IABSE Symposium, Bangkok 2009

Appraisal of Eco-friendly Concrete by using Pond Ash and Crusher Stone Dust as Fine Aggregate

Mrs. Radha S. Bang,
Sr. Lect. in Civil Engg.,
Government Polytechnic,
Aurangabad, MS, India.
rsbang@rediffmail.com

Mahendra R. Chitlange,
Head, APM Dept.,
Government Polytechnic,
Aurangabad, MS, India.
mrchitlange1@rediffmail.com

Dr. I. K. Pateria,
Deputy Director (Technical),
Pradhan Mantri Gram Sadak Yojana, NewDelhi, India.
pateriya1@gmail.com

Radha S. Bang, born 1972, received her Civil Engineering degree from Amravati University Amravati. Her area of interest is composite concrete and use of marginal materials in concrete.

Mahendra R. Chitlange, born 1964, received his Civil engineering degree from Nagpur University, Nagpur. His area of interest is composite concrete and steel fiber reinforced concrete.

Dr. I. K. Pateriya has 20 years of experience in teaching at Government College of Engineering, Aurangabad. His area of interest is composite concrete.

Summary

In India, fly ash generation reached to 130 million tonne per year (mtpy) during 2006-07, leaving about 70 mtpy unutilised posing serious disposal problem. A substantial part of fly ash is disposed off in the form of slurry, called as pond ash occupying hundreds of hectors of land. Environmentally compatible disposal through utilisation of waste materials by appropriate technologies is of increasing importance and imposes interesting technical challenges. There is an extreme scarcity of natural sand to be used as fine aggregate in concrete. Hence it indicates urgent need of effective utilisation of pond ash and crusher stone waste and conserves the natural resources. This paper addresses the use of pond ash and crusher stone waste as fine aggregate by replacing natural sand with pond ash in 25%, 50% and 75% of the total fine aggregate with crusher stone waste. The feasibility of pond ash with crusher stone waste is studied by performing compressive strength, and also correlating it by performing NDT tests.

Keywords: Pond ash, Natural sand, Crusher stone waste, Super plasticizer, Compressive strength, Non destructive test, Sustainable development.

1. Introduction

The world concrete industry consumes over ten billion tones of aggregate annually; therefore, industrial by-products must increasingly be substituted for natural aggregates. As a general practice in India, Fly ash and Bottom ash are mixed with water and transported to ash ponds called as pond ash (PA). In India 200 million tonnes of fly ash and 100 million tonnes of pond ash is available, almost free of cost. Crusher stone waste, which is available abundantly from crusher units at a low cost in many areas, provides a viable alternative for river sand in concrete. Crusher dust not only reduces the cost of construction but also reduces the impact on the environment by consuming the material generally considered as a waste product with few applications. Also there is an extreme scarcity of natural sand to be used as fine aggregate in concrete. Experimental work on pond ash and crusher stone waste has been oriented towards identification of its properties and correlating their behaviour as a fine aggregate. Efforts have been made to study the physical properties and gradation of natural sand pond ash concrete (NSPAC) and crusher stone waste pond ash concrete (CSWPAC). The focus of present study is to investigate and compare the compressive strength on standard cubes with NDT testing.

https://doi.org/10.2749/222137809796068244

2. Experimental Program

Concrete mixes were designed in accordance with IS 10262-1982 and IS 456-2000 by assuming good degree of quality control and moderate exposure conditions The exact amount of concrete ingredients were weighed on electronics balance with 10 gm accuracy and mixed thoroughly in laboratory concrete mixer till the consistent mix was achieved. The mixes were prepared by using natural sand and crusher stone waste and replacing it with varying percentages of pond ash such as 0%, 25%, 50%, 75% to evaluate the feasibility. To maintain workability super plasticizer was used. Concrete cubes of size 15x15x15 cm were casted and standard test procedure is followed in accordance with IS: 516-1959. The adopted mix proportions were prepared by weight batching method. Compressive strength was found at 7, 28 and 56 days and test results are compared for NSPAC and CSWPAC. The rebound hammer and pulse velocity tests were performed on the cubes before crushing at 28 days curing period.

3. Results and Discussion

The particle size distribution of fine aggregate i.e. pond ash shows the finer limit while the natural sand shows the coarser limit. The crusher stone waste shows somewhat higher finer particles compared to natural sand. The combined grading of crusher stone waste with pond ash results in better average grading of particles. The crusher stone waste concrete gives consistent higher compressive strength than the companion natural sand concrete. It is observed that as the percentage of pond ash increases the cement content and CA to FA ratio also increases. The water cement ratio was kept constant for all mixes but the slump value of crushed stone waste concrete was marginally on lower side and reduces the tendency of segregation. The comparative compressive strength of NSPAC and CSWPAC was studied. At 7 days curing period the strength achieved by 25% PAC is 79%, 50% PAC is 50% and 75% PAC is 40% to that of 0% PAC. At 28 days curing period the strength achieved by 25% PAC is 92%, 50 PAC is 80% and 75% PAC is 61% to that of 0% PAC. At 56 days curing period the strength achieved by 25% PAC is 101%, 50 PAC is 95% and 75% PAC is 71% to that of 0% PAC. The presence of pond ash in concrete, strengthen the concrete with age as shown in figure 1. The rebound hammer test gives the results on lower side in the range of 75% to 84% to that of 28 days cube strength. As the pond ash content increases the ultra sonic pulse velocity decreases. For 75% PAC, it reduces to 90% to that of 0% PAC. The lower bulk density of pond ash, results in light weight concrete.

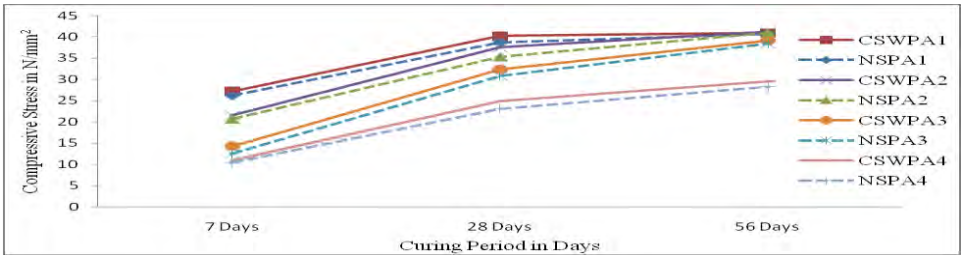

Fig. 1- Compressive strength of concrete with curing period

4. Conclusions

The natural sand can be replaced fully by crusher stone waste in concrete as fine aggregate without affecting the strength of it. On the contrary, it gives higher strength than the conventional concrete, may be due to sharp edged particles and better bond with the cement paste. The addition of pond ash towards partial replacement of fine aggregate up to 25% gives almost same strength while 50% replacement gives 80% strength to that of conventional concrete at 28 days. At 56 days, 25% pond ash content gives higher strength than the companion concrete while 50% pond ash gives almost same strength. The use of pond ash results in the increased cohesiveness and total absence of bleeding. The presence of pond ash in concrete helps towards inhibiting alkali-aggregate reaction. The effective use of industrial by products i.e. crusher stone waste and pond ash in concrete industry contributes towards consumption of waste with conservation of natural resources i.e. river bed sand. This leads to the eco-friendly sustainable development of world wide construction industry.