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Utilization of Rice Straw Ash in Mortar Mixes

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Abstract: *Rice Straw Ash is the agriculture waste material that creates most of the environmental challenges. These challenges continuously increase in the globe, which can create a huge problem for human health. Therefore some studies have been conducted to find out some of the sustainable solutions and able to reduce these agriculture waste by using it in construction material and also able to reduce the conservation of natural resources. We have attempted to solve this problem that the agriculture waste materials could be a fine material to employ it as fine aggregate instead of natural sand in mortar mix. The core of this study is the utilization of Rice Straw Ash which is known as agriculture waste to replace it as fine aggregate or natural sand in mortar. Rice straw ash has 65% to 80% of silica in its ingredient. Silica is fine material and it produces strength in mixes. RSA could produce similar functions like silica fume, in most cases, RSA increases the compressive strength, flexural strength, decrease water permeability and workability of the mortar. In this review, we have done experimental work on RSA as partial replacement of fine aggregate in mortars for improving its mechanical properties.*

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

1. INTRODUCTION

Mortar is a mixture of binding materials such as (fine aggregate, cement, and water). When water is added to the inert materials binding material develops the property that tie-up not only the inert material but also the surrounding stone, bricks, and concrete masonry unite. Over the most recent 20 years, the decreasing of natural materials like artificial sand which is also known as (river sand) or fine aggregate. A huge part of mortar is generating fine aggregate and daily utilization of mortar increases and production of mortar is extensively high all over the world. To reduce this problem some alternative materials. Because of this a lot of countries have passed problems in the supply of natural sand. In order to meet the increasing demands of construction development. Lots of countries have faced a shortage of natural sand suitable for construction. On the other hand, some alternative materials or disposal of wastes such as fly ash (FA), bottom ash (BA) and agricultural wastes can be focused as the major environmental challenges. This challenge continues to increase with the increase of these wastes. Therefore, studies have been conducted to find suitable solutions for the shortage of natural sand and a huge increase in wastes disposal. One logical option to solve this problem is employing these materials as a part of fine aggregate instead of natural sand in mortar. The huge amount of agricultural waste materials used in the construction industry as a substitute for natural materials there would have three benefits: conservation of natural resources removal of waste materials and freeing up valuable land for others use. The utilization of rice straw ash as a fine aggregate has the potential to reduce both the environmental impact and cost associated with building materials.in this review paper adding rice straw ash as fine aggregate at the percentage of 0% to 100% to improve the mechanical properties of cement mortar and also conserve natural resources.

2. LITERATURE REVIEW

Chouhan Harshwardhan Singh "et al." (2019) Has evaluated the effect of dimensional limestone waste on the mechanical properties like compressive strength, flexural strength, adhesive and bond strength, water absorption, density, drying shrinkage, and microstructure analysis(SEM, XRD, and FTIR). In the experiment, dimensional limestone waste is used in different percentages 0%, 20%, 40%, and 60% as fine aggregate in cement mortar. The result shows that an increase in the DLSW and DLCS content up 20% to 60% increased the compressive and flexural strength and reducing the water-cement ratio when increasing DLSW and DLSC up to 40%. On the basis of the above test result, we concluded that DLSW and DLCS can be used in mortar and concrete production. It will help in reducing both environmental waste and conserve natural resources. [1]

Pandey Arunabh "et al." (2019).These experimental works show to analysis the physical properties(specific Gravity, SEM, XRD) and chemical properties(XRF) of used material, in this experiment used rice straw ash and micro silica in difference percentage as 5%, 10%, 15%, 20%, 25%, 30% and 2.5%, 5%, 7.5%, 10% by the weight of ordinary Portland cement. This experiment analysis the compressive strength, flexural strength behavior of the quality pavement concrete. Many tests have been done the result show initial and final setting time increased when increasing the rice straw ash content. [2]

Kabeer Ahmed syed. K.I. "et al." (2018) have done an investigation on mortar with the use of marble powder as fine aggregate in mortar to reduce the uses of natural material, reduce the cost of the project, and have eco-friendly environment. Because of the used waste marble powder which is known as waste material and generates from cutting and shipping of marble tiles. The

following replacement has been done from (0% to 100%) marble powder to river sand. And the result shows after testing workability, drying shrinkage, compressive strength, bond and adhesive strengths, density, water absorption, and dynamic Young's modulus. Results show that mortar mixes with 20% substitution of river sand by marble powder can be used for masonry and rendering purposes. The use of 20% of Marble powder would enable considerable saving water in and river sand in construction projects and also improve the chemical properties of the mortar-like compressive strength, fresh bulk density, tensile bond strength and decrease the water absorption. [3]

Dabai M. U "et al." **(**2017) have done the investigation on six mortar cubes which replaced cement by rice straw ash (0%, 2%, 4%, 6%, 8%, and 10%) by weight of cement to check compressive strength. The result of Compressive strength tests shows that at 2% replacement with RSA at the age of curing after 2, 7, and 28 days. Was found to be 15.77, 34.73, and 48.53 N/mm^2 and increased with age of curing but decreased at 10% replacement for 7days (18.06 N/mm^2) and 28days (27.23 N/mm 2) with increase in RSA content for all mixes. And it indicates that RSA can be used at 2%, 4%, and 6% to replace cement at the age of 2 to 28 days age of curing, and increase the initial and final setting time when increase rice straw ash. [4]

Munshi Surajit "et al." *(2016)* these experimental works show to analyze the physical properties (X-ray Diffraction, Compressive Strength, Flexural Strength, Normal Consistency, Workability, Water permeability, of the concrete. In this experiment have used ground rice straw ash in different percentages like 5%, 10%, and 15% by the weight of cement. The test result shows the compressive strength and flexural strength gradually increase up to 10% of the binder by rice straw ash compared to control concrete, and also the permeability of rice straw ash mortar depends on the age of mortar and cement replacement ratio. In general, permeability reduces with incrementing in the compressive strength and age of mortar. In this study locally available rice straw ash has used to reduce both the environmental impact and the construction cost. Locally rice straw has been burnt off the temperature of 600C^0 to make rice straw ash. It has more than 76% silica content.[5]

Revathi S "et al." (2015) these experimental works show to analyze the mechanical properties like compressive strength, density, water absorption and sorptivity of the mortar. In this experiment use groundnut husk ash in different percentages 0%, 10%, 20%, 30%, 40%, 50% and 60% by partial replacement of the natural river sand. The result shows density values decrease with an increase in groundnut husk ash content. Groundnut husk ash increment the compressive strength of the mortar, and the sorptivity and water absorption of mortar increased when increasing the percentage of groundnut husk ash content. [6]

Munshi Surajit "et al." (2013). Have done studies on the effect of rice straw ash as a replacement of cement in mortar. Rice Straw Ash replace cement by 5%, 10% and 15% by weight of cement. In this experiment, the locally available Rice Straw Ash burnt to in an uncontrolled manner. Results show RSA increases compressive strength up to 12.5% with 10% cement replacement and initial and final setting time increases with the increase of Rice Straw Ash.[7]

Demirel Bahar "et al." (2010) Has done experimentally on the utilization of waste marble dust as fine aggregate on concrete to find the effect of waste marble dust on the mechanical properties of the concrete. To check the mechanical properties like compressive strength, porosity, ultrasonic pulse velocity, dynamic modulus of elasticity and unit weight by adding 0%, 25%, 50% and 100% waste marble powder by the weight of fine aggregate. The result shows that the unit weight of the concrete increased as a result of the fact that a certain amount of waste marble dust has been added to the concrete as a very fine aggregate substitute. The compressive strength has increased of concrete when increasing the percentage of waste marble at different curing ages and also UPV increased the concrete with an increasing percentage of waste marble dust and porosity decrease.[8]

Torkittikul Pincha, "et al." (2010) Have done research on utilization of ceramic waste as fine aggregate within Portland cement and fly ash concrete to discover the feasibility of using ceramic waste and fly ash to produce mortar and concrete. Utilization of ceramic waste as fine aggregate improves the compressive strength of mortar and concrete due to the rougher surface of the CWA increment the strength. Usage of the CWA amount up to 50% without fly ash increase the compressive strength. When increasing the CWA content up to 100% decreasing the strength due to the angular shape of the CWA particle significantly reduced the workability of the concrete making it much more difficult to compact, thereby lowering strength. The profits of using ceramic waste as fine aggregate in concrete containing fly ash were therefore verified.[9]

El Damatty A.A. "et al." (2009) have done a study on a sustainable solution for the environmental problem resulting from the Removal of Rice Straw by chemical method to reduce the greenhouse gases the process is based on incineration technology using a special reactor. The rice straw ash (RSA) bring about from this technology is rich in silica and can act as a mineral admixture that improves the durability and strength of concrete. In this experiment has used rice straw as a different percentage of 7.5%, 10%, and 12.5% partial replacement by the weight of cement. Increment the compressive strength and resistance to the chloride-ion penetrability of RSA concrete (12.7%, 18.18%, and 23.2%) as compared to conventional concrete. Farmers have a habit to randomly burn rice straw as the most economical method of removal. This practice does not only produce smoke, but also breathable dust that contains crystalline silica and other health hazard substances. In paper studies

about the compressive strength and Rapid Chloride Penetrability of mortar by using a different percentage of rice straw ash (RSA) as a replacement of cement.[10]

Mohamed A. EI-Sayed "et al." (2006). Have done studies on experimental work to check the impact of partial replacement of rice straw ash in different percentage 5%, 10%, 15%, 20%, and 25% by the weight of binder. These experimental works show to analyze physical, chemical properties, the pozzolanic activity of rice straw ash, milling and incineration methods also show the rice straw ash effect in water-cement ratio, initial and final setting time. the result shows initial and final setting time, standards consistency ratio and water demand increased and workability reduce when increasing the rice straw ash content of the concrete and mortar. It has 82% of the silica content it can be used as a cement replacement. [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

3. CONCLUSIONS

1. Rice Straw Ash is superb agriculture waste that can replace cement and fine aggregate in concrete.
2. Rice Straw Ash has a huge amount of silica in its combination which helps to improve the mechanical properties of materials.
3. Utilization of Rice Straw Ash (0 up to 10) % produce a desirable improvement to the mechanical properties of the concrete and mortar
4. Utilization RSA up to some percentage increment the initial and final setting time of the concrete
5. Utilization of RSA in a mortar the compressive strength and water permeability have produced superb result as compare to 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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BIOGRAPHIES

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