International Journal of Engineering, Management, Humanities and Social Sciences Paradigms (IJEMHS)
Volume 30, Issue 02, Quarter 02 (April to June 2018)
An Indexed and Referred Journal with Impact Factor: 2.75
ISSN (online): 2347-601x
www.ijemhs.com

Impact of Fly Ash on Portland Pozzolana Cement in Strength

Vishal[1] and Ajit Singh[2]

**[1]M. Tech. Scholar, Department of Civil Engineering,
CBS Group of Institutions, Jhajjar, Haryana (India)
[2]Assistant Professor, Department of Civil Engineering,
CBS Group of Institutions, Jhajjar, Haryana (India)**

Publishing Date: June 07, 2018

Abstract

The era of infrastructure increased in recent year, so the advancement of concrete technology exaggerated day by day in life. Use of concrete exaggerated the consumption of natural resources and energy sources. In recent years inordinate measure of fly ash generated in thermal industries. The previous couple of years, some cement firms have started mistreatment ash in producing cement called hydraulic cement, however, the utilization of ash remains terribly low. There's intolerably opportunity for the fly ash in cement likewise as in concrete. This work describes the use of Non-conventional artefact (Fly ash) that is definitely our there. During this work cement and fine aggregate has been partly replaced by fly ash consequently within the range of 0% (without fly ash), 0%, 6%, 12%, 18%,24% and 30% by weight of cement for M-25 Mix Concrete mixtures were moulded, tested and compared in terms of compressive and split strength.

Keywords: *Fly Ash, Pozzolana Cement, Strength.*

Introduction

Portland cement is an essential component of concrete, and India currently produces about 100 million tons of this material annually; the manufacturing of Portland cement in India directly results in the emission of over 80 million tons of CO2 annually. Without the introduction of new technologies and practices to use larger proportions of supplementary cementing materials (SCMs) such as fly ash, either directly in concrete production, or through the increased use of blended cements incorporating significant percentages of SCMs, the production of ordinary Portland cement, will increase significantly in India to meet the rapidly increasing demand from the concrete industry. Consequently, this would translate into a significant increase of CO2 emissions.

Leaving the waste materials to the environment directly can cause environmental problem. Hence the reuse of waste material has been emphasized. Waste can be used to produce new products or can be used as admixtures so that natural resources are used more efficiently and the environment is protected from waste deposits. These industrial wastes are dumped in the nearby land and the natural fertility of the soil is spoiled. Fly ash is the finely divided mineral residue resulting from the computation of ground or powdered coal in electric power generating thermal plant. Fly ash is a beneficial a mineral admixture for concrete. It influences many properties of concrete in both fresh and hardened state. Moreover, utilization of waste materials in cement and concrete industry reduces the environmental problems of power plants and decreases electricity generation costs. Cement with fly ash reduces the permeability of concrete and dense calcium silicate hydrate (C-S-H). Research shows that adding fly ash to concrete, as a partial replacement of cement (less than 35%), will benefit both the fresh and hardened states. While in the fresh state, the fly ash improves workability. This is due to the smooth, spherical shape of the fly ash particle. The tiny spheres act as a form of ball bearing that aids the flow of the concrete. This improved workability allows for lower water-to-cement ratios, which later leads to higher compressive strengths.

Results

Table 1: Compressive strength of concrete when cement replaced

S. No.	Cube designation	Compressive strength (N/mm^2)			%age of fly ash
		7 days	28 days	56 days	
1	A1	22.7	31.8	35.90	0
2	A2	19.1	32.5	37.6	6
3	A3	19.9	33	37.9	12
4	A4	20.2	33.8	38.1	18
5	A5	21.1	32.4	38.6	24
6	A6	17.6	29.1	37.5	30

Water Cement Ratio

Further, it was observed that at 7 days curing strength of fly ash Portland Pozzolana Cement (PPC) concrete decreased with increase in replacement level. It was observed that at 30% replacement of Portland Pozzolana Cement (PPC) with fly ash compressive strength at 7 days curing is decreased 23.47% than that of referral concretes. It showed that increase in fly ash content in concrete reduced the rate of strength gain at early ages due to slow hydration process. However, the trend at 28 day was not similar as the trend of 7 day. At 28 day curing strength of fly ash PPC concrete was more than that of referral concrete up to 24% replacement level. Beyond 24% replacement level decreased in strength was observed with increased in replacement level.

Table 2: Compressive strength of concrete when fine aggregate replaced

S. No.	Cube designation	Compressive strength (N/mm^2)			%age of fly ash
		7 days	28 days	56 days	
1	B1	22.7	31.8	35.90	0
2	B2	23.91	32.16	36.18	6
3	B3	24.6	32.9	36.87	12
4	B4	24.94	33.05	37.19	18

5	B5	25.6	33.8	39.1	24
6	B6	26.1	35.5	40.1	30

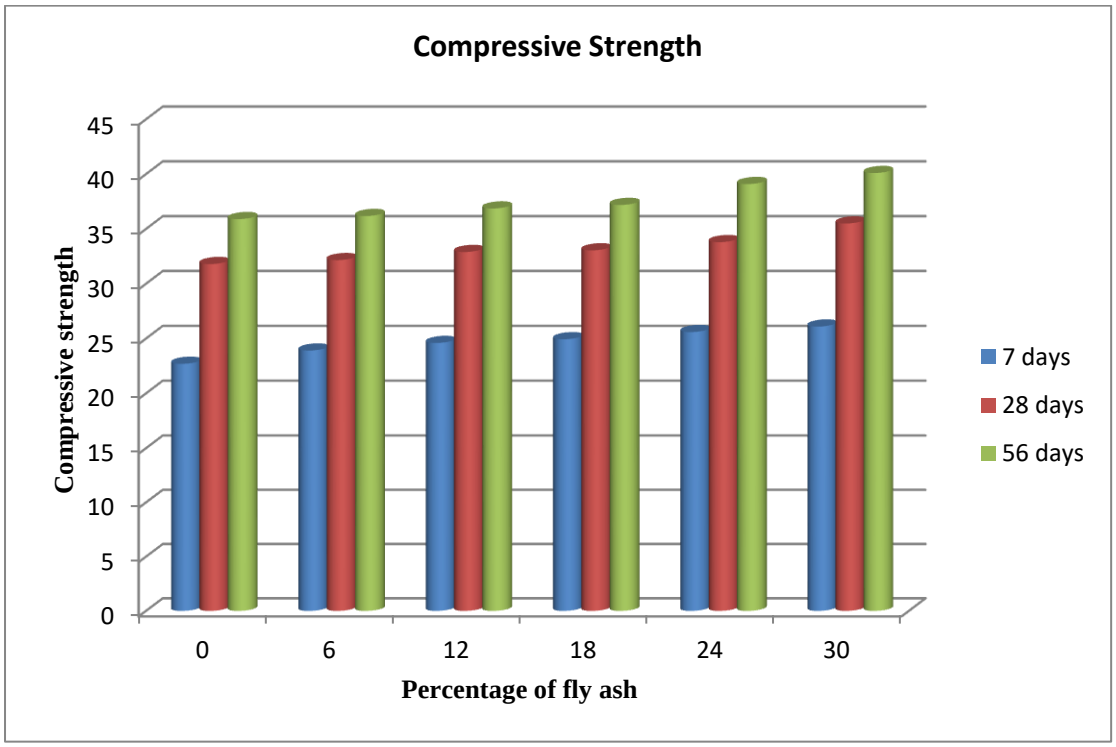

Figure 1: Compressive Strength of Fly Ash Concrete [fine aggregate replace (Column chart)]

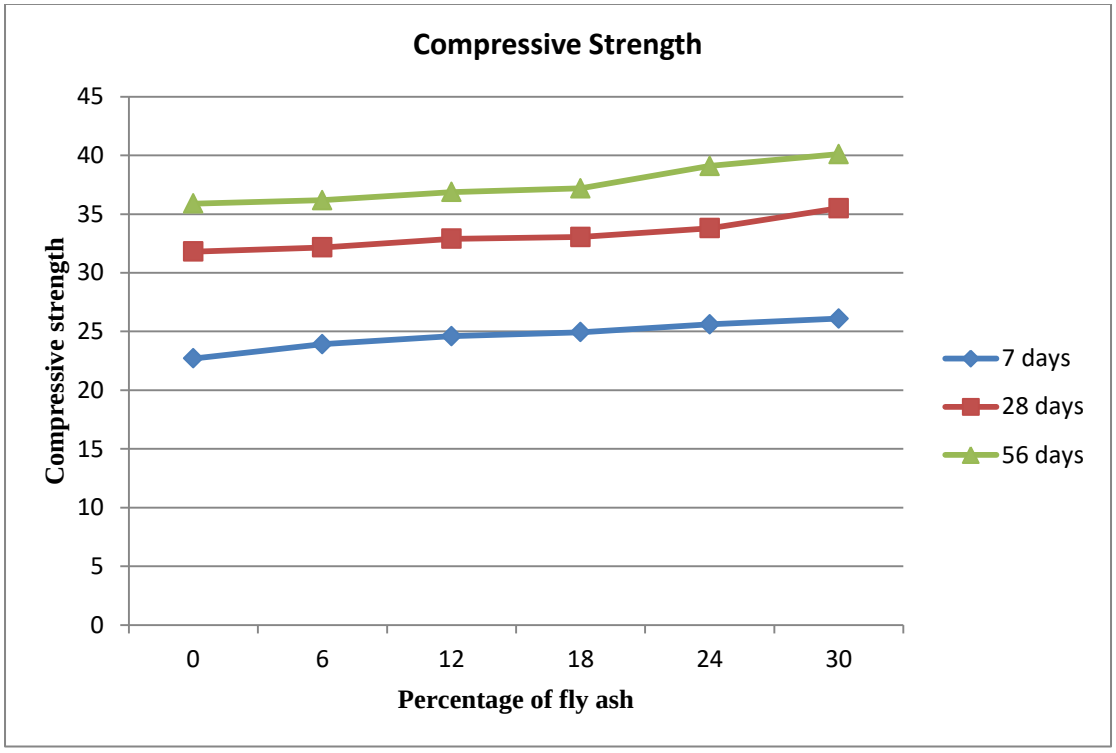

Figure 2: Compressive strength of Fly Ash Concrete [fine aggregate replaced (Line chart)]

Conclusions

From the above study following conclusions are drawn:

- Compressive Strength (when cement replaced with fly ash)
  - The compressive strength of fly ash concrete up to 18% replacement level is slightly equal to referral concrete at 28 and 56 days.
  - Optimum replacement level of fly ash is 24%, at 24% replacement level increase in strength at 28 and 56 days is 1.8% & 7.5%.
- Compressive strength (when fine aggregate replaced with fly ash)
  - The compressive strength of fly ash concrete at 24% replacement level increased in strength with referral concrete is 6.28% and 8.91% at 28 & 56 days.
- Splitting tensile test (when cement replaced with fly ash)
  - The split tensile strength of fly ash concrete up to 12% replacement level is more than referral concrete at 7, 28 and 56 days.
  - Optimum replacement level of fly ash is 24%
  - At 12% replacement level increase in tensile strength at 7, 28 and 56 days is 34.44%, 19.42% and 24.43%.

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 using bottom 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 green concrete 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 recycled concrete 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.
[7] 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.