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Research Paper

EFFECT OF WHEAT HUSK ASH -AS A POZZOLANIC MATERIAL ON MORTAR

CIVIL ENGINEERING

Keywords: Wheat Husk Ash, fly ash, silica fume, rice husk ash, compressive strength, Consistency

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ABSTRACT

Global warming and environmental demolition have become manifest problems in recent years, enhance concern about global environmental issues, and a vary over from the mass-production, mass-consumption, mass-waste the world of the past to a zero-emission society is now viewed as important. prevent the fatigue of natural resources and enhancing the usage of waste materials has become a significant problem of the modern world.Experimental investigation on the effect of Wheat Husk Ash on mechanical Properties and durability. Including compressive strength, water absorption Consistency is reported in this project. The test results indicate that the mechanical properties of Wheat Husk Ash modified mortar are improved to a great extent. Whereas the water absorption is reduced of modified mortar as compared to that of plain mortar. it is Also interesting to note that partial replacement of cement by 12.5%, 25%, 37.5% of Wheat Husk Ash improve both mechanical and durability of modified mortar. The Wheat Husk Ash is varied from 0 to 37.5% by weight of cement.

I. INTRODUCTION

The present study fits well into the necessities of the actual scenario and perspectives for the future where the overall goal is to achieve sustainable construction producing facilities and infrastructure that meet requirements in a cost-effective manner while minimizing resource depletion of energy and raw materials and optimizing performance throughout their life cycle. The cement industry is one of the responsible for a significant consumption of natural resources and represents a barrier to reduce industrial environmental issues. By substituting supplementary cementing materials (SCMs) for clinker the cement industry has reduced the use of raw materials and thus has lowered CO2 emission.This study investigates the effect of wheat husk ash (WHA) on the mechanical strength of mortar.[1]The study showed that the replacement of cement by WHA increases the mechanical strength of mortar. Nowadays, most mortar mixture contains supplementary cementitious material which forms part of the cementitious component. In recent years significant attention has been given to the use of the pozzolan Wheat Husk Ash as a mortar property-enhancing material, as a partial substitute for portland cement, or both. To study the effect of partial replacement of cement by Wheat Husk Ash, studies have been conducted on mortar mixes for 1:4 and 1:5 proportion at 12.5%, 25%, 37.5% replacement levels of Wheat Husk Ash. Properties of hardened mortar such as Compressive strength, consistency, Water absorption (Durability) have been assessed. [5]

Table 1: Chemical Properties WHA[6]

Oxides	Percentages
CaO	10.6
SiO_2	50.7
Al_2O_3	0.48
MgO	2.20
Alkalies (K_2O, Na_2O)	K2O - 0.07 Na2O - 5.41
SO_3	6.13

II .LITERATURE REVIEW

This paper investigates the effect of wheat straw ash (WSA) on the mechanical strength of autoclaved mortar. Mortar specimens were exposed to autoclave for 2.5 hours at a pressure of 2 MPa. Three percentages of WSA substitution levels (3.6%, 7.3%, and 10.9%) by weight of sand were utilized in the work. [10]In this paper, magnesium silicate was produced by using wheat husk ash. Wheat husk was burned at 600 °C to obtain an amorphous ash structure, and the ash was processed with NaOH solution with heat to take out silica. Na_2SiO_3 (Sodium silicate) solution and magnesium salts were used to synthesize magnesium silicate. [11]As per the author wheat is a very important agricultural product, and is along with the grains that has the highest sustenance value in the world. The present study aimed to describe the structure of wheat hull and wheat hull ash obtained after burning wheat hull at 400 to 1000 °C for 5 h. This study also investigated the potential of wheat hull as a source for the production of silica xero gel. [12]. In this paper author investigates sustainable construction is a concept linked to convert waste management into resource management. As per a survey data only 17% waste is recycled in Japan and this recycling ratio is below 5% in the world as a whole. More than 2 billion tons of agricultural and bio wastes are burnt every year for various purposes leaving behind tones of ashes and often dumped as

waste. [13]. According to study in this paper the high silica content of wheat straw is an important limiting factor for straw pulping. In this work, the percentageof silica in balled straw samples were examined according to their physical components, including internodes, nodes, leaves, rachis, grain, other plant bodies, and other plant spikes.[15]. As per the author Wheat husk an abundantly available agriculture waste in wheat rising areas, having an average of 9 percent of silica that can be retrieved as Amorphous Silica under controlled burning situation.[16]. According to this study Agricultural residue ash is known to be a very reactive source of supplementary cementitious material (SCM) for utilize in concrete It was exposed that the ash alkali percentage correlated with the ash LOI and amorphous silica content.[17]. As per the author the cement industry produces about 5% of the global anthropogenic carbon dioxide (CO2) emissions. Global demand for cement is forecast to grow by 4.7% annually, which will increase CO2 emissions. Bio-cement require less energy concentrated clinker, with its linked carbon emission, to produce a good cementing agent.[18]. Various researchers in the recent past have investigated the pozzolanic properties of many waste materials like fly ash, electric arc furnace slag (a by-product of steel production), ground broken bottles, ashes produced from various agricultural waste such as palm oil waste, rice-husk ash, wheat straw ash, etc. Eighty-four (84) beam specimens were cast, with seventy-two having cement replaced with soldier-ant mound clay varying from 5% to 30% at 5% interval. [19]. As per author the wheat straw of one variety and year was studied in detail on a lab-scale. Studies on the effects of burning time and temperature prove, for the first time, that the alkali in the wheat straw is sufficient to solubilise up to 25% of the silica in the ash at room temperature. Combustion at temperatures below 600 °C gives the highest silica extraction by producing the most alkaline solutions, avoid calcium solubility and sustain silica in a more reactive structure. [20]. In this paper I examine two building materials that illustrate the way in which agricultural practices affected choices in the building industry in North Africa. The mortar of linings in cisterns in North Africa often contains ash, and I suggest that wheat and manure are the likely sources of this ash. [21]. The major objective of this paper is to observe the potential use of various solid wastes for producing construction materials. The paper is based on the broad review of available literature on the construction materials including different kinds of solid wastes. Also, the industrial and urban management systems are generating solid wastes, and most often dumping them in open fields.[22]. According to author Pozzolan materials obtained from different sources, when used as partial substitute for Portland cement in cement based applications play ail important role not only towards sustainable development but in reducing the constituent costs as well Present study was conducted to investigate the synergic effect of Rice- Husk Ash (RHA) and Wheat Straw Ash (WSA) on the strength properties of ash substituted mortar Ash materials were obtained after burning die wastes at 600^{o}C for 5 h at a control rate of 2°C m [23]

III .MATERIAL PROPERTIES

Material Selection:

The materials used for the research program are.

a) Cement
b) Sand
c) Wheat husk ash
f) Water

- ***Cement:***
  Grade : 43
  Type : Ordinary Portland cement
- ***Fine Aggregate:***
  Fineness modulus: 2.742
  (As per IS code 383-1970)
  Specific gravity of aggregates: 2.53
  Water Absorption: 1.2 %
- ***Water:***
  Potable water was used in this study.
- ***Wheat Husk Ash***
  Wheat husk ash used was obtained from Agricultural land from Sevagram.

IV .RESEARCH PROGRAM

Tests On Cement & WHA:

- Fineness Test. (As per IS: 4031 (Part 1) – 1996)
- Consistency Test. (As per IS: 4031 (Part 4) – 1988 & IS: 5513 – 1976)
- Initial & Final Setting Time Test. (As per IS: 4031 (Part 5) – 1988 &
- IS: 5513 – 1976)
- Soundness Test. (As per IS: 4031 (Part 3) – 1988 & IS: 5514 – 1969

Dry mix:

First weight batching is done and dry mix is prepared as per requirement (i. e. 1:4 & 1:5).WHA is also added during the dry mixing process with different percentages (i. e. 12.5%, 25%, 37.5%). The water is then added in the dry mix. The mould of 70.6 mm size. The mould and base plate shall be coated with a thin film of mould oil before use.

Casting& Finishing:

The respective proportion of different ingredients is weighed into the electric mortar mixer. Following steps are followed

1. Ratio of cement is 1:4
2. Add Wheat Husk Ash
3. Add quantity of water (p/4+3) % of combined weight of cement & sand.
4. Mix for three minutes.
5. Size of mould is 7.0cm x 7.0cm x7.0cm

After a uniform mortar is obtained, consistency kept constant by using the flow table apparatus.

Curing:

Curing is done for 7days, 14 days, 28days, 56 days and 90 days in the curing tank of laboratory at standard temperature. The specimens first separated from the moulds after 24 hrs. and final identification marks are done on each specimen. The test specimens are then stored in the curing tank at a place free from vibration. The temperature of the place of storage is

within the range of 22° to 32°C.

Laboratory Test Conducted:

- ***Compressive Strength Test***

1. Size of Specimen:(70.6 X 70. 6X 70.6) mm
2. Area of Specimen:0.00498sq. m
3. Volume of specimen:3.51 X 10^{-4} cu. m

The test is to be performed on Compression testing machine.The load at failure is recorded in kN.Compressive strengthin(load/area) N/mm² .The results for different mix proportion designations are computed and analysed.

- ***Water absorption Test (1:4 & 1:5)***

A cube specimen was cast for each mix to determine water absorption coefficients after 28 days curing. This test is conducted to check the water absorption which indirectly measures the durability of the different mortar matrices.

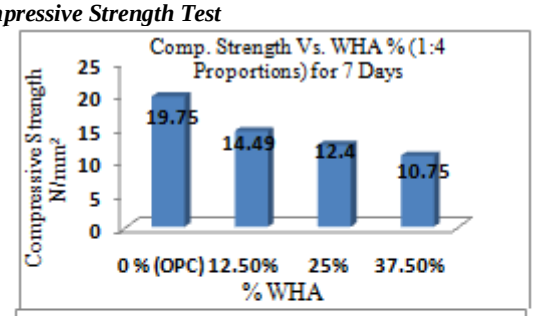
Consistency of mortar by using flow table:

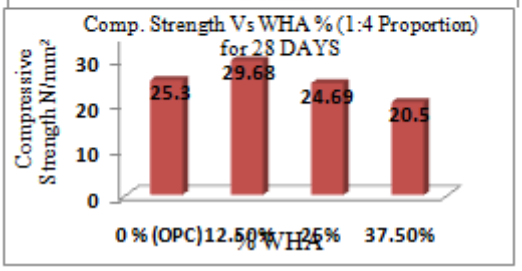
- ***Compressive Strength Test (As per IS: 516 – 1959)***

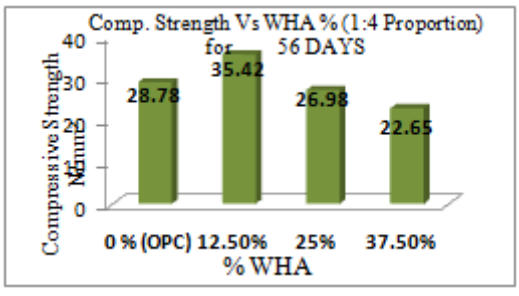
The specimens for each are cast with different percentages of WHA. Strength of WHA mortar initially does not match with the strength of control specimen at 7days but it nearly matches at 28 days and improves at 56days.

V .RESULTS AND DISCUSSIONS

- ***Compressive Strength Test***







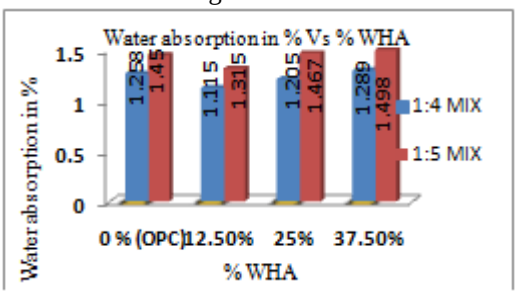
- ***Water absorption test (1:4 & 1:5)***

Rate of water absorption of different mixes after 28 days of curing are Tabulated in Table. And calculated by following formula.

Water absorption (%) = $(W_1 - W_0)/W_0 \times 100$

W1 - dry wt of mortar in gms

W0 - wet wt of mortar in gms



CONCLUSION

The consistency of the mortar with pulverized WHA did not show appreciable changes as compared to the control mix.

Water requirement or normal consistency of a mix increases with increment in percentage of Wheat Husk ash replacement. From the research program, it is found that mortar with Wheat Husk ash can be developed successfully with appropriate strength characteristics. The compressive strength increases with the increase in the percentage of pulverized WHA up to replacement (12.5%) of cement in mortar for different mix proportions. The reason for gain of strength in OPC could be fast reaction of Wheat Husk ash particles due to fine nature. Wheat Husk ash increases the strength of mortar largely because it increases the strength of the bond between the cement paste and the sand particles. The properties shown by Wheat Husk ash mortar are much better than plain cement mortar. We can conclude that water absorption decreases with increase in percentage of replacement by WHA. Water absorption coefficient decreases with increasing % of WHA up to 12.5%. This shows that there is a reduction in the size of capillary pores as stated theoretically. Hence, WHA mortar is less susceptible to deterioration and hence more durable. Water absorption coefficient decreases with increasing % of Wheat Husk ash up to 12.5% replacement. This shows that there is a reduction in the size of capillary pores as stated theoretically. Hence, Wheat Husk ash mortar is less susceptible to deterioration and hence more durable. It would be reasonable to say that inclusion of Wheat Husk ash to the mortar actually forms denser matrices thereby improving resistance of the matrices against water ingress which is one of the most important reasons that increases the deterioration of mortar. So, by using Wheat Husk ash, the mortar matrix gets a denser composition filling even the micro-voids thus enhancing the impermeability of mortar. Better impermeability may ensure better crack-resistance and corrosion resistance as well as less prone to chemical attack. Sufficient trial mixes and various tests should be carried out with the on-site mortar ingredients to get the desired properties for a particular constructional application. The percent of Wheat Husk ash to be replaced should be assessed on the basis of the property of mortar to be enhanced in particular. The WHA can be utilized in mortar making and hence solve a potential disposal problem. Though

Wheat Husk ash is harmful for human being, but the cost of Wheat Husk ash is negligible thus WHA can be conveniently used in mortar.

FUTURE SCOPE

1. Wheat husk ash can be used with
2. Admixtures for increasing strength of mortar with partial replacement of cement.
3. Partial replacement of cement by Wheat husk ash reduces the density of mortar and thus adding it reduces the dead load on the structure.
4. Using of Wheat husk ash helps in reducing the environment pollution during the disposal of excess Wheat husk ash.
5. Wheat husk ash contains considerably higher percentage of silica than other replacement material.
6. Cement is costly and scarce so the partial replacement of these materials Wheat husks ash.
7. Wheat husk ash be used as plasticizers, admixtures & super plasticizers.

APPLICATIONS

1. The Wheat Husk Ash is use in concrete.
2. The percentage of silica in Wheat Husk Ash is high therefore the Wheat Husk Ash is used in construction material by replacement of sand.
3. Wheat Husk Ash mortar can be more efficient in resisting heating or freezing effects.

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