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Review Article

A Review On Compressive And Flexural Strength Of Concrete Containing Fly Ash In Normal And Acidic Environment

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Abstract: Concrete has become an indispensable construction material and it is now used in greater quantities than any other material. In the present context durability, strength, economy and stainable development are key issues for development. Concrete as key ingredient for construction is used to construct various industries and laboratory where it may be exposed to acidic environment which results in loss of material and strength. Thus to make concrete durable against acidic attack admixture may be added. The admixtures such as fly ash, granulated blast furnace slag, rice husk, silica fume etc. can be added to improve the desire property of concrete. Out of all the above, the use of fly ash has gained prominence due to growing awareness about the benefits and easy availability of the good quality fly ash. In India about 60% of power plant runs on coal which produce 175 MT of fly ash per year. More than 70,000 acres of land is presently occupied by ash ponds. Thus using fly ash as construction material helps in sustainable development and makes concrete durable. This paper describes about the results obtained from various research done on the partial replacement of cement with fly ash and other admixtures in concrete.
Keywords: Acidic (HCL) environment, Compressive strength, Durability, Fly ash, Flexural Strength

INTRODUCTION

Developing is nature of human being, with passing time human made his journey from cave to hut and now to a sky scraper. As time passes demand for infrastructural growth increases. Satisfying this demand with economy and durability is important. As industrialization increases pollution also increases thus with economy and durability sustainable development is also necessary.

Conversion of waste into a resource material is an age-old practice of civilization. Thus using waste material such as fly ash, rise husk ash, coir fiber etc. as admixture in concrete can help in achieving economy and change in desire property of concrete. In India about 60% of power plant runs on coal which produce 175 MT of fly ash per year. Due to such a huge production fly ash is easily available and used in various construction work line:-

1. Part replacement of OPC in cement concrete.
2. High volume fly ash concrete.
3. Roller Compacted Concrete used for dam & pavement construction.
4. Manufacture of ash bricks and other building products.
5. Construction of road embankments, structural fills, low lying area development.

At present day More than 70,000 acres of land is occupied by ash ponds. Thus using fly ash as admixture in concrete can give an economical way of construction and also helps in sustainable development. Concrete as the key ingredient is used to construct various industrial structures where it may be exposed to acidic environment. Due to acid attack material loss takes place which reduces the strength of concrete. Finally the life of the structure reduces. To stand against this acidic environment fly ash may be added to concrete to increase the durability of concrete.

Fig-1: Fly ash

PREVIOUS RESEARCH

R.Nagalakshmi [1] produced concrete by replacing 20% of cement with fly ash and replacing 10%, 20% and 30% of coconut shell as coarse aggregate for concrete of grade M25. The experimental result showed that compressive strength, split tensile strength and flexural strength decreases. Compressive strength reduces from 33.33 to 30.78 N/mm^2 after adding CS and Fly ash.

C. Marthong, et.al [2] produced concrete with three different OPC grade: 33, 43 and 53 as classified by BIS and replaced cement with fly ash by 10%, 20%, 30% and 40%. The results of experimental study showed that the strength of concrete reduced as the fly ash contents increases in OPC. Fly ash concrete was more durable as compared to OPC concrete and fly ash up to 40% replacement increased with grade of concrete.

Satish D. Kene, et.al [3] produced concrete with replacing cement by 30% Fly ash and 0% Rice Hush Ash, last proportion taken 0% Fly ash and 30% Rice Hush Ash, with gradual increase of Rice Hush Ash by 1% and simultaneously gradual decrease of Fly ash by 1%. The results obtained by the experimental study shows that the compressive strength increased with increase in percentage of fly ash and rice husk, ash and workability of concrete reduced. The weight of concrete reduces up to 15% after 90 Days of curing.

Dhillon, et.al [4] carried out a study to see the effect of the fly ash content with steel and polypropylene fibres Cement had been replaced with 15, 20 and 25 per cent fly ash by mass. Two types of fibres, steel as well as polypropylene fibres had been used in percentages of 0.5% and 1.0% by volume the results showed that with increase in percentage of fly ash replacement there was decrease in compressive, flexural and split tensile strength

Moinul Islam, et.al [5] studied the effects of fly ash on strength development of mortar and the optimum use of fly ash in mortar. Cement was partially replaced with six percentages (10%, 20%, 30%, 40%, 50% and 60%) of class F fly ash by weight. The result of the study showed that strength increases with the increase of fly ash up to an optimum value, beyond which, strength values start decreasing with further addition of fly ash. Among the six fly ash mortars, the optimum amount of cement replacement in mortar was about 40%, which provided 14% higher compressive strength and 8% higher tensile strength as compared to OPC mortar. M.D.A.

Thomas, et. al [6] produced concrete that contains ternary blends of Portland cement, silica fume, and a wide range of fly ashes. The results showed that the combination of silica fume and fly ash is complementary: the silica fume improved the early age performance of concrete with the fly ash continuously refining the properties of the hardened concrete as it matured.

N.R. Dakshina, et.al [7] carried out an experimental study on sulphate ion attack on ordinary, standard and higher grade concretes at early ages of 7 days and 28 days. The main variable investigated in this study was percentage variation of fly ash. The cement was replaced by fly ash up to 40% at a regular interval of 10%. The results After 28 days of immersion of concrete cubes in 5% concentrated H_2SO_4, the concrete with 40%Fly ash had shown a better performance in Ordinary and Standard grades. From compressive strength point of view, the investigations had showed an improvement in fly ash concretes over conventional concretes in all the Three Grades. Therefore replacement of cement by fly ash was recommended in sulphate-attacked areas.

Darsh Belani, et.al [8] used Fly Ash in construction of rigid pavement to provide a low cost pavement. The fly ash was replaced within the range of 10-40% by weight of cement. Compression and flexural strength were measured. The result showed that for CBR value of 2% and wheel load of 30KN; cost of rigid pavement decreased up to 120 Rs. Thus involving fly ash can help in developing economically.

R. Thangaraj, et.al [9] produced high volume fly ash concrete (HVFAC) using a cement replacement level of 50%, 55% and 60% in M_{20} and M_{25} grades of concrete. The results showed the compressive strength of HVFAC was improved by about 50% cement replacement by fly ash with 1.5% of plasticizer was equal to control concrete. HVFAC mixtures were sustainable as they consume less Portland cement, large volume of an individual waste and produced a highly durable product.

Aan Jatale, et.al [10] studied the compressive strength of concrete when cement was partially replaced with 20%, 40% and 60% of fly ash. The results showed that using fly ash improves workability of concrete. Compression strength reduced with increase in fly ash content. The strength reduced up to 50% when 60% of fly ash was replaced with cement.

Lohani T.k, et.al [11] studied workability and strength of geopolymer concrete when partially replaced with fly ash. The results showed that the slump value increased with increase in percentage of fly ash based geopolymer for the replacement of cement with the same w/c ratio. The strength of fly ash geopolymer concrete increasd compared to geopolymer concrete.

Manish Rohit, et.al [12] studied the compressive and flexural strength of High volume fly

ash concrete where cement was replaced up to 50%, 55% and 60% of fly ash and was reinforced with 12 mm triangular shape polyester fiber as secondary reinforcement. The results for plain HVFAC showed that all samples gain targeted strength at 28 days and notable increase in the strength continuous beyond 28 days. Increase in % of fly ash reduces % gain at different age of concrete.

Jayeshkumar Pitroda, et.al [13] produced a concrete of grade M_{25} and M_{40} by replacing cement up to 10%, 20%, 30% and 40% by fly ash. The results of compression strength showed the reduction in strength of concrete with increase in fly ash concrete. The cost of concrete also reduced.

K. Madhan Gopal, et.al [14] studied the behaviour of fly ash based geopolymer concrete exposed to 5% of acidic environment. The result showed that the fly ash base geopolymer concrete resisted acidic attack better as compared to normal concrete. Loss of compression strength of normal concrete is almost the double the loss of strength in fly ash based geopolymer concrete.

H. Sudarsana Rao, et.al [15] studied the effect of acidity (HCL, H_2SO_4) present in water on strength of normal concrete. The results showed that the initial and final setting time is retracted. Compressive strength reduced as the material is loss.

Rajamane N.P, et.al [16] prepared a fly ash blended concrete mixture of M_{25} grade with fly ash contents in binder portions of the concretes being 25%. The concrete was under sulphate attack for one year. The strength of fly ash concrete was studied under sulphite attack. Compressive strength of concrete mixtures recorded only about 0 to 2 MPa growths between the ages 90 and 180 days. During this period, the split tensile and flexural tensile strengths showed marginal increase. Thus, there was only insignificant increase in strengths after 90 days.

S C Maiti, et.al [17] developed the mixing proportion of fly ash with concrete and studied the compressive strength of concrete. Concrete of various grade like M_{15}, M_{20}, M_{25} and M_{30} were used with replacement of cement by 15%, 25% and 35% of fly ash. The results showed that the strength of concrete reduced with increase in the proportion of fly ash. Water to cement ratio reduced with increase in fly ash content.

Khusbu Rajhans, et.al [18] studied the strength of concrete where cement was replaced by fly ash, rice husk ash and both at same time. The cement was replaced by 6%, 12%, 18% and 24%. The result shows that the Compressive Strength increased with the increase in the percentage of F A and RHA up to replacement (12% FA and 12% RHA) of cement in concrete for M25 grade concrete.

P. Murthi, et.al [19] studied the sulphuric acid (H2SO4) and hydrochloric acid (HCl) resistance of the binary blended concrete at the replacement level of cement by 20% of fly ash and the ternary blended concrete at the replacement level of cement by 8% of silica fume. The results showed that the PCC specimens of all the M_{20}, M_{30} and M_{40} grade concrete were severely deteriorated after immersion of 5% H_2SO_4 solutions and 5% HCl solutions up to 32 weeks. The mass loss of 28 and 90 days cured M_{20} grade PCC specimens was 19.6% and 16.1% respectively. The PCC specimens are severely affected the acid attack and hence the SDF (strength deterioration factor) values of PCC specimens were more than 78%.

R.S. Deotale, et.al [20] studied the compressive and flexural strength and acid resistance of concrete. The concrete was prepared with addition to fly ash, rice husk ash and steel fibers. The mix was prepared with proportion of 30% FA and 0% RHA mix together in concrete by replacement of cement, last proportion taken 15% FA and 15% RHA, with gradual increase of RHA by 2.5% and simultaneously gradual decrease of FA by 2.5% and to improve the strength of concrete steel fibers were added and fiber volume fraction was 0%, 0.25%, 0.5%, 0.75% and 1.0% in volume basis in the proportion of 10% RHA and 20% FA. The results showed the increase in Compressive strength with the increase in the percentage of Fly ash and Rice Husk Ash up to replacement (22.5%FA and 7.5% RHA) of Cement in Concrete for different mix proportions. Steel fibres had shown more significant effects on flexural and tensile strength at 0.75% by volume fractions.

CONCLUSSIONS

The following are the conclusions from the present study.

- Durability of concrete increases when fly ash is added.
- Strength of concrete reduces with increase in the content of fly ash.
- Strength of geopolymer concrete increases with fly ash.
- Loss in material reduces when fly ash concrete is subjected to acidic environment.
- Water to cement ratio reduces.
- Cost of concrete is reduced.
- Fly ash reduces permeability.

REFERENCES

1. Nagalakshmi R; Experimental study on strength characteristics on M25 concrete with partial replacement of cement with fly ash and coarse aggregate with coconut Shell. International

Journal of Scientific & Engineering Research, 2013; 4(1).
2. Marthong C, Agrawal TP; Effect of Fly Ash Additive on Concrete Properties. International Journal of Engineering Research and Applications, 2012; 2(4):1986-1991.
3. Kene SD, Domke PV, Deshmukh SD, Deotale RS; Assessment of concrete strength using fly ash and rice husk ash. International Journal of Engineering Research and Application,2011; 1(3):524-534.
4. Dhillon R, Sharma S, Kaur G ; Effect of steel and polypropylene fibres on strength characteristics of fly ash concrete. International Journal of Research in Advent Technology, 2014; 2(3):146-155.
5. Islam MM, Islam SM; Strength Behavior of Mortar Using Fly Ash as Partial Replacement of Cement. Concrete Research Letters, 2010;1 (3).98-106.
6. Thomas MDA, Shehata MH, Shashiprakash SG, Hopkins DS, Cail K; Use of ternary cementitious systems containing silica fume and fly ash in concrete. Cement and Concrete Research, 1999; 29:1207–1214.
7. Dakshina NR, Ramaseshu D, Seshagiri Rao MV; Studies on fly ash concrete under sulphate attack in ordinary, standard and higher grades at earlier ages. Asian Journal of Civil Engineering, 2007; 8(2):203-214.
8. Belani D, Pitroda J; Value addition to fly ash utilization by ecoefficient development of rigid pavement in rural roads. International Journal of Advanced Engineering Research and Studies, 2013;2(3):75-78.
9. Thangaraj R, Thenmozhi R; Performance of High Volume Fly Ash in Concrete Structures. IOSR Journal of Mechanical and Civil Engineering, 2012; 3(1): 34-43.
10. Jatale A, Tiwari K, Khandelwal S; Effects On Compressive Strength When Cement Is Partially Replaced By Fly-Ash. IOSR Journal of Mechanical and Civil Engineering, 2013; 5(4): 141-149.
11. Lohani TK, Jena S, Dash KP, Padhy M; An experimental approach on Geopolymeric recycled concrete using partial replacement of industrial byproduct. International Journal Of Civil And Structural Engineering, 2012; 3(1):
12. Rohit M, Patel I, Modhera CD; Comparative Study on Flexural Strength of Plain and Fibre Reinforced HVFA Concrete by Destructive and Non Destructive Techniques. Research Inventy: International Journal of Engineering and Science, 2012; 1(2): 42-48.
13. Pitroda J, Zala LB, Umrigar FS; Experimental investigations on partial replacement of cement with fly ash in design mix concrete. International Journal of Advanced Engineering Technology, 2012;3(4):126-129.
14. Gopal MK, Kiran BN; Investigation on Behaviour of Fly Ash Based Geopolymer Concrete in Acidic Environment. International Journal of Modern Engineering Research, 2013; 3(1):580-586.
15. Sudarsana Rao H, Reddy V, Vaishali SG; Effects of acidity present in water on strength and setting properties of concrete, 29th Conference on Our World In Concrete & Structures: 25-26 August 2004.
16. Rajamane NP, Dattatreya JK, Sabitha D; Residual compressive strengths of fly ash concretes exposed to one year of accelerated sulphate attack, international journal of civil engineering and technology, 2014; 5(3):317-326.
17. Maiti SC, Wason RC, Julak HK, Maidasani A; Development of mix proportioning procedure for fly ash concrete, 27th Conference on Our World In Concrete And Structure, 29-30 Aug 2002.
18. Rajhans K, Sharma CR: Studies on Concrete Characteristic Strength Using Fly Ash and Rice Husk Ash. Int. Journal of Engineering Research and Applications, 2014; 4(2):40-44.
19. Murthi P, Sivakumar V; Studies on acid resistance of ternary blended concrete. Asian Journal of Civil Engineering, 2008; 9(5): 473-486.
20. Deotale RS, Sathawane SH, Narde AR; Effect of Partial Replacement of Cement by Fly Ash, Rice Husk Ash with Using Steel Fiber in Concrete. International Journal of Scientific & Engineering Research, 2012; 3(6):1-9.