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Experimental Study on Strength of Concrete by Partial Replacement of Fine Aggregate by Pond Ash

P SARAVANAN, MR.M.SELVA BHARATHI,M.E.,

Department of Civil Engineering, Jayam College of Engineering and Technology, Nallanur, Tamilnadu, India

Assistant Professor, Department of Civil Engineering, Jayam College of Engineering and Technology, Nallanur, Tamilnadu, India

ABSTRACT: Pond ash is produced at alarming charge as a coal gas waste from thermal strength plant life in India. It is comparable to fly ash, besides coarser in dimension and transported to ponds in the structure of slurry. With environmental concerns, it turns into very necessary to eat this waste.

On the different hand, ecological stability is disturbed due to fast consumption of herbal sand as exceptional mixture in traditional concrete. Hence it is tried to make use of pond ash as quality mixture with herbal sand for sustainable improvement of concrete enterprise in India.

The designed with 5, 10, 15, 20, 25 percentage pond ash by way of changing natural sand as quality mixture and take a look at specimens had been organized for compressive, flexural and cut up tensile strength. The grade of the concrete used for this investigation is M25. The power homes of these concrete are observed at 7 days, 21 days and 28 days respectively..

I. INTRODUCTION

Safe and financial disposal of industrial waste which includes coal ash from thermal electricity vegetation continues to continue to be a motive of challenge to the industrial societies.

Alternative use of these waste merchandise in civil engineering applications, drastically researched and extensively adopted in continental Europe and America, is step by step being realized in growing international locations along with India. Nearly 73% of India's whole mounted energy era capability is thermal-based, of which coal primarily based era is 90%, the final comprising diesel, wind, gasoline and steam. The eighty five utility thermal strength stations in India, except the countless captive Power vegetation use bituminous and sub-bituminous coal and produce massive portions of fly ash.

The thermal electricity stations in India at current generate almost one hundred twenty five million ton of coal ash each and every year, out of which solely about 15% is currently utilized in cement, concrete, bricks and geotechnical applications. The excessive ash content material of Indian coal (30-50%) is contributing to these giant volumes of fly ash. As a popular exercise in India, fly ash and backside ash are blended with water and transported to ash ponds. The ash as a result deposited in pond is known as as Pond Ash (PA).The World Bank has counseled India that through 2015, land disposal of coal ash would name for about a thousand rectangular kilometers.

The ash ponds motive severe respiratory and different ailments, visible and aesthetic issues in nearly all the important industrial cities in India. Hence, there is a want to efficiently use this pond ash. In the existing

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investigation, the opportunity of partial substitute of herbal sand (NS) with pond ash as nicely as whole alternative of herbal sand with pond ash and overwhelmed sand (CS) in making concrete is studied. Utilization of pond ash can end result now not solely in lowering the magnitude of the environmental problems, however also to take advantage of pond ash as a uncooked cloth for cost delivered merchandise and preserve standard materials.

Ash is the residue after combustion of coal in thermal strength plants. Particle dimension of the ash varies from round one micron to round 600 microns. The very nice particles (fly ash) accrued from this ash generated via electrostatic precipitators are being used in the manufacture of blended cements. Unused fly ash and backside ash (residue amassed at the backside of furnace) are combined in slurry shape and deposited in ponds which are regarded as pond ash. Most of the Thermal Power plant life in Indian undertake moist techniques of disposal and storage of the ash in giant ponds and dykes. In the moist method, each the fly ash accrued from electrostatic precipitators and the backside and grate ash are combined with water and transported to the ponds in a slurry form.

Pond ash is being produced at an alarming price and efforts are required to safely dispose it and if viable locate methods of using it. Fly ash gathered thru hoppers has been extensively everyday as pozzolanic and is being used via the building industry. Pond ash being coarser and much less pozzolanic is no longer being used, or extra importantly in locations the place the exceptional combination is contaminated with unsafe chemical compounds such as sulphates and chlorides and pond ash accumulation posing environmental problems. The partial alternative of sand by using pond ash in concrete is attempted. It is discovered that it is feasible to use solely pond ash as fantastic mixture barring compromising on energy and durability. This find out about opens up a important avenue for utilization of pond ash.

II. LITERATURE REVIEW

2.1 GENERAL

A precise survey was once made on the exceptional pleasant mixture proportions used for the structural elements. The a number impact of pond ash associated research in concrete have been performed via personalities from round the world. An summary works have been given in this literature review.

2.2 LITERATURE REVIEW

Bapat et al studied the compressive power of concrete containing high volumes of pond ash as a substitute of cement and in contrast with Portland cement concrete and concrete made with the fly ash. They observed that pond ash used to be efficaciously used in excessive volumes to make concrete of decrease strength. Sushil Kumar investigated the impact of addition of ponded fly ash on the workability of concrete for 20, 40, 60 and 80% of high-quality combination changed with ponded ash andwith greater cement and more water brought to restoration workability. He estimated that a most of 40% of fantastic combination can be changed with ponded fly ash withthe addition of 30% of more cement which would then normally lead to uneconomical mixes.

Mangaraj et al stated the find out about of drift of cement mortars and workability of cement concrete the place the great combination was once changed up to 30% with pond ash and pronounced suitability for medium energy concrete. Fly ash accrued via Electrostatic precipitators has been broadly universal in building enterprise as a pozzolanic material. Pond ash being coarser and much less pozzolanic is no longer being used.

Ranganath et al in their learn about on pond ash has proven that particles under 45um have a high quality impact on the electricity of cement concrete at 10% and 20% alternative of cement and concluded that pond ash includes each reactive small particles and non-reactive or poorly reactive massive particles. About one thousand million lots of pond ash is presently handy in India, nearly free of cost. Source of herbal sand is getting depleted and additionally turning into costly. Based on the investigations, the overwhelmed sand concretes exhibit greater compressive, cut up tensile and flexural energy than the corresponding concretes with herbal sand as high-quality aggregate.

P. Aggarwal et al has studied on the achievable of the usage of backside ash as pozzolanic material. The excellent used to be multiplied by way of grinding till the particle dimension retained on sieve 325 mm used to be much less than 5% by means of weight. The consequences confirmed that pastes of cement with substitute by way of authentic or floor backside ash, between 10-30% resulted in longer preliminary placing time, relying on the fineness of the

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ashes, in contrast to putting time of the cement paste. Original backside ash mortar had greater water requirement than that of the cement mortar and floor backside ash mortar had lesser water requirement than that of the cement mortar. Bottom ash ought to be used as a pozzolanic cloth if it was once floor having retention on 325-micron sieve much less than 5%. The municipal strong waste backside ash (MSWBA) was once used as choice combination for the manufacturing of constructing concrete providing a attribute energy at 28 days of 25 Mpa. An try was once made to strengthen 'Light Weight Concrete' in which flyash and backside ash have been used as partial alternative of cement and pleasant aggregate. The consequences of furnace backside ash on workability, compressive strength, and permeability, depth of carbonation and chloride penetration of concrete have been investigated.

The herbal sand was once changed with furnace backside ash through 30, 50, 70 and one hundred percent through mass at constant free w/c ratio of 0.45 and 0.55 and cement content material of 382 kg/m3. The outcomes confirmed amplify in the workability of concrete, and lowered compressive strength, at constant cement content material and w/c ratio. No destructive have an effect on on the long-term power was once served.Air permeability, sorptivity and carbonation price for backside ash concrete was once greater as in contrast to manipulate concrete. However the chloride transport coefficient reduced with the amplify of the alternative degree up to 50%, past which it increased. A light-weight concrete the usage of flyash (FA), furnace backside ash (FBA) and Lytage (LG) as a alternative of OPC, herbal sand and coarse mixture respectively was once manufactured.

Milind P. Bhamare et al determined that Pond ash must be utilized by means of figuring out its traits which significantly relies upon on the particle sizes. From the examination on pond ash used for cement alternative it can be inferred that the ordinary consistency of cement defer in accordance to the share pond ash. Also from the examination on the pond ash included cement, it can be inferred that the pond ash acts as retarder & will increase the preliminary putting time of the cement paste. It is additionally located from the evaluation of the compressive electricity outcomes that as the pond ash proportion will increase in the cement paste the compressive power decreases due to low pozzolanic property of the pond ash.

Arunkumar Dwivedi et al concluded that Pond ash mortar exhibited greater compressive energy as in contrast to normal Portland cement (OPC) mortar for series-I (sand replacement). For series-I, the bulk dry density reduces with amplify in proportion substitute of pond ash when in contrast with OPC mortar. The charge of minimize in bulk dry density of mortar is located to be greater for series-II (cement replacement) as in contrast to series-I (sand replacement). For series-I, pond ash mortar offers most compressive power for 30 percent alternative for 28 days curing period. Also offers most compressive energy for 20 p.c alternative for ninety days curing period. For series-I, flexural electricity will increase for 5% and 10% alternative however for other substitute percentages, it decreases. While changed with cement (series-II), the compressive energy for all the substitute share decreases. For series-II, the flexural electricity cost is extra for 20% alternative as in contrast to all different replacements. The most desirable pond ash content material is located to be 30% of sand substitute indicates round fifty four p.c greater compressive energy after 28 days curing.

Bharathi Ganesh et al made the following conclusions that Pond ash has decrease particular gravity (1.76) which is much less than that of Sand (2.63). As the substitute stage will increase workability decreases for identical water content material ensuing in harshness of the combine will increase which effects in discount in workability and ensuing in expanded demand for dosage of admixture. Since pond ash contributes to extended floor region of Fine Aggregate, it needs for barely improved water content material or extended dosage of admixtures. Pond ash samples fulfill grading limits of almost Zone IV, extra finer particle content material in pond ash may also assist in reaching increased packing density, ensuing in barely greater compressive energy than Normal Concrete at decrease substitute levels. Additional electricity of concrete made with pond ash substitute may also be due to the truth that even pozzolanity of pond ash may also make a contribution to the strength. As the substitute stage of pond ash will increase compressive power will increase up to 25%. At 25% alternative level, power is most and is same to Normal Concrete, indicating greatest stage of substitute of sand by means of Pond Ash as Fine Aggregate. Very low Sorption or Initial Surface Absorption of concrete shows accurate packing with much less pores in it. This might also be due to the reality that make bigger in fines reduces the voids and subsequently decreases the sorption as properly as preliminary floor absorption. All Concrete mixes at ease the sturdiness requirement imposed by means of the applicable sturdiness parameter.

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P. P. Bhangale et al additionally studied and concluded that the density of concrete reduces with the extend in the share of pond ash the compressive energy of concrete with pond ash will increase with multiplied curing period. The most compressive electricity takes place at the identical percentage of CA/FA which have proven the great workability in the mixes with paste volumes, w/c ratios and one-of-a-kind tiers of substitute of high-quality combination with ponded ash. Mixes having greater high-quality combination percentage proven power same to most electricity found at later ages. However, mixes with decrease first-class mixture percentage proven decrease energy at all ages. Such discount in energy can be attributed to the formation of voids/pores due to lack of adequate fines. Considering the compressive energy standards and fee of concrete, the substitute of first-class combination with pond ash is viable and the variant of electricity of ponded ash concrete in evaluation to reference concrete lies inside ± 10% up to the age of 28 days for more than a few mixes.
International Journal of Latest Trends in Engineering and Technology (IJLTET)Vol. two Issue two March 2013 295 ISSN: 2278-621X. The compressive strengths of ponded ash concrete are equal to or greater than the reference concrete at anygiven age. The utilization of ponded ash enhances the electricity substantially at later ages. The extra advantage in phrases of power can lead to economy. Utilization of ponded ash use in concrete is one of the positive methods of utilization of this industrial by using product of BTPS and this will go to a lengthy way in attaining sustainable improvement and to make sure that technological know-how of ponded fly ash utilization as a alternative of sand in cement concrete have to be attainable each technically and economically.

2.3 LITERATURE SUMMARY

The above papers advised that the addition of pond ash will increase the mechanical traits of mortars. The 28 day compressive power of concrete normally will increase with the pond ash content. Bottom ash can also substitute a low quantity of OPC in civil engineering functions in the future, even though greater lookup will have to be carried out in the past to verify its have an effect on on durability. The density of concrete reduces with the extend in share of pond ash. The compressive electricity of concrete with pond ash will increase with extended curing period. The break up tensile electricity of concrete with pond ash will increase up to the addition of 15% pond ash sand replacement. The flexural power of concrete with pond ash will increase upto the addition of 15% pond ash sand replacement.

2.4 PROBLEM STATEMENT

A combine graph for M25 grade of concrete is to be proposed for which pond ash is changed with sand in various share of 5 – 25% (in 5% increment). The compressive strength, flexural energy and tensile power of concrete (normal cast) with changed concrete (using pond ash) are compared.

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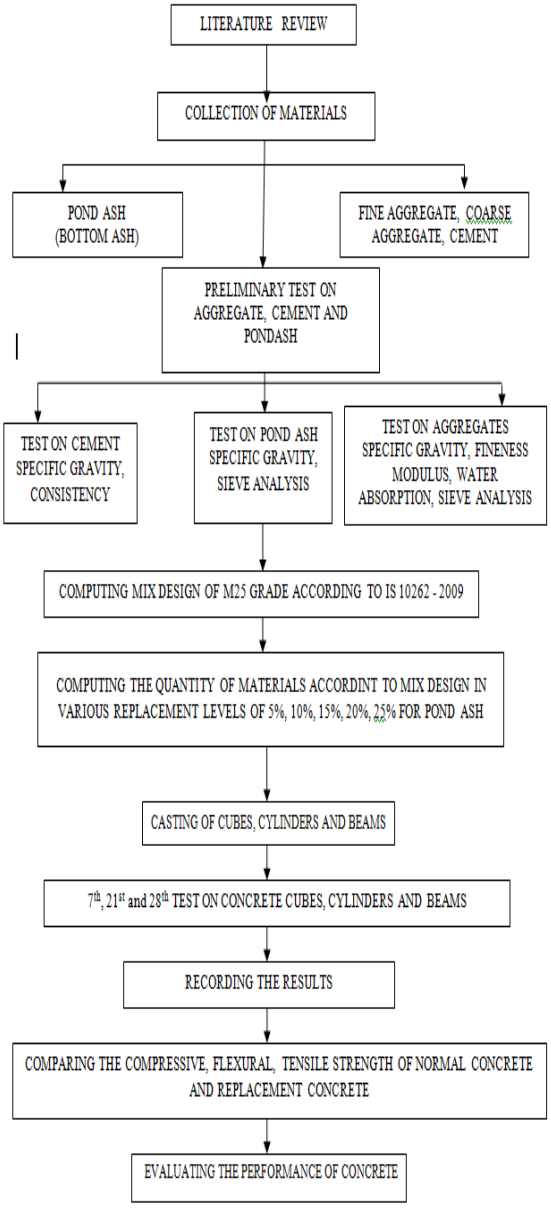
III. METHODLOGY



IV. BASIC INGREDIENTS & PRELIMINARY TESTS

4.1 MATERIAL DESCRIPTION

4.1.1 CEMENT

Portland Pozzolana Cement is manufactured via mixing pozzolanic materials, OPC clinker, and gypsum both grinding them collectively or separately. Today Portland Pozzolana Cement is extensively in demand for industrial and residential buildings, roads, dams and computer foundations. Pozzolana is an vital ingredient in PPC which is

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oftentimes used in the shape of:

- Fly ash
- Volcanic ash
- Silica fumes
- Calcite clay

PPC is resistant to harsh water assaults and prevents the formation of calcium hydroxide at the time of cement placing and hydration. It withstands aggressive gases, thermal cracks, moist cracking, etc. The BIS fine specs for Pozzolana substances used in PPC have been stated below:

- Fly ash – IS3812:1981
- Calcined clay – IS1344:1981

PPC is used in heavy load infrastructure and constructions such as marine, hydraulic structures, mass concreting works, plastering, masonry mortars and all functions of everyday Portland cement. Portland Pozzolana Cement is quite famous in India and with many cement flowers putting up jetties for transportation, initial expenses would regularly limit as well.

4.1.2 WATER

It is the key ingredient, which when combined with cement, types a paste that binds the combination together. The water motives the hardening of concrete via a system referred to as hydration. Hydration is a chemical response in which the foremost compounds in cement from chemical bonds with water molecules and end up hydrates or hydration products. The function of water is vital due to the fact the water to cement ratio is the most fundamental component in the manufacturing of “perfect” concrete. Too tons water reduces concrete strength, whilst too little will make the concrete unworkable.

Portable faucet water on hand in the laboratory with pH cost of 7 and conforming to the necessities of IS456-2000 used to be used for making concrete and curing the specimens as well.

4.1.3 AGGREGATES

These are chemically inert, strong our bodies held collectively with the aid of the cement. Aggregates come in a variety of shapes, sizes, and substances ranging from great articles of sand to massive coarse rocks. 70 to 80% of the quantity of concrete is mixture preserving the value of the concrete low. The resolution of an combination is determined, in part, with the aid of the favored traits of the concrete.

For example, the density of concrete is decided via the density of aggregate. Soft, porous aggregates can end result in susceptible concrete with low put on resistance, whilst the use of tough aggregates can make robust concrete with a excessive resistance to abrasion. Aggregates strongly affect concrete’s freshly combined and hardened properties, combination proportions, and economy.

Generally, flat and elongated particles are averted or are restricted to about 15 percentage by means of weight of the complete aggregate. Unit-weight measures the extent that graded combination and the voids between them will occupy in concrete. The void content material between particles impacts the quantity of cement paste required for the mix. Angular mixture will increase the void content. Larger sizes of well-graded combination and increased grading minimize the void content. Absorption and floor moisture of mixture are measured when choosing mixture due to the fact the interior shape of combination is made up of stable substances and voids that might also or might also now not comprise water.

4.1.3.1 FINE AGGREGATE.

An mixture that passes via 4.75 mm and is retained on 75 micron sieve is acknowledged as satisfactory aggregate. Natural river sand with fraction passing via 2.36 mm sieve used to be used and examined as per IS2386 (part 1)-1963. The fineness modulus of sand used is 3.38 with a precise gravity of 2.60.

4.1.3.2 COURSE AGGREGATE

Aggregate that are retained in 4.75 mm sieve passing via eighty mm sieve are recognized as coarse aggregate. Cube

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specimens had been castes for M25 manage combine the usage of coarse aggregates of most sizes 20 mm. The bodily homes have been examined as per IS2386 (part 1)-1963. The fineness modulus of coarse mixture used is 7.22 with a unique gravity of 2.76.

4.2 TESTS OF MATERIALS

- Specific gravity test
- Fineness modulus test
- Water absorption test

4.3 TESTS OF BASIC MATERIALS

4.3.1 FINE AGGREGATE

4.3.1.1 SPECIFIC GRAVITY TEST (IS 2720 (Part III/ Sec I) – 1980)

PROCEDURE

Dry the pycnometer and weigh it with its cap (W1). Take about 200gm of sand passing via 4.75mm sieve into the pycnometer and weigh once more (W2). Add adequate de-aired water to cowl the soil and screw on the cap. Thoroughly dry the pycnometer from outdoor and weigh it (W3). Fill the cleaned pycnometer definitely with water up to its pinnacle with cap screw on. Weigh the pycnometer after drying it on the backyard absolutely (W4). Repeat the manner for three samples and attain the common cost of precise gravity.

FORMULA USED

$G = (W2 – W1) / [(W2 – W1) – (W3 – W4)]$

Where,

W1 = Empty weight of pycnometer.

W2 = Empty weight of pycnometer + sand.

W3 = Empty weight of pycnometer + sand + water.

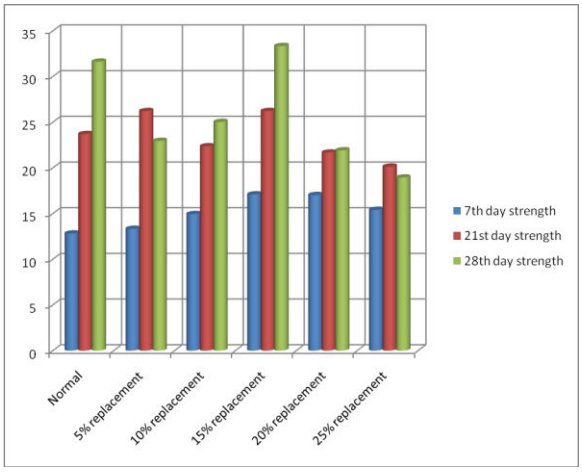
W4 = Empty weight of pycnometer + water.

V. RESULTS AND DISCUSSION

5.1 Discussion about compressive power of concrete with pond ash

The compressive energy of concrete with 15 p.c substitute of sand by using pond ash indicates that the power will increase as in contrast with managed concrete.

The alternative tiers are taken in X-axis while the compressive power is taken in Y-axis.



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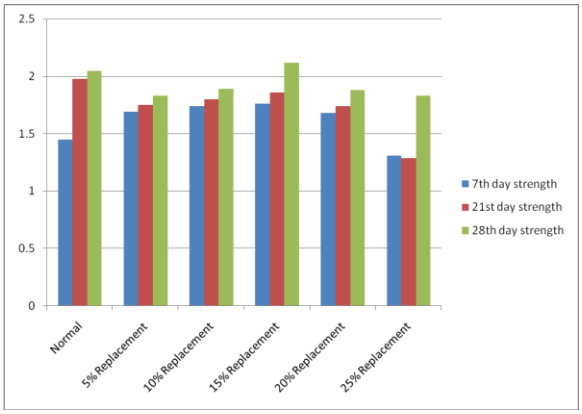
5.2 Discussion about tensile energy of concrete with pond ash

The tensile electricity of concrete with 15 percent alternative of sand through pond ash indicates that the energy will increase as in contrast with managed concrete.

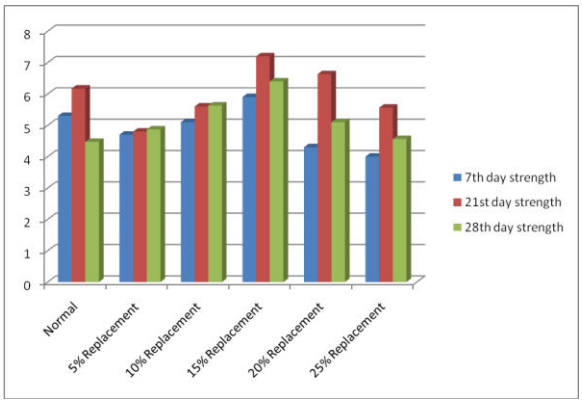
The substitute degrees are taken in X-axis whilst the compressive electricity is taken in Y-axis.



5.3 Discussion about flexural power of concrete with pond ash

The flexural energy of concrete with 15% alternative of sand through pond ash suggests that the power will increase as in contrast with managed concrete.

The substitute ranges are taken in X-axis whilst the compressive energy is taken in Y-axis.



VI. CONCLUSION

The compressive electricity of concrete will increase with amplify in Pond ash content material up to 15%. Thereafter there is moderate decline in power due extra quantity of pond ash which reduces the w/b ratio and lengthen pozzolanic activity. The greater power in case of 15% addition is due to enough quantity of pond ash on hand to react with calcium hydroxide which quickens hydration of cement. Thus, pond ash is proved to be a electricity growing issue in concrete. The compressive energy of concrete with 15% substitute of sand by way of pond ash indicates that the power will increase as in contrast with managed concrete. The tensile power of concrete with 15% alternative of sand by using pond ash indicates that the power will increase as in contrast with managed concrete. The flexural electricity of concrete beams with 15 p.c substitute of sand by way of pond ash indicates that

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the energy will increase as in contrast with managed concrete.

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