INCORPORATION OF RICE HUSK ASH AND WASTE PAPER SLUDGE ASH AS PARTIAL REPLACEMENT OF CEMENT IN M30 CONCRETE

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ABSTRACT In this developing era concrete and cement mortar are widely used by the construction Industry. As we also know that during the manufacturing of cement large amount of Co_2 is released into the environment, but if we use such material that will replace the quantity of cement content therefore indirectly we are contributing towards the prevention of our planet from global warming and other pollutions . Also in this research work the Rice Husk Ash and waste Paper Sludge are used .The paper sludge which is the byproduct collected from paper mill and rice husk ash obtained from the rice processing units ,by adding these two products with concrete ,not only replaces the cement content but also increases the strength of concrete like compressive, flexural & split tensile strength etc .These two materials RHA & WPSA were incorporated with concrete with varying percentages of 5%,10%,15%, & 20% and there is an equal distribution of RHA and WPSA in every mix. The proper codal provisions were followed during the manufacturing the concrete cubes of 150 X 150 X 150mm , cylinders of size 70 X 150 and beams of size 100 X 100 X 500mm casted with varying percentages of RHA & WPSA . The total number of specimen which were prepared are 30 cubes 10 cylinders and 10 beams were casted with proper curing and the series of tests were conducted on these specimens like Split tensile ,Flexural strength and Compressive strength .

INTRODUCTION

GENERAL

Concrete is one of the mostly widely used material in the world. It is the mixture of cement, fine aggregate, coarse aggregate and water. The strength of concrete depends upon the ingredients which are used in preparing this .The cost of constructional materials increases day by day due huge demand of it. So the concrete engineers look towards the alternative material that not only improves the strength of concrete but replaces the cement content which intern relate the cost of our construction work. The main advantage of incorporating the supplementary cementing material not only improves the strength but also help in preventing the pollution. It also improves the durability. Durability is linked to the physical, chemical and mineralogical properties of material and permeability. Several studies in the developing countries including Thailand, Pakistan and Brazil worked on the materials like Rice Husk Ash and waste paper sludge ash, these materials not only enhance the properties on concrete but also contributes towards the green environment.

RICE HUSK ASH

Rice husk ash (RHA) is a byproduct from the burning of rice husk. Rice husk is extremely prevalent in East and South-East Asia because of the rice production in this area. The ironic land and tropical climate make for perfect conditions to cultivate rice and is taken advantage by these Asian countries. The husk of the rice is removed in the farming process before it is sold and consumed. Rice husk ash is produced in large quantities globally every year and due to the difficulty involved in its disposal, can lead to RHA becoming an environmental hazard . Rice husk ash is a natural pozzolana which is a material that when used in conjunction with lime, has cementitious properties. Several studies have shown that due to its high content of amorphous silica, rice husk ash can be successfully used as a supplementary cementitious material in combination with cement to make concrete products. RHA can be carbon neutral, have little or no crystalline $Si0_2$, or no toxic materials, as in the case of off-white rice husk ash. According to the Food and Agricultural Organization of the United Nations, global production of rice, the majority of which is grown in Asia, totaled 746.4 million tons in 2013. This means that the volume of unused rice husks amounted to 150 million tons. Due to their abrasive character, poor nutritive value, very low bulk density, and high ash content only a portion of the husks can be used as chicken litter, juice pressing aid, animal roughage and pesticide carrier. The remaining husks are transported back to field for disposal, usually by open field burning. RHA is obtained by burning of rice husk. When RH is properly brunt, it has high silica content and can be used as an admixture in mortar and concrete. About 20-22% rice husk is generated from paddy and 20-25% of the total husk becomes a Rice Husk ash after burning. The RHA is used as Pozzolanic material for making concrete.

WASTE PAPER SLUDGE ASH

Papers obtained from the paper mill are called waste paper sludge and the burning of this sludge known as waste paper sludge ash. Paper fibers can only be recycles a limited number of times before they become too short or weak to make high quality paper. Which means that the broken, low- quality paper fibers are separated out to become waste sludge. The raw dry paper sludge mainly contains silica and calcium oxide, followed by alumina and magnesium oxide. The paper mill sludge consumes a large percentage of local landfill space for each and every year. Some companies burn their sludge in incinerators, contributing to our serious air pollution problems. To reduce disposal and pollution problems emanating from these industrial wastes, it is most desire to develop profitable materials from them. Keeping this in view, investigations were undertaken to produce low cost concrete by blending various ratios of cement with hypo sludge .In 1995, the U.S. pulp and paper industry generated about 5.3 million metric tons of mill wastewater-treatment residuals (on oven-dry basis), which is equivalent to about 15 million metric tons of dewatered (moist) residuals. About half of this was disposed in landfills/lagoons, a quarter was burned, one-eighth was applied on farmland/forest, one sixteenth was reused/recycled in mills, and the rest, one sixteenth, was used in other ways.

METHODOLOGY

- The material properties are tested as per Indian standards code (IS 383 – 1996) procedures.
- Mix design for concrete proportion has been developed as per IS 10262 – 1982 and IS 456.
- Casted and cured the concrete specimens as per Indian standards procedures.
- The cast specimens are cubes, cylinders and beams. The cast specimens were cured for 7 and 28 days.
- The percentage replacement of RHA+WPSA by cement are 5%,10%,15% and 20%.
- The cast specimens after curing were subjected to compression testing, split tensile testing and flexural strength testing.
- Test results are obtained and discussed with the help of graphs under ‘Result and Discussions’

RESULTS AND DISCUSSIONS

1. Compressive strength test results

Curing days	Control mix(M1)	5%(M2) N/mm^2	10% (M3) N/mm^2	15% (M4) N/mm^2	20% (M5) N/mm^2
7 days	19.84	20.12	19.78	16.93	14.36
28 days	29.75	30.02	29.77	26.05	22.92

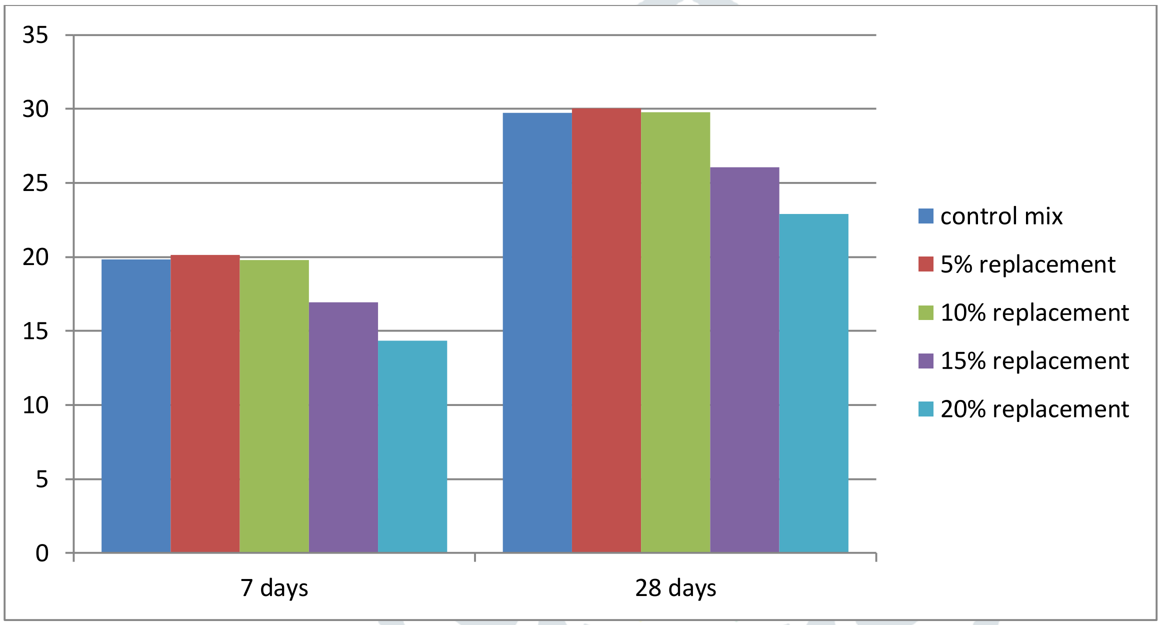

Chart showing the comparative compression strength test at various mixes

The above test result shows that the compressive strength at 7 and 28 days for 5% is little more than control mix and the compressive strength of M2(10% replacement) is equal to control mix and for M4(15% replacement) and M5 (20% replacement) compressive strength decreases. Hence the test shows that RHA +WPSA can be replaced upto 10% with cement.

2. Split tensile strength test result

Curing days	Control mix(M1)	5%(M2) N/mm^2	10% (M3) N/mm^2	15% (M4) N/mm^2	20% (M5) N/mm^2
28 days	4.575	4.57	4.56	3.81	3.12

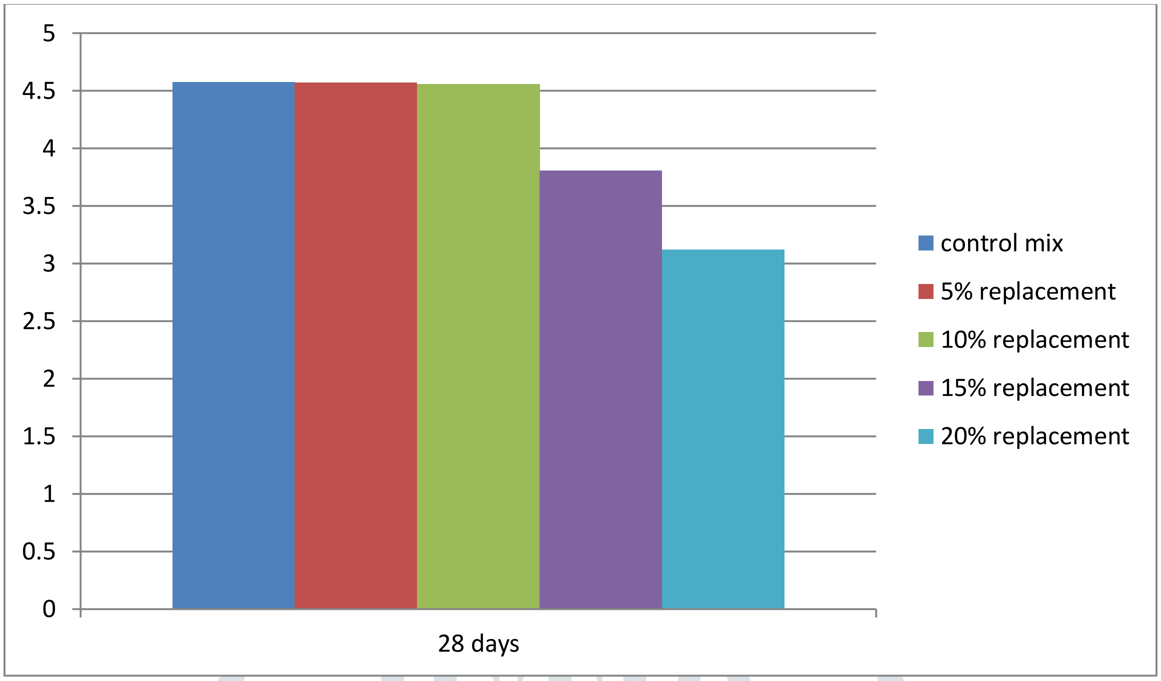

Chart showing the comparative split tensile strength test at various mixes

The above test result shows that the split tensile strength at 28 days at 5% and 10% replacement is nearly equal as control mix and then decreases for M4(15% replacement) and M5 (20% replacement). Hence the test shows that RHA +WPSA can be replaced upto 10% with cement.

3. Flexural strength test result

Curing days	Control mix(M1)	5%(M2) N/mm^2	10% (M3) N/mm^2	15% (M4) N/mm^2	20% (M5) N/mm^2
28 days	5.215	5.21	5.36	4.95	4.895

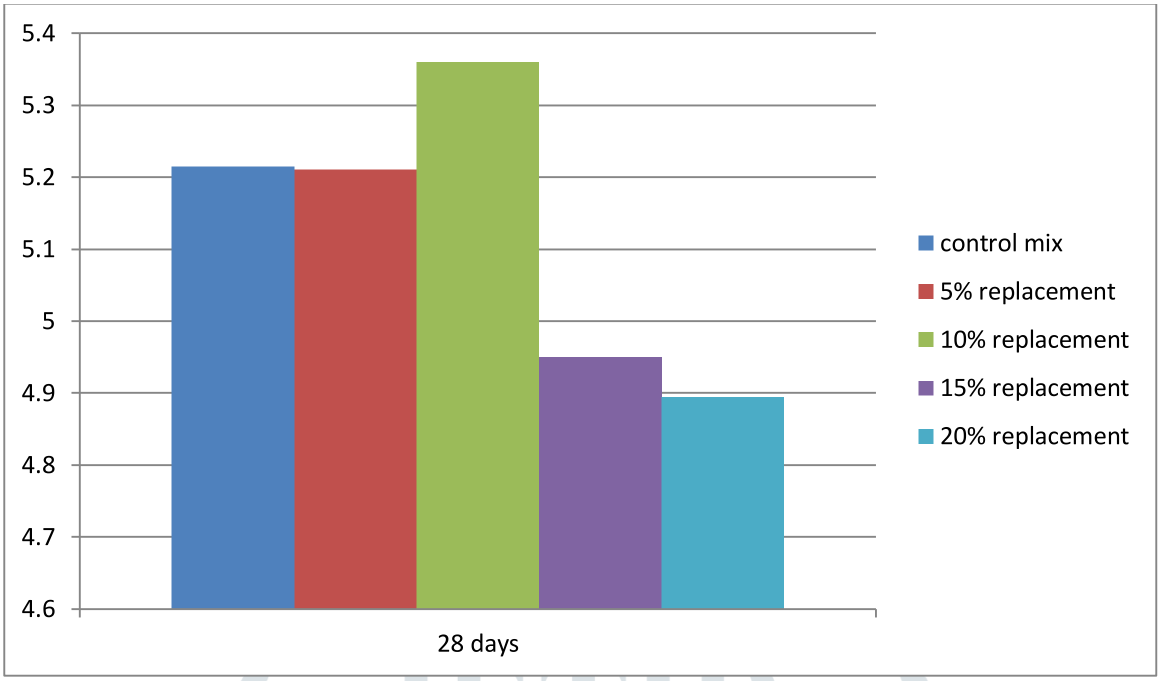

Chart showing the comparative flexural strength test at various mixes

The above test result shows that the flexural strength at 28 days at 5% replacement is equal to control mix and at 10% replacement it increases than control mix and then decreases for M4(15% replacement) and M5 (20% replacement). Hence the test shows that RHA +WPSA can be replaced at up to 10% with cement.

CONCLUSION

Conclusions

The results indicated that the compressive strength of concrete up to 10% replacement of RHA +WPSA with cement is found to be nearly same as control mix.

With the judicious analysis done, the following conclusions were arrived:

- The compressive strength test showed that the compressive strength at 7 and 28 days is equal to control mix for M2 (i.e. when 5% of cement is replaced by RHA+WPSA) and M3(i.e. when 10% of cement is replaced by RHA+WPSA) and decreases for M4(i.e. when 15% of cement is replaced by RHA+WPSA and M5(i.e. when 20% of cement is replaced by RHA+WPSA)

- The split tensile test showed that the tensile strength after 28 days for M2 and M3is nearly same as control mix.
- The flexural strength test showed that the flexural strength is highest for M3 (i.e. when 10% of cement is replaced by RHA+WPSA) and it is equal to control mix for M2(i.e. when 5% of cement is replaced by RHA+WPSA) and it decreases for M4 and M5.

- Considering the strength factor, the above experimental investigation shows that it is very advisable to adopt M2 andM3 as the strength, for M3 it is relatively higher than other mixes.
- Unsurprisingly, M4 and M5 performs the poorest in terms of all the strengths mentioned above and are not advisable to use.

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