IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Preliminary Use of Fly Ash as Complementary Material in Pozzolana Cement Concrete

[1]Arshid Ahmad Bhat, [2]Er.Ashish Kumar

[1]PG Research Scholar,Deptt of civil engineering,Rimt University Gobindgarh Panjab .

[2] Assistant Professor Deptt of civil engineering,Rimt University Gobindgarh Panjab.

Abstract: Cement is the most commonly used building material, accounting for 7% of worldwide carbon dioxide emissions. The most major contribution to global warming is carbon dioxide. Efforts have been made to minimize CO2 emissions in the environment in every way that is practicable, but cement has yet to find a sustainable substitute. The use of fly ash concrete in building is an effort to minimize the quantity of cement needed. The study's purpose is to look at the use of fly ash concrete in construction as a solution to two environmental challenges. One, enormous volumes of fly ash are disposed of by thermal power plants, causing environmental degradation via vast areas of landfills, and two, the cement industry releases a significant proportion of carbon dioxide into the atmosphere. The growth of concrete technology has been increasingly visible in everyday life as the infrastructure era has evolved in recent years. The use of concrete increased the use of natural resources and energy sources. The presence of fly ash in cement and concrete is unacceptable. Fly ash concrete is both cost-effective and eco-friendly. It also increases the durability of concrete. Currently, less than half of India's fly ash production is used. Infrastructural development is at an all-time high throughout the globe, and it is a good indicator of a country's growth. Throughout the experiment, fly ash was partly replaced for cement and fine aggregate, resulting in a range of 0 percent (without fly ash), 10%, 20%, 30%, 40%, and 60% by weight of cement for M-25 Mix. Concrete mixes' compressive and split strength were molded, tested, and compared.

Key Words:cement ,fly ash ,concrete ,fly ash concrete,fine aggregate,coarse aggregate

I. INTRODUCTION

Portland cement is a major component of concrete, and India manufactures about 100 million tonnes of it each year. Portland cement manufacturing in India releases roughly 80 million tonnes of CO2 into the environment each year. Ordinary Portland cement production will continue to decline unless new technologies and practices are introduced that allow for greater use of supplementary cementing materials (SCMs) such as fly ash, either directly in concrete production or through increased use of blended cements containing significant percentages of SCMs. As a result, CO2 emissions would be significantly bigger.

Directly dumping waste items into the environment could result in environmental dangers. As a result, the importance of reusing waste has been stressed. Waste may be exploited to manufacture new items or as admixtures in other products, allowing natural resources to be utilised more efficiently and shielding the environment from waste deposits. These industrial pollutants are deposited on nearby property, undermining the soil's inherent fertility. Fly ash is the finely divided mineral waste left over after the processing of pulverised or powdered coal in a thermal power plant. Fly ash is a beneficial element to employ as a concrete addition It has an impact on a variety of qualities in both fresh and hardened concrete. Furthermore, using waste materials in the cement and concrete industry decreases power plant environmental challenges while also decreasing energy producing expenses. Concrete permeability and thick calcium silicate hydrate are lowered by fly ash cement (C-S-H) (C-S-H) (C-S-H). According to studies, incorporating fly ash as a partial replacement for cement (less than 35 percent) in concrete benefits both the fresh and hardened phases. The fly ash increases workability when it is still fresh. This is related to the fly ash particle's smooth, spherical shape. Because of the greater workability, lower water-to-cement ratios are attainable, resulting in better compressive strengths

II. LITERATURE REVIEW

Maslehuddin et al. (1996) investigated the development of compressive strength and corrosion resistance characteristics of concrete mixes including fly ash (equivalent to sand replacement) (equal quantity of sand replacement). Concrete compositions with water-cement ratios of 0.35, 0.40, 0.45, and 0.50 used 0 percent, 20%, and 30% fly ash additives. Based on the test results, they discovered that adding fly ash to concrete improves early age compressive strength and long-term corrosion resistance. The better performance of these mixes compared to ordinary concrete mixes was attributed to the densification of the paste structure caused by pozzolanic action between the fly ash and the calcium hydroxide freed as a result of cement hydration.

Given the scarcity of traditional and conventional materials, rising costs, and energy and environmental concerns, Suresh (2001) stated that there is an urgent need to produce more building materials for various elements of construction, and that the role of alternative and innovative options would come into sharp focus. Novel building materials and methods, particularly for waste products like fly ash, have been identified as an essential necessity. Land, financial, regulatory, media, marketing, testing, and awareness development will all require institutional support, and some existing projects will need to be significantly strengthened; more importantly, entrepreneurship for the production of appropriate fly ash-based walling, roofing, and flooring materials, including Portland Pozzolana Cement and other cements, will need to be increasingly supported and developed in order to achieve better strides.

According to Chakraborty (2005), it is possible to make concrete using up to 50% fly ash that meets the strength requirements of concrete classes M20, M40, and M60. When compared to control concretes of equal grade made just with OPC, this concrete will develop appropriate early age strength, better strength at later ages, and significantly reduced chloride-ion penetrability. It is possible to increase the proportion of fly ash in a given amount of cementitious materials by replacing part of the PPC with fly ash, resulting in concrete with comparable performance to concrete containing the same amount of cementitious materials and the same proportion of fly ash as a partial replacement for OPC.

Gupta and Kumar (2008) discovered that employing fly ash as a mineral ingredient to partly substitute cement resulting in a 56-day improvement in concrete strength. Using 450 kg/m3 cement and 20 percent fly ash as cement replacement material, the average increase in strength from 28 to 56 days is around 12 percent . When compared to 90 days (anticipated probable) compressive strength, the average increase in strength is roughly 6 percent .

Agarwal and Sharma (2009), the present tests demonstrate that adding powdered SNF enhances the outcomes. The quantity of fly ash in OPC may be increased by up to 35%. The addition of fly ash to cement has no harmful influence on its compressive strength up to 35 percent . The findings will assist to expand the use of fly ash in OPC, lowering the quantity of limestone needed in clinker manufacture.

Zachar and Naik (2010), employing fly ash in concrete is a proven approach to boost strength and longevity, and it has the potential to replace Portland cement. For big volume fly ash concrete, NALCO fly ash should be employed to replace 30-35 percent of the cement. The necessary strength of the Mix in 28 days may be reached by replacing 30 percent of the fly ash with cement.

Kayali et al (2011) demonstrated that at least 7 days of outstanding curing should be administered. If fly ash replaces cement in a direct mass for mass ratio of 50 percent or higher, the concrete will be vulnerable to chloride ion attack.

Dinesh et al (2013) observed that applying up to 37.50 percent fly ash as a cement substitute ingredient resulted in a drop in concrete density. When cement is replaced with fly ash, the degree of workability diminishes as the quantity of fly ash grows. Based on the data, it can be assumed that the replacement of fly ash is controlled by a variety of parameters, including the fineness of the fly ash. The compressive strength of the extremely fine material is great. When the cost of fly ash is zero, replacing concrete is the most cost-effective approach. When fly ash is added to concrete, it not only enhances the long-term strength of the concrete, but it also makes it more cohesive and saves Portland cement. The employment of fly ash is then us Mukherjee and Vesmawala (2013), fly ash may be utilized to generate "green construction" materials, roads, and agriculture, among other things. Three hundred thousand persons may be employed if the producing stock is totally utilised, resulting in a business volume of over Rs. 4,000 crore. Fly Ash is employed 50 percent in the cement and concrete industry, 17 percent in low-lying area fill, and 17 percent in roads and embankments (15 percent). (15 percent). (15 percent). The government has also adopted policies to allow for the use of fly ash in dyke raising (4 percent), and brick making (2 percent). (2 percent). (2 percent). The National Highway Authority of India (NHAI) is now using 60 lakh m3 of Fly Ash, with another 67 lakh m3 planned for future projects ,We will all work together to improve fly ash consumption from 38 percent to 100 percent .

III. MATERIALS

A.cement

Throughout the experiment, separate batches of prism brand Pozzolana Portland Cement (PPC) were used. Portland cement is primarily composed of two basic ingredients: argillaceous and calcareous.B.fine aggregate

Sand from the local area that has been processed through a 75mm IS sieve is utilized. The table below shows the many qualities of fine aggregates.

Table 1

properties	Value obtained
Faineness Modulus	2.67
Specific gravity	2.70
Water Absorption	1.46%

C. Coarse Aggregate

The coarse aggregate was purchased from a nearby quarry and came in two sizes: one fraction went through a 20mm screen and the other through a 10mm sieve. The coarse aggregate has a specific gravity of 2.959 and a fineness modulus of 7.137. The compacted bulk density values of cource aggregate are 1466 and 1629 kg/m3, with a water absorption value of 1.27 percent.

D. Concrete

IS 10262 is followed in the design of the concrete mix (2009). The cement content utilized in the mix design is 380 kg/m3, which meets the minimal requirement of 300 kg/m3 to minimize balling. As coarse and fine aggregates, good stone aggregate and natural river sand from Zone II were employed. The coarse aggregate was 20mm and 10mm in size. For both the fine and coarse E, a sieve analysis in accordance with IS 383-1970 was performed.

For mixing and curing, potable water is employed. The water cement ratio (w/c) was established at 0.47.

Fly ash, F.Fly ash is a by product from the burning of coal in an electrical production facility . It is a siliceous and aluminous substance that chemically combines with calcium hydroxide or free lime(CH) that originated during reaction of cement and water to generate comound possessing cementious qualities

Table2

Physical properties		
S.No	ppc	Fly ash
Specific gravity	2.66	2.31
Mean grain sise	21.6	21
Specific area cm2/gm	2771	2681
colour	Grey	Grey to black

IV. EXPERIMENTAL STUDY

Compressive and split tensile strength of cubs and cylinders were evaluated using an IS 516-1959 compression testing equipment at a loading rate of 140kg/cm2/min (about 30 tones per minute). Two dial guages pointing in diametrically opposed directions were vcasting for testing.:-

The cube size 150mm for compressive strength. The cylinder size 300mm height and dia.150mm for split tensile strength. the information of cubs and cylinders mentioned below.

Table 1:cubes,cement partially replaced with fly ash for compressive strength

S.No	Cube designation	Size(mm)	Fly ash %age
1	B1	150x150x150	0
2	B2	150x150x150	10
3	B3	150x150x150	20
4	B4	150x150x150	30
5	B5	150x150x150	40
6	B6	150x150x150	50
7	B7	150x150x150	60

Table 2:cubes fine aggregate partially replaced with fly ash for compressive strength

S.No	Cube designation	Size(mm)	Fly ash %age
1	B1	150x150x150	0
2	B2	150x150x150	10
3	B3	150x150x150	20
4	B4	150x150x150	30
5	B5	150x150x150	40
6	B6	150x150x150	50
7	B7	150x150x150	60

Table 3:cylinders,cement partially replaced with fly ash for split tensile strength

S.No	Cube designation	Size(mm)	Fly ash %age
1	B1	150x150x150	0
2	B2	150x150x150	10
3	B3	150x150x150	20
4	B4	150x150x150	30
5	B5	150x150x150	40
6	B6	150x150x150	50
7	B7	150x150x150	60

V .RESULTS AND DISCUSSION

Table 4 illustrates the compressive strength of referral concrete at 7, 28, and 56 days. The addition of fly ash enhances the strength of the combination, as demonstrated in this table. Strength rises until the fly ash concentration reaches 30 percent , after which it drops. However, at a 20 percent replacement level, the boost in strength is more obvious. Figure 1 illustrates the difference in compressive strength with increasing amounts of fly ash. The compressive strength of concrete with and without curing as a function of curing time is illustrated in this figure. When the water/cement ratio is 0.47, the compressive strength of PPC is 22.8 N/mm2, 31.7 N/mm2, and 35.58 N/mm2 at 7, 28, and 56 days, respectively.

Table 4. compressive strength of fly ash concrete

S.No	Cube designation	Compressive strength(n/mm2)			%age of fly ash
		7 days	28 days	56 days	
1	B1	22.8	31.9	35.8	0
2	B2	20,5	33.4	38.5	10
3	B3	20.7	33.2	38.7	20
4	B4	17.8	28.7	37.4	30
5	B5	14.3	20.8	28.6	40
6	B6	12.8	19.2	24.4	50
7	B7	7.5	14.8	17.4	60

When Fine Aggegate is substituted for Flyash: Table 5 shows the compressive strength of reference concrete at 7,28 and 56 days. This table clearly shows that the strength increases with the addition of flyash, and that the percentage of flyash content increases continuously. Figure 2 depicts the variation in compressive strength with different percentages of flyash. The Compressive Strength Of Flyash Concrete When Fine Aggregate Is Partially Replaced With Flyash At 50% Replacement Level Increases In Strength Is 15.4 Percent And 18 Percent At 28 And 56 Days With Referral Concrete Cubes

Table 5.compressive strength of fly ash concrete

S.No	Cube designation	Compressive strength(n/mm2)			%age of fly ash
		7 days	28 days	56 days	
1	B1	22.8	31.9	35.8	0
2	B2	20,5	33.4	38.5	10
3	B3	20.7	33.2	38.7	20
4	B4	17.8	28.7	37.4	30
5	B5	14.3	20.8	28.6	40
6	B6	12.8	19.2	24.4	50
7	B7	7.5	14.8	17.4	60

Split Tensile Strength of Flyash Concrete (Partially Replaced Cement with Flyash): Table 6 shows the split tensile strength of referral concrete and flyash concrete after 7, 28, and 56 days. This table clearly shows that the strength increases with the addition of flyash. Strength increases until 20% flyash content is reached, after which it decreases. However, at 10% replacement level, the increase in strength is more noticeable. Figure 3 depicts the variation of tensile strength with different percentages of flyash. These graphs show the tensile strength of concrete with and without curing as a function of curing time. PPC has tensile strengths of 4.6 N/mm2, 6.8 N/mm2, and 7.8 N/mm2. When the water/cement ratio is 0.47 at 7, 28, and 56 days.

Table 6. split tensile strength of fly ash concrete

S.No	Cube designation	Compressive strength(n/mm2)			%age of fly ash
		7 days	28 days	56 days	
1	B1	22.8	31.9	35.8	0
2	B2	20,5	33.4	38.5	10
3	B3	20.7	33.2	38.7	20
4	B4	17.8	28.7	37.4	30
5	B5	14.3	20.8	28.6	40
6	B6	12.8	19.2	24.4	50
7	B7	7.5	14.8	17.4	60

5.1 CONCLUSIONS

From the overhead investigation following outcomes are strained:

A . Compressive Strength (while cement regained with fly ash)

1] At 28 & 56 days the compressive strength of the fly ash concrete upto 30% restroration zone is marginally balanced to guideline code

2] The ideal layer of fly ash reinstatement is 20%;at 20% replacement,the improvement in strength at 28 & 56 days is 2% and 2.9% respectively.

B .Compressive strength (while fine aggregate regained with fly ash)

3] At 28 and 56 days, the compressive strength of fly ash concrete at 50 percent reinstatement layer raised by 15.6 percent and 18.5 percent, respectively, while balanced to guided concrete..

C. Splitting tensile test (while cement regained with fly ash)

4] At 7,28 and 56 days, the split tensile strength of the fly ash concrete is larger than guided concrete up to 20% reinstatement layer.

5] The idea level of fly ash reinstatement is 20%.

6] Tensile strength raises by 13.98 percent , 5.69precent and 19.80precent at 20 percent reinstatement layer after 7,28 and 56 days.

D. Cost analysis

appling 30 percent fly ash as a cement reinstatement part in concrete can trim actual costs by to 24 percent.

7] After 56 days of curing,PPC appears to have reached its maximum strength.

8] The gradual hydration process of fly ash PPC concrete resulted in an increases in strength after 56 days of curing.Fly ash is a Pozzolanic substance with a slow reaction time

REFERENCES

1. *Alhassan A. Y. Apata A.O.. (2012*) "The Behaviour of Portland –Pozzolana Cement Concrete in Aggressive Environments". Journal of Emerging Trends in Engineering and Applied Sciences. (ISSN: 2141-7016). (JETEAS) 3 (4): 2012 pp. 673-676. Jeteas.scholarlinkresearch.org. © Scholarlink Research Institute Journals.

2. Alam J., Akhtar M.N., (2011) "Fly ash utilization in different sectors in Indian Scenario". International journal of emerging trends in Engineering and Development. Issue 1, Vol 1 August.

3. Bakoshi T., Kahno K., Kawasaki S., Yamaji N., (1998**)** "Strength and durability of concrete usingbottom ash as replacement for fine aggregate," ACI Spec. Publ. (SP-179) 159-172.011.

4. Badur S. Choudhary R, (2008**)** "Utilization of hazardous wastes and By-products as a greenconcrete material through s/s process: a review," Advanced Study Center Co. Ltd.Rev.Adv.Master.Sci. 17, 24-61

5. Berndt M.L. (2009) "Properties of sustainable concrete containing fly ash, Slag and recycledconcrete aggregate." Construction and Building Materials Volume 3, Issue 7, Page no. 2606-2613.

6. Cangialosi F., Intini G. Liberti L., Notarnicola M., Di Canio F., (2010) "Activated Coal Fly Ash as Improved Mineral Addition in Cement and Concrete". Second International Conference on Sustainable Construction Materials and Technologies June 8 – June 30, ISBN 978-1-4507-1490-7.

6. Chakraborty A.K. (2005) "HVFAC for Structural Applications," Department of Civil Engineering Bengal Engineering and Science University, Shibpur, Howrah – 711103, West Bengal, India. May.page 1-24.

7. Despande, V.P. (1982) "Removal of suspension from ash slurry in Effluent of stream Generationplant. "Indian Journal of environmental Health 24(1).

8. Gupta M.K., Kumar A., (2008) "factors affecting cement content in concrete", department of civil

.