Utilization of Rice Straw Ash as a Replacement of Cement and Fine Aggregate in Mortar Mixes a Review

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Abstract: *Rice Straw Ash is the waste material from agriculture that causes much of the environmental challenges. In the world, these problems are increasingly rising, which can produce an immense public health crisis. Some studies have therefore been undertaken to identify some of the sustainable solutions and to reduce agricultural waste by using it in building materials and also to reduce the conservation of natural resources.*

We have tried to address this problem by using agricultural waste materials as a fine aggregate instead of natural sand in the mortar mix, which may be a fine material. The use of Rice Straw Ash, known as agricultural waste, to substitute as fine aggregate or natural sand in mortar is the core of this research. The ingredient in rice straw ash is 65 percent to 80 percent silica. Silica is a fine material that creates strength in blends. Similar functions could be created by RSA, such as silica fume, in most situations, the compressive strength, flexural strength, water permeability and mortar workability are improved by RSA. In this research, we performed experimental work on RSA as a partial replacement of fine mortar aggregate to improve its mechanical properties.

Key Words: Rice Straw Ash; Mortar; Compressive Strength; Density; Water Absorption, porosity,

1. INTRODUCTION

Mortar is a material used in masonry construction to fill the gaps between the bricks and blocks. Mortar is a mixture of sand, a binder such as cement, and water and is applied as a paste which then sets hard. The earliest known mortar was used by the ancient Egyptians and was made from gypsum. This form was essentially a mixture of plaster and sand and was quite soft. Cement is a mixture of argillaceous and calcareous materials mixed with gypsum, sintered and pulverized into fine particles. It has a cohesive and adhesive properties when mixed with water, which makes it capable of bonding material fragment into a compact whole Cements are classified calcium silicate and calcium aluminate. Calcium silicate is further classified into Portland and slag, while calcium aluminate is classified into high aluminate and pozzolonac cement Rice stalk and husk are composed of both organic and inorganic matter. Organic matter consists of cellulose, lignin, hemi cellulose, some proteins and vitamins while the major component of inorganic minerals is silica. The actual composition of rice stalk and husk varies with the type of paddy, inclusion of brand and broken rice in the husk, geographical factors, crop season, samples preparation and relative humidity, this is a bio waste from the rice plant. The silica is absorbed from the ground and gathered in the straw where it makes a structure and is filled with cellulose. When cellulose is burned, only silica is left which is grinded to fine powder which is used as pozzolana, Rice straw over the years has been considered a waste product of rice cultivation, for this reason it is mostly left unattended and constitutes a source of significant environmental concern. The use of rice stalk ash as additive in cement will considerably reduce; if not entirely resolved the environmental concern associated with the rice straw.

2. LITERATURE REVIEW

Chouhan Harshwardhan Singh "et al." (2019) Has assessed the impact of dimensional limestone squander on the mechanical properties like compressive strength, flexural strength, glue and bond strength, water retention, thickness, drying shrinkage, and microstructure analysis(SEM, XRD, and FTIR). In the test, dimensional limestone squander is utilized in various rates 0%, 20%, 40%, and 60% as fine total in concrete mortar. The outcome shows that an expansion in the DLSW and DLCS content up 20% to 60% expanded the compressive and flexural strength and decreasing the water-concrete proportion while expanding DLSW and DLSC up to 40%. Based on the above test outcome, we inferred that DLSW and DLCS can be utilized in mortar and solid creation. It will help in diminishing both ecological waste and save common assets [1]

Pandey Arunabh "et al." (2019).These test works show to examination the physical properties(specific Gravity, SEM, XRD) and synthetic properties(XRF) of utilized material, in this analysis utilized rice straw debris and miniature silica in distinction rate as 5%, 10%, 15%, 20%, 25%, 30% and 2.5%, 5%, 7.5%, 10% by the heaviness of common Portland concrete. This examination investigation the compressive strength, flexural strength conduct of the quality asphalt

concrete. Numerous tests have been done the outcome show beginning and last setting time expanded while expanding the rice straw debris content. [2]

Kabeer Ahmed syed. K.I. "et al." (2018) have done an examination on mortar with the utilization of marble powder as fine total in mortar to diminish the employments of common material, lessen the expense of the venture, and have eco-accommodating climate. On account of the pre-owned waste marble powder which is known as waste material and creates from cutting and delivery of marble tiles. The accompanying substitution has been done from (0% to 100%) marble powder to waterway sand. What's more, the outcome shows subsequent to testing functionality, drying shrinkage, compressive strength, bond and cement qualities, thickness, water assimilation, and dynamic Young's modulus. Results show that mortar blends in with 20% replacement of stream sand by marble powder can be utilized for stone work and delivering purposes. The utilization of 20% of Marble powder would empower significant saving water in and waterway sand in development ventures and furthermore improve the substance properties of the mortar-like compressive strength, new mass thickness, malleable security strength and abatement the water ingestion. [3]

Dabai M. U "et al." (2017) have done the examination on six mortar blocks which supplanted concrete by rice straw debris (0%, 2%, 4%, 6%, 8%, and 10%) by weight of concrete to check compressive strength. The consequence of Compressive strength tests shows that at 2% supplanting with RSA at the time of relieving following 2, 7, and 28 days. Was discovered to be 15.77, 34.73, and 48.53 N/mm2 and expanded with period of restoring however diminished at 10% trade for 7days (18.06 N/mm2) and 28days (27.23 N/mm 2) with increment in RSA content for all blends. What's more, it shows that RSA can be utilized at 2%, 4%, and 6% to supplant concrete at 2 years old to 28 days period of restoring, and increment the underlying and last setting time when increment rice straw debris. [4]

Munshi Surajit "et al." (2016) these trial works show to break down the actual properties (X-beam Diffraction, Compressive Strength, Flexural Strength, Normal Consistency, Workability, Water porousness, of the solid. In this analysis have utilized ground rice straw debris in various rates like 5%, 10%, and 15% by the heaviness of concrete. The test outcome shows the compressive strength and flexural strength steadily increment up to 10% of the fastener by rice straw debris contrasted with control concrete, and furthermore the porousness of rice straw debris mortar relies upon the period of mortar and concrete substitution proportion. When all is said in done, porousness diminishes with augmenting in the compressive strength and period of mortar. In this investigation locally accessible rice straw debris has used to lessen both the ecological effect and the development cost. Locally rice straw has been singed off the temperature of 600C0 to make rice straw debris. It has over 76% silica content.[5]

Revathi S "et al." (2015) these exploratory works show to dissect the mechanical properties like compressive strength, thickness, water retention and sorptivity of the mortar. In this analysis use groundnut husk debris in various rates 0%, 10%, 20%, 30%, 40%, half and 60% by fractional substitution of the characteristic waterway sand. The outcome shows thickness esteems decline with an expansion in groundnut husk debris content. Groundnut husk debris increase the compressive strength of the mortar, and the sorptivity and water assimilation of mortar expanded while expanding the level of groundnut husk debris content. [6]

Munshi Surajit "et al." (2013). Have done investigations on the impact of rice straw debris as a substitution of concrete in mortar. Rice Straw Ash supplant concrete by 5%, 10% and 15% by weight of concrete. In this analysis, the locally accessible Rice Straw Ash consumed to in an uncontrolled way. Results show RSA increments compressive strength up to 12.5% with 10% concrete substitution and introductory and last setting time increments with the expansion of Rice Straw Ash.[7]

Demirel Bahar "et al." (2010) Has done tentatively on the usage of waste marble dust as fine total on cement to discover the impact of waste marble dust on the mechanical properties of the solid. To check the mechanical properties like compressive strength, porosity, ultrasonic heartbeat speed, dynamic modulus of flexibility and unit weight by adding 0%, 25%, half and 100% waste marble powder by the heaviness of fine total. The outcome shows that the unit weight of the solid expanded because of the way that a specific measure of waste marble dust has been added to the solid as an extremely fine total substitute. The compressive strength has expanded of solid while expanding the level of waste marble at various restoring ages and furthermore UPV expanded the solid with an expanding level of waste marble residue and porosity decline.[8]

Torkittikul Pincha, "et al." (2010) Have done research on usage of clay squander as fine total inside Portland concrete and fly debris cement to find the possibility of utilizing earthenware waste and fly debris to create mortar and cement. Usage of fired waste as fine total improves the compressive strength of mortar and cement because of the more unpleasant surface of the CWA increase the strength. Use of the CWA sum up to half without fly debris increment the compressive strength. While expanding the CWA content up to 100% diminishing the strength because of the precise state of the CWA molecule essentially decreased the usefulness of the solid making it considerably more hard to smaller, in this manner

bringing down strength. The benefits of utilizing clay squander as fine total in cement containing fly debris were accordingly checked. [9]

El Damatty A.A. "et al." (2009) have done an examination on a manageable answer for the ecological issue coming about because of the Removal of Rice Straw by substance technique to diminish the ozone depleting substances the cycle depends on cremation innovation utilizing a unique reactor. The rice straw debris (RSA) achieve from this innovation is plentiful in silica and can go about as a mineral admixture that improves the solidness and strength of cement. In this examination has utilized rice straw as an alternate level of 7.5%, 10%, and 12.5% fractional substitution by the heaviness of concrete. Augmentation the compressive strength and protection from the chloride-particle vulnerability of RSA concrete (12.7%, 18.18%, and 23.2%) when contrasted with customary cement. Ranchers have a propensity to haphazardly consume rice straw as the most affordable technique for expulsion. This training doesn't just deliver smoke, yet in addition breathable residue that contains translucent silica and other wellbeing peril substances. In paper examines about the compressive strength and Rapid Chloride Penetrability of mortar by utilizing an alternate level of rice straw debris (RSA) as a substitution of concrete. [10]

Mohamed A. EI-Sayed "et al." (2006). Have done examinations on trial work to check the effect of incomplete substitution of rice straw debris in various rate 5%, 10%, 15%, 20%, and 25% by the heaviness of folio. These exploratory works show to examine physical, synthetic properties, the pozzolanic action of rice straw debris, processing and burning techniques likewise show the rice straw debris impact in water-concrete proportion, starting and last setting time. the outcome shows beginning and last setting time, norms consistency proportion and water request expanded and functionality decrease while expanding the rice straw debris substance of the solid and mortar. It has 82% of the silica content it very well may be utilized as a concrete substitution. [11]

3. RESULT AND ANALYSIS

Table -1: Result and analysis of above literature review

No	Author	Year	Utilization area	Materials used	Percentage of materials	Test	Result (Decrease/Increase/desirable
1	H.S.Chouhan	2019	Mortar	OPC, FA, Dimensional Limestone Waste	0, 10, 20, 30, 40, 50, 60%	Compressive strength, flexural strength, workability	Increase
2	Arunabh pandey	2019	concrete	OPC, FA, CA, RSA and Micro silica	5%,10 %,15%, 20%, 25%, 30%	Standard consistency, initial and final setting time	Increase
3	K.I. Syed Ahmed Kabeer	2018	Mortar	OPC, FA Marble Powder	0, 20, 40, 60, 80, 100%	Compressive Strength	Increase
4	Dabai. M.U	2017	Mortar	OPC,FA Rice Straw ash	0, 2, 4, 6, 8, 10%	Compressive strength, Workability, Initial and Final setting	Increase
5	Surajit Munshi	2016	Mortar	OPC,FA Rice Straw ash	0, 5, 10, 15%	Compressive Strength, Flexural strength	increase
6	Revathi .s	2015	Mortar	Groundnut husk ash, OPC, FA	0, 10, 20, 30, 40, 50, 60%	Compressive Strength	Increase
7	Surajit Munshi	2013	Mortar	OPC, FA Rice Straw ash	5, 10, 15%	Compressive Strength, Initial and Final Setting time	Increase
8	Torkittikul pincha	2010	Concrete, Mortar	Ceramic Waste, OPC, FA, CA	0, 10, 20, 30,40, 50, 60, 70, 80, 90, 100%	Compressive Strength	Increase
9	Demirel Bahar	2010	Concrete	OPC,FA, CA, Waste Marble Dust	0, 25, 50, 100%	Compressive Strength	Increase

10	E.I.Damatty A.A	2009	Concrete	OPC, FA, CA, RSA	7.5, 10, 12.5%	Compressive Strength, Rapid chloride penetrability	increase
11	Mohammad A.E.I.S-sayed	2006	Cement paste	OPC, FA Rice Straw Ash	5, 10, 15, 20, 25%	Standard consistency, Initial and Final Setting time	Increase

4. CONCLUSIONS

1. Rice Straw Ash is magnificent farming waste that can supplant concrete and fine total in cement.
2. Rice Straw Ash has a colossal measure of silica in its blend which assists with improving the mechanical properties of materials.
3. Use of Rice Straw Ash (0 up to 10) % produce a desirable improvement to the mechanical properties of the concrete and mortar
4. Usage RSA up to some rate increase the underlying and last setting season of the concrete
5. Use of RSA in a mortar the compressive strength and water porousness have delivered magnificent outcome as contrast with the conventional mortar
6. By utilization of the RSA in cement give desirable improvement to flexural strength of mortar as compare to conventional mortar
7. The utilization of Rice Straw Ash which is known as agriculture waste in construction industries which is daily increasing can provide an eco-friendly environment.

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REFERENCES

[1] H. S. Chouhan, P. Kalla, R. Nagar, and P. K. Gautam, "Gainful utilization of dimensional limestone waste as fine aggregate in cement mortar mixes," Constr. Build. Mater., vol. 221, pp. 363–374, 2019.

[2] A. Pandey and B. Kumar, "Effects of rice straw ash and micro silica on mechanical properties of pavement quality concrete," J. Build. Eng., vol. 26, no. June, p. 100889, 2019.

[3] K. I. S. A. Kabeer and A. K. Vyas, "Utilization of marble powder as fine aggregate in mortar mixes," Constr. Build. Mater., vol. 165, pp. 321–332, 2018.

[4] M. U. Dubai and M. Muhammad, "Studies on the Effect of Rice Straw Ash as Admixture of Ordinary Portland Cement Mortar," vol. 4, no. 7, pp. 112–119, 2017.

[5] S. Munshi and R. P. Sharma, "Experimental Investigation on Strength and Water Permeability of Mortar Incorporate with Rice Straw Ash," Adv. Mater. Sci. Eng., vol. 2016, 2016.

[6] I. Journal, "Effect of Groundnut Husk Ash as fine aggregates in mortar," Int. J. Innov. Res. Sci. Eng. Technol., vol. 4, no. 3, pp. 1314–1320, 2015.

[7] S. Munshi, G. Dey, and R. Prasad Sharma, "Use of Rice Straw Ash as Pozzolanic Material in Cement Mortar," Int. J. Eng. Technol., vol. 5, no. 5, pp. 603–606, 2013.

[8] B. Demirel, "The effect of the using waste marble dust as fine sand on the mechanical properties of the concrete," vol. 5, no. 9, pp. 1372–1380, 2010.

[9] P. Torkittikul and A. Chaipanich, "Utilization of ceramic waste as fine aggregate within Portland cement and fly ash concrete," Cem. Concr. Compos. vol. 32, no. 6, pp. 440–449, 2010.

[10] A. A. El Damatty and I. Hussain, "An economical solution for the environmental problem resulting from the disposal of rice straw," Appropr. Technol. Environ. Prot. Dev. World - Sel. Pap. from ERTEP 2007, pp. 15–23, 2009.

[11] M. A. El-Sayed and T. M. El-Samni, "Physical and Chemical Properties of Rice Straw Ash and Its Effect on the Cement Paste Produced from Different Cement Types," J. King Saud Univ. - Eng. Sci., vol. 19, no. 1, pp. 21–29, 2006.

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