrete (10% replacement of Fly Ash)
- Comparing the Flexural strengths, the self-curing concrete using PEG-400 (at 0.6%) is gaining 4.2% more strength than that of conventional concrete (10% replacement of Fly Ash)
- The optimum dosage of PVA is found to be **0.4%.**
- The compressive strength attained by self curing concrete at 0.4% of PVA is 1.8% less than that of conventional concrete
- The Split-Tensile strength attained by self curing concrete at 0.4% of PVA is 9.2% more than that of conventional concrete
- The Flexural Strength obtained by self curing concrete at 0.4% of PVA is 2% less than that of conventional concrete
- The Compressive strength of self-curing concrete using PVA (at 0.4%) is nearly equal to that of conventional concrete (10% replacement of Fly Ash)
- The split-Tensile Strength of Self-Curing Concrete using PVA (at 0.4%) is 12.7% less than that of conventional concrete (10% replacement of Fly Ash)
- The Flexural strength of self-curing concrete using PVA (at 0.4%) is 4.28% less than that of conventional concrete (10% replacement of Fly Ash)
- Comparing the results of PEG-400 and PVA,**PEG-400** has shown the maximum strengths at 28 days
- The compressive strength of self-curing concrete using PEG-400(at 0.6%) is 0.9% more than the compressive strength of the self-curing concrete using PVA (at 0.4%)
- The split tensile strength of self-curing concrete using PEG-400(at 0.6%) is 34.3% more than the Split-Tensile Strength of the Self-Curing Concrete using PVA (at 0.4%)
- The flexural strength of self-curing concrete using PEG-400(at 0.6%) is same as flexural strength of the self-curing concrete using PVA (at 0.4%).

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