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Examining the Use of Pond Ash and Rice Husk Ash (RHA) in Place of Cement and Fine Aggregates

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Abstract - Green Concrete is a concrete which is made with concrete waste which are eco-friendly and it also uses less energy for production and it also produces less carbon dioxide (CO2) compare to the ordinary concrete. It is cost effective as the materials used here are all waste and crystalline materials, so that it can easily react with cement.

By studying the various paper get to know that researchers replaced fine aggregate upto 25% by pond ash and replaced cement upto 70% by various cementitious materials but by researching it is known that upto a certain percentage fine aggregate can be replaced, if more replacement of fine aggregate will done then the compressive strength decreased.

During these studies, both fine aggregate and cement are replaced with rice husk ash and pond ash. The replacement ratios are 0-15% and 0-10%, respectively.

***Key Words*: Rice husk ash, Pond Ash, cementitious materials, increase compressive strength**

1. INTRODUCTION

The green concrete made from concrete waste uses less energy and produces less carbon dioxide (CO2) than ordinary concrete. It is made from recycled concrete waste and is eco-friendly. The most important ingredient with which green concrete is made of is supplementary cementitious materials (SCMs) like fly ash, silica fumes and recycle concrete which is good for a sustainable nature.

A bioproduct from rice, Rice-Husk Ash (RHA) is obtained through the burning of rice husks in presence of oxygen. The waste material of rice husk is richly found in the rice manufacturing organization, and it hold about 30%-50% of natural carbon. In the world the current rice production is evaluated about 700 million tons. Rice husk ash is an essential material which mainly include an amorphous silica with a small amount of crystalline phase and thus the pozzolana act in the concrete reasonable with the help of amorphous silica.

Pond Ash (Coal Bottom Ash) is a slurry which is used as coal fixed power station for the disposal of coal combustion production such as bottom ash and fly ash. Pond ash is a coal burnt material and its particle size is large for this material and is used for landfilling. Thus, the material size is large so it can used as a cementitious material and fine aggregate.

The main aim of the project is to reduce the Carbon Dioxide (CO2) emission of the environment by using rice husk ash and pond ash with the replacement of cement and fine aggregate. Rice husk ash and pond ash is crystalline cementitious materials and it can react easily with cement and fine aggregate. While studying the various paper I have noticed that in Portland Pozzolana Cement (PPC) cement already 30% fly ash is present so, replaced cement 0-15% by rice husk ash (RHA) and replaced fine aggregate 0-10% by pond ash (Coal Bottom Ash).

1.1 Material

Partical Size

- Cement - 7~200µm (0.007~0.2 mm)
- Rice Husk Ash - 5 to 10 µm
- Pond Ash - 33.44 mm and 23.44 mm
- Fine Aggregate - 0.075 - 4.75mm
- Coarse Aggregate - 4.75 – 20mm

Chemical Composition	Portland Cement (PC)	Rise Husk Ash (RHA)	Pond Ash (Coal Bottom Ash)
SiO_2	21.28	89.90	61.85
Al_2O_3	5.60	0.46	30.48
MgO	2.06	0.79	3.5
Fe_2O_3	3.36	0.47	3.23
CaO	64.64	1.01	0.72
K_2O	1.47	4.50	0.92
$SiO_2 + Al_2O_3 + Fe_2O_3$	30.24	90.83	95.56

1.2 Advantages

- Rice Husk Ash - The qualities of concrete, such as impermeability, workability, strength, and corrosion of steel reinforcement, can all be enhanced by substituting rice husk ash for cement while creating concrete.

- Pond Ash - The ash is used for three main reasons: to provide economical concrete, for recycling and to reduce waste management.

2. Literature Review

Srikanth et. al.[1] Observed that 70% of the fly ash produced by the combustion of coal is treated, while the other 30% is precipitated as bottom ash. Although there are some restrictions, pond ash can be used to replace fine aggregate in concrete. Pond ash's plasticizer property is negligible because of the lower CaO level. Additionally, the building site and ash ponds affect availability. If I use the same 25% replacement Pond Ash to replace 10 kg of fine aggregate, my amount of Pond Ash, using the absolute weight replacement method, will be 2.1675 kg, while the weight of fine aggregate will be 7.8325 kg.

In all the journals, the ratio of specific gravity of pond ash to fine aggregate has been taken as 1. That is the reason why the volume is greater than 3 kg/m3. But if the ratio is less than 1, it means there is a reduction in the slump value of fresh material.

Mahdi et. al.[2] To measure the compressive strength, water absorption, density, and pulse velocity of the concrete, 100 mm-diameter concrete cubes were cast. Concrete with cement replacement and a varied amount of pond ash as fine aggregate was chosen for further examination due to the compressive strength and workability of the initial samples. According to ASTM C496-11 [23], concrete mixtures' pulse velocity, tensile strength, and shrinkage as a result of drying were determined at 7, 28, 91, 120, 150, and 180 days after mixing [23]. Flexural strength and concrete pulse velocity (km/s) relationship The proportion of porous particles in concrete rises with the amount of pond ash added, allowing the water content to gradually flow out as the concrete dries. The use of Pond Ash as a complete or partial replacement for fine aggregate in concrete decreased the workability of fly-ash-bottom-ash concrete. Fly ash and bottom ash concrete mixtures demonstrated greater tensile and flexural strengths than control concrete mixtures after 28 days of curing.

Avadhut et. al.[3] M stands for concrete mix design, and the M indicates the characteristic compressive strength of concrete when tested at the 28th day after casting. Concrete specimens were prepared by replacing 0%, 15%, 17.5%, 20%, 22.5%, and 25% of the fine aggregate with pond ash for both M30 and M40 grades. Results of tests conducted are tabulated in Table III (for M30-grade concrete) and Table IV (for masonry). Concrete with pond ash content has a maximum compressive strength of 20% of the replacement level. However, there is no specific trend showing a definite increase in compressive strength up to this level. Concrete specimens with pond ash content show a significant reduction in compressive strength compared to specimens with no ash. This appears to be a problem of mix design rather than the effect of replacing fine aggregate with pond ash. The compressive strength of concrete specimens made by substituting pond ash for fine aggregate shows no discernible trend in either direction. Generally speaking, pond ash specimens with a 20% replacement demonstrate the highest compressive strength.

Rath et. Al. [4] Local heat and/or dry circumstances increase the likelihood of concrete shrinkage, which decreases the resilience of structures. The partial substitution of cement with fly ash and pond ash yields satisfactory results according to an equation that has been proposed. The goal of this study is to look into the shrinkage impact caused by partial cement replacement with fly ash, pond ash, or a combination of the two. In this study, fly ash, pond ash, or both are used in place of cement to assess the early age shrinkage of fifteen mixes. Conclusion: The formation of porosity might lower compressive strength while the rate of shrinkage lowers with higher pond ash replacement. On the surface of the structure, cracks develop which lead to concrete shrinkage. Structures' cost, strength, and durability are all reduced as a result. On the construction site, using high-volume fly-ash concrete is advised to minimise cement paste shrinkage. When fly ash and pond ash are used in place of cement, both alone and together, shrinkage strain is reduced, which could boost durability. The sustainability of natural resources is also promoted by using fly ash or pond ash in place of cement.

Arvind et. al.[5] Smoldering the husk at a temperature below 800 °C produces fiery remains with silica in a shapeless structure. The short blazing spans (15–360 minutes) caused a high carbon content for the created material, even with high burning temperatures of 500–700 °C. Rice husks may be smouldering into fiery remains that satisfy the physical qualities and compound mineral admixtures. The upgraded RHA, obtained by controlled blazing and pounding, has been used as a pozzolanic material as part of bonding and cement. RHA concoction structures are influenced because of the burning procedure and silica content within the powder at that temperature. Rice-husk ash was blazed for roughly 72 hours in an uncontrolled burning method.

Vashisht et. al.[6] Concrete's primary component, cement, serves as a binding agent. Approximately 900 kg of CO2 are released for every tonne of concrete produced. The purpose of this study is to investigate the profitable use of contemporary trash as an alternative to cement in construction projects. Blast furnace slag, silica fume, rice husk ash, cenospheres, and fly ash are a few examples of

industrial wastes that can be used as cementitious materials that are stronger. Rice husks are burned to produce rice husk ash (RHA). The best outcome is achieved when concrete contains 15% rice husk ash. The 28-day compressive strength for ordinary concrete is found to be 27.75 MPa, whereas it is 32.78 MPa for concrete with 15% husk ash, indicating that 15% is the ideal amount of rice husk to employ. The split tensile strength of conventional concrete after 28 days is found to be 1.526 MPa, whereas that of 15% rice husk ash concrete is found to be 1.697 MPa. 15% is the recommended amount of rice husk ash to use in cement concrete. The strength is below 20 MPa for other RHA percentages, hence 15% is the ideal RHA percentage to use.

Kaarthik et. al. [7] The manufacturing of Portland cement is responsible for more than 5% of worldwide CO2 emissions. When rice husk ash (RHA) is added to cement, the slump and compaction factors of the concrete are reduced by 27% and 9%, respectively. The study's objectives are to comprehend how RHA affects the characteristics of freshly-poured and hardened concrete, as well as to establish the ideal ratio of cement to RHA. A number of the rice husk ash's properties were identified and contrasted with those of cement. When compared to cement, it was discovered that rice husk ash had a very low specific gravity. Concrete that contained varied amounts of rice husk ash (RHA) improved in compressive strength from 27 MPa to 29 MPa after 28 days of curing when 10% RHA was added.

3. CONCLUSIONS

Studies are shown on various paper that researchers used single materials like Rice husk Ash (RHA) and pond ash (Coal Bottom Ash) in their research work but here two materials are used together to obtain the compressive strength of concrete.

All materials used here are in waste material to save the natural materials further use of the generation to come.

By studying the various paper get to know that researchers replaced fine aggregate upto 25% by pond ash and replaced cement upto 70% by various cementitious materials but by researching it is known that upto a certain percentage fine aggregate can be replaced, if more replacement of fine aggregate will done then the compressive strength decreased.

Since, rice husk ash replaces cement in this research work to the extent of 0–15% and pond ash to the extent of 0–10%, both fine aggregate and cement are replaced.

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