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An Experimental Investigation of Rice Husk ash and Waste Paper Sludge ash as Partial Replacement of Cement in Concrete

Eliyas Majeed and Er. Deepak
Department of Civil Engineering,
Desh Bhagat Univesity, Mandi Gobindgarh (Punjab), India

(Corresponding author: Eliyas Majeed)
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ABSTRACT: Most of the construction industries use cement and concrete as raw material. However, the manufacturing of cement and concrete is produced by consuming lot of energy and different types of environmental pollutants are emitted into the atmosphere that cause different health effects to the individual. Keeping nature into consideration, we need to deal with the waste, but if the mechanical Waste are incorporated with certain agents that are biological in origin like rice husk and waste paper sludge as replacement to cement may help in minimizing the impact both in terms of environmental quality and human health ad simultaneously will enhance the quality of concrete as well. In this thesis rice husk ash and waste paper sludge ash was used as partial replacement of cement. The paper sludge is a result of paper making in the paper factory and rice husk is obtained from the preparation of rice from paddy. By including these parts into the bond it builds the quality, flexural and compressive quality of cement. The rice husk ash RHA and waste paper sludge ash (WPSA), were added to the cement at different rates (5%, 10%, 15%, 20%) and ((5%, 10%, 15% 20%). The total no of experiments which were prepared was 78 cubes and 78 cylinders. After different tests were conducted like split strength test, compressive strength test, flexural strength test, normal consistency test, setting time test and water absorption test. It was concluded that rice husk ash (RHA) and waste paper sludge ash (WPSA) is highly useful for the partial replacement of cement in concrete.

Keywords: concrete, risk husk, WPSA, tests, eco-friendly

I. INTRODUCTION

Concrete is the mixture of cement, sand and aggregates with or without admixture and is widely used in the construction industry. The durability of concrete depends upon concreting operations .The cost of construction materials is increasing day by day. The strength of cement relies on proportioning, blending and compacting of the fixings. The favorable circumstances by consolidating these supplementary solidifying materials incorporate vitality utilization sparing (in bond creation), minimal effort, designing properties change, and natural protection through lessening of waste store Hossain *et al* (2011) [1].

Toughness is connected to the physical, concoction and mineralogical properties of materials and penetrability. Any change in these properties is probably going to help sturdiness. Expansion of a pozzolanic material to solid blend may lead an impressive change in the nature of the solid and its strength (Alias *et al* 2014) [2]. A pozzolanic material or pozzolanic has been portrayed as a siliceous and aluminous material.

At normal temperature and with the nearness of dampness it synthetically responds with calcium hydroxide (lime) to shape mixes having cementations properties. Rice husk powder (RHA) and silica smolder (SF) squander paper ooze fiery debris (WPSA)are considered as rich-silica materials or pozzolanic materials used to supplant a segment by mass fundamental of Portland bond keeping in mind the end goal to change the physical and designing properties of concrete and cement. At the point when these materials mixed with concrete and within the sight of water, they can respond with Calcium Hydroxide $Ca(OH)_2$ which shapes in hydrated Portland bond to deliver extra Calcium Silicate Hydrate (C-S-H) (Chandak R. 2013) [3].

Quality and porousness of solidified cement are the fundamental impacts related with the pozzolanic and cementations reactions. Several considers in creating nations including Guyana, Thailand, Pakistan and Brazil, have demonstrated that rice husk slag (RHA) can be utilized as a halfway substitution for bond in concrete.

The capacity to utilize a rural waste item to substitute a level of Portland bond would not just diminish the cost of solid development in these nations, yet would likewise give a method for discarding this slag, which has minimal elective employments (Khan *et al* 2009) [4].

Rice husk ash (RHA) is the by-product obtained from the burning of rice. Rice husk is to a great degree common in East and South-East Asia on account of the rice creation here. The rich land and tropical atmosphere make for culminate conditions to develop rice and is exploited by these Asian nations. The husk of the rice is evacuated in the cultivating procedure before it is sold and expended. It has been discovered useful to copy this rice husk in furnaces to make different things (Rao *et al* 2014) [5]. The rice husk cinder is then utilized as a substitute or admixture in bond. In this way the whole rice item is utilized as a part of an effective and earth neighborly approach.

The techniques for discarding the straw and stubble deposit staying in the fields after reap are either copying or baling. Albeit some restricted employments of rice straw, for example, creature feed or paper making are kept up. However, the rest of the husks are transported back to field for transfer, generally by open field consuming. Thus most ranchers tend to consume the straw in open fields, boosting air contamination and genuine human medical issues because of the discharge of carbon monoxide.

Muck expends a huge level of nearby landfill space for every last year. Norouznejad *et al* (2014).

The fundamental objectives of the present work are to examine the conduct of cement for different extent of RHA, WPSA and blend of (RHA+WPSA) with the quality parameters and functionality parameters. Furthermore, to inspect the possibility of utilizing natural rice husk slag and waste paper slop fiery remains to diminish the measure of bond Shah R.A *et al* (2013) [6].

II. METHODOLOGY AND EXPERIMENTAL WORK

Ordinary Portland cement. Ordinary Portland Cement (OPC) of 43 Grade (Khyber cement) was utilized over the span of the examination. The physical properties of the concrete as decided from different tests adjusting to Indian Standard IS: 12269:1987.

Aggregates. Aggregates constitute the main part of a concrete blend and give dimensional security to concrete. This give around 75% of the body of the solid and thus its impact is critical.

Fine Aggregates. The aggregates sand utilized for the work was privately obtained and adjusted to Indian Standard Specifications IS: 383-1970.

III. RESULTS AND DISCUSSIONS

Table 1: Sieve Analysis of Fine Aggregate.

Weight of sample taken =1000 gm					
Sr. No	**IS-Sieve (mm)**	**Mass Retained (gm)**	**Cumulative mass Retained**	**Cumulative %age mass Retained**	**Cumulative %mass passing through**
1	4.74	1	1	0.1	99.9
2	2.36	21	22	2.2	97.8
3	1.18	77	99	9.9	90.1
4	600µ	154	253	25.3	74.7
5	300µ	264	517	51.7	48.3
6	150 µ	425	942	94.2	5.8
7	Below150µ	58	1000	100	0
	Total			**283.4**	

FM of fine aggregate = 283.4/100=2.83

Table 2: Physical Properties of fine aggregates.

Characteristics	Value
Specific gravity	2.63
Bulk density	5%
Fineness modulus	2.83

Coarse Aggregates. Locally accessible coarse aggregates having the greatest size of 20 mm was utilized as a part of this work. The totals were tried according to Seems to be: 383-1970.

RHA. In this work, Rice Husk was taken from R. K. Undertakings, Lassipora and Pulwama, Jammu and Kashmir, India. Rice husk right off the bat wash with versatile water at that point dried in the sun. After then, rice husk consumed in the open air to change over it into fiery remains.

Table 3: Sieve Analysis of Coarse Aggregate (20 mm).

Weight of sample taken =2000 gm					
Sr.	**IS-Sieve (mm)**	**Mass Retained (gm)**	**Cumulative Mass Retained**	**Cumulative %age mass Retained**	**Cumulative % mass Passing through**
1	40	0	0	0	100
2	20	146	146	7.30	92.7
3	10	1732	1878	93.9	6.1
5	4.74	118	1996	99.8	0.2
6	2.36	0	1996	99.8	0.2
7	1.18	0	1996	99.8	0.2
8	600µ	0	1996	99.8	0.2
9	300µ	0	1996	99.8	0.2
10	150 µ	0	1996	99.8	0.2
11	Below150µ	4	2000	100	0
Total				**800**	

FM of Coarse aggregate = 800/100 =8.00

Table 4: Properties of Coarse Aggregates.

Characteristics	**Value**
Type	Crushed
Colour	Grey
Shape	Angular
Nominal Size	20 mm
Specific Gravity	2.62
Total Water Absorption	0.89
Fineness Modulus	8.00

Table 5: Physical properties of Rice Husk Ash.

Appearance	Fine powder
Particle Size	Sieved through 90 micron sieve
Specific gravity	2.14
Color	Light grey
Bulk density	0.78g/cc

Waste paper sludge ash. Squander paper slop was taken from Industrial Paper Company Lassipora Pulwama J&K. Squander paper was signed in the open air in order to change over it into fiery remains. The concrete mix design was done by using IS 10262:2009 for M-20 grade of concrete.

Before throwing, the whole forms were cleaned and oiled legitimately. These were fixed legitimately before throwing. The coarse totals, fine totals, bond and different fixings (RHA and WPSA) were measured first with precision. The solid blend was finished by hand blending on a non-engrossing stage. Firstly the dry blend is finished. At that point made a space in the focal point of dry blend and 70 to 80% water was included, blend consistently and lay was sprinkled on the blend. For each blend 12 tests were threw, 6 3D shapes (150 x 150 x 150mm) for compressive quality at 7 and 28 days and 6 barrels for part elasticity at 7and 28 days. Throwing was finished with fluctuating rate 5%, 10%, 15% & 20% individually as a halfway supplanting of bond with rice husk fiery remains and waste paper ooze powder. Add up to 156 samples were made 78 solid shapes and 78 barrels. The compaction was finished by hand utilizing tamping bar. The concrete was filled in the molds in four layers and each layer was around one fourth of the tallness of form.

Table 6: Physical properties of Waste Paper Ash.

Appearance	Fine powder
Particle Size	Sieved through 90 micron sieve
Color	Dark grey
Specific gravity	1.16
Bulk density	1.2g/cc

Each layer was packed with 25 strokes of the round end of the tamping bar. The strokes ought to be appropriated over the whole territory of the form. At last the surface of concrete was leveled and completed and smoothened by metal trowel.

Relieving is the way toward keeping the loss of dampness from the concrete while keeping up an attractive temperature administration. It is basic to utilize legitimate and sufficient restoring strategies to lessen the permeability of the concrete and improve its strength by broadening the hydration of the cement, especially in its surface zone.

Likewise relieving keeps the presentation of concrete to a hot environment and to drying winds which may prompt brisk drying out of dampness in the concrete and in this way subjected it to constriction worries at a phase when the concrete would not be sufficiently concrete to opposes them. Concrete is generally restored by water despite the fact that scaling mixes are additionally utilized. It makes the concrete more grounded, stronger, more impermeable and more impervious to scraped spot and to ice relieving is finished by splashing water or by spending wet hessian fabric over the surface. Generally, restoring begins when the concrete is adequately hard. Typically at least 14 long periods of relieving for customary cement is the necessity. In any case, the rate of solidifying of cement is particularly diminished with the lessening of surrounding temperature. The time of restoring will not be under 10 days. In this work restoring was finished by drenching the samples in the relieving tank, after they are expelled from the throwing moulds. The sample are relieved for 7 and 28 days and taken out from water at the season of testing.

CONCLUSIONS

-Split Tensile Strength of Control Concrete, RHA Concrete, WPSA Concrete & Mix (RHA+WPSA) at 28 Days.

-The compressive strength and split tensile strength increased up to 20% with 5% replacement of WPSA. Further increase in WPSA decreases the strength gradually and up to 10% replacement it can be used as a supplementary material in M20 grade of Concrete.

-The above results shows that it is possible to design M20 grade of concrete incorporating with RHA content up to 10%.

-As test results shows the Mix (RHA+WPSA) can also be used as a replacement of cement.

-Control mix with 5% WPSA showed higher Compressive Strength than Control mix, RHA concrete and Mix (RHA+WPSA) concrete.

-The study showed that the early strength of RHA, WPSA and Mix (RHA+WPSA) concrete was found to be less and the strength increased with age.

-The workability of RHA, WPSA and Mix (RHA+WPSA) concrete has been found to decrease with the increase in replacements.

-Based on the results of Split Tensile Strength test, it is convenient to state that there is substantial increase in Tensile Strength due to the addition of RHA, WPSA and Mix (RHA+WPSA).

-Use of Waste Paper Sludge Ash, Rice Husk Ash and Mix (RHA+WPSA) in concrete can prove to be economical as it is non-useful waste and free of cost.

-Use of waste paper sludge ash in concrete will preserve natural resources that are used for cement manufacture and thus make concrete construction industry sustainable and waste paper sludge can be used as fuel before using its ash in concrete for partial cement replacement and also the disposal problem for paper industries for this waste material is fully solved.

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