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STRENGTH PERFORMANCE OF CEMENT MORTAR BY USING RICE HUSK ASH AND WASTE GLASS POWDER AS CEMENTITIOUS MATERIAL

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ABSTRACT

The mortar mix is widely used material in the field of construction, due to its durability, strength and its usage for masonry and plastering to make the structure safe from weathering action to beautify the aesthetic view of the structure. Presently mortar is considered as an omnipresent because of its usage for finishing work in structures. It is a combination of cement, fine aggregate and water. In this combination, cement is the fixing material for the aggregate. The aim to this research was to analyze the behavior of normal cement mortar made with blended RHA and WGP of different mixes prepared at 10% of RHA and 5%, 10%, 15% and 20% of WGP and obtained the results of the various fresh and hardened properties. Five types of mixes were made by replcing RHA at 10% and WGP at interval of 5%. The replacement levels of OPC by RHA is fixed at 10%, however, WGP is replaced with varying dosage of 5%, 10%, 15% and 20% by the weight of cement. A nominal mix proportion of 1:3 at w/c ratio of 0.50 was used for all mixes and specimens were tested at age of 3, 7 and 28 days. 45 cubes of 50mm x 50mm x 50mm were caste for compressive strength at 3, 7 and 28 days respectively. It was deducted from the research that the increasing dosage of RHA was reducing the flowability of concrete. The compressive strength of mortar cubes increased, by replacing RHA by 10% and WGP by 5%. Maximum compressive strength with inclusion of RHA and WGP was achieved at 10% RHA and 5% replacement of cement with WGP i.e. 19.89 MPa, 25.80 MPa and 31.76 MPa at 3, 7 and 28 days respectively. It is concluded from conducted parameters that 10% RHA and 5% replacement of cement with WGP is optimum.

Keywords: Cement Mortar, Rice Husk Ash, Waste Glass powder, Flowability, Compressive Strength.

I. INTRODUCTION

The mortar mix is widely used material in the field of construction, due to its durability, strength and its usage for masonry and plastering to make the structure safe from weathering action to beautify the aesthetic view of the structure. Presently mortar is considered as an omnipresent because of its usage for finishing work in structures. It is a masterpiece of cement, fine aggregate and water. In this combination, cement is the fixing material for the aggregate. [1] 1.4 tons of cement are used for the production of concrete worldwide. Cement accounts for 5% to 7% of greenhouse emission, which is a chief contributor to global temperature rise [2].

Manage air contamination and protect ozone layer, researchers intend to change it with non-degradable waste, called a waste hierarchy, which aims to recycle waste due to disposal problems [3]. Many researchers have replaced cement with other materials like rice husk ash (RHA) and waste glass powder [4-5]. They are not only environmentally friendly, but also economical, and can also strengthen the solution.

Rice husks are the outer shells of rice grains that contain large amounts of silica, usually in excess of 80-85%. [6]. It accounts for about 30% of total weight of rice grains, and usually containing 80% organic matter and 20% inorganic or lifeless matter. Rice husk generate millions of tons annually in agricultural and industrial processes and are a kind of waste. After incineration, it can make up about 20% of the weight of (RHA) [7]. RHA is a highly volcanic ash [8]. Amorphous silica having high specific surface area in RHA causes high pozzolanic reactivity. Rice husk ash is utilized in mixtures of lime and pozzolan and may be favorable for partial replacing material of OPC [9].

In recent years, various types of mixed materials have been used in cement slurries. Millions of tons of glass wastes are produced every year around the world [10]. When glass becomes garbage, it is thrown into a landfill, which is unacceptable because it will not decay in the atmosphere. Major constituent of glass is silicon dioxide.

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Using broken glass chips in cement slurry as a partial replacement agent of cement is a valued step for the development of a renewable (environmental, energy-saving) infrastructure system. When the glass waste is crushed into fine grained particles, it may undergo a pozzolanic reaction with Portland cement for forming calcium Para Silicate Hydrate (C-S-H) [11].

This study uses different proportions of (RHA) and (WGP) to replace cement to ensure the freshness, physical properties and enhanced performance of the cement slurry, thereby ensuring environmental protection, cost effectiveness and maximum durability.

II. MATERIALS AND METHODOLOGY

Ordinary Portland Cement (OPC): Cement is used as cementing material for preparation of mortar, for this experiment Ordinary Portland Cement will used. Cement which will be used for this test is Portland Cement manufactured by Lucky cement company and obtained from local market.

Fine Aggregate: Fine Aggregate is used as the filler material in mortar, sand which will pass through 4.75mm and will retained on 0.0075mm sieve will be used and obtained from local market.

Rice Husk Ash: RHA will be obtained from Rice mill located in Sukkur district. RHA will be acquired by using furnace at controlled temperature of 800 degree centigrade for 2 hours; required ash will be sieved through NO.30 sieve.

Waste Glass Powder (WGP):Waste glass powder will be prepared by grinding scraped glass collected from window shield shops. The desired glass waste powder will be sieved through NO. 4 sieve.

Water: Potable water will be used for preparation mortar mix of allowable quality of mortar.

It is necessary to follow the suitable research methodology; the planned and proper methodology would be adopted in which the 1st step is to collect material. Cement used in this in this research will be of Lucky Cement factory obtained from local market where as the sand used in this research work which pass from NO.4 and retained on NO.200 sieve (ASTM). RHA which one is replacing material is collected from Rice mill located in Sukkur district. RHA will be acquired by using furnace burning at controlled temperature of 800 degree centigrade for 2 hours; required ash will be sieved through 45 microns sieve. Waste glass powder will be prepared by grinding scraped glass collected from window shield shops. The desired glass waste powder will be sieved through NO. 4 sieve (4.75mm). Potable water will be used for preparation mortar mix of allowable quality. In the 2nd step mix design of material would be prepared at the ratio of 1:6 cement and fine aggregates. Different mixes would be prepared replacing cement by 10% of RHA and 5%, 10%, 15%, and 20% of WGP. In the 3rd step the workability of mortar by Flow Table Test would be determined as per (ASTM C-1437) and would be casted into cube of dimensions 50x50x50mm and would be cured for 3, 7, and 28days. In the 4th step the harden properties like compressive strength test would be performed on the samples according to (ASTM C-109) standard and experimental data would be noted.

III. RESULTS AND DISCUSSION

Flowability

To observe the flowability of cement mortar, Flow Table test was performed on fresh mortar paste at different percentages of RHA and WGP as addition in the mortar mix. Results were obtained and presented in Fig. 1. Results indicated that the flowability of mortar paste is decreasing with the addition of RHA at 10% and rise in the addition of WGP at 5%, 10%, 15% and 20% respectively does not affect flowability, as we have fixed the w/c ratio for all type of mix i.e., 0.50, it declared that RHA absorbed more water. It was observed that as the RHA amount increased by 10% the water demand of the mortar mix was also increased. It was also observed that the WGP raise at interval of 5% but it does not affect the water demand of mortar mix. Therefore, if the same workability is needed, the water to cement (w/c) ratio should be raised. Alternatively, one can add various admixtures, such as plasticizers or superplasticizers, to retain the necessary strength with the needed workability. It was noted that the amount of water needed by the mortar mix increased when RHA is added.

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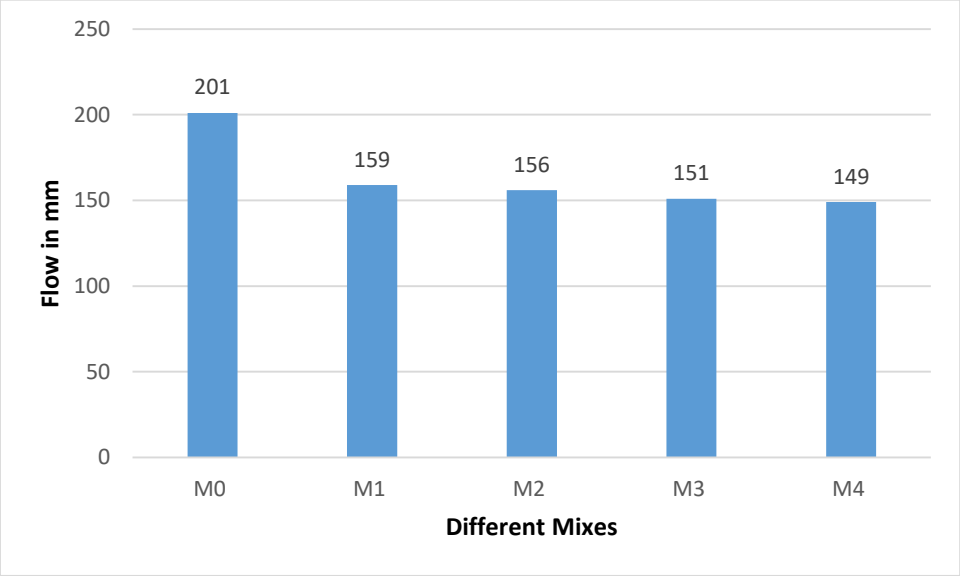

Fig. 1. Flowability results with different proportions

Compressive Strength

The test was carried out through compressive testing machine as shown in Fig. 4 by testing total of 45 cubes. This test was done by testing 3 cubes at different proportions of cement with addition of RHA and WGP at 3, 7 and 28 days curing in potable water. The values gained from the compressive strength tests at different proportions after designated curing periods i.e., 3days, 7days, 28days are presented in Fig. 2. Results demonstrated that compressive strength of mortar containing RHA and WGP at proportion of 10% and 5% respectively was increased as compared to controlled mix.

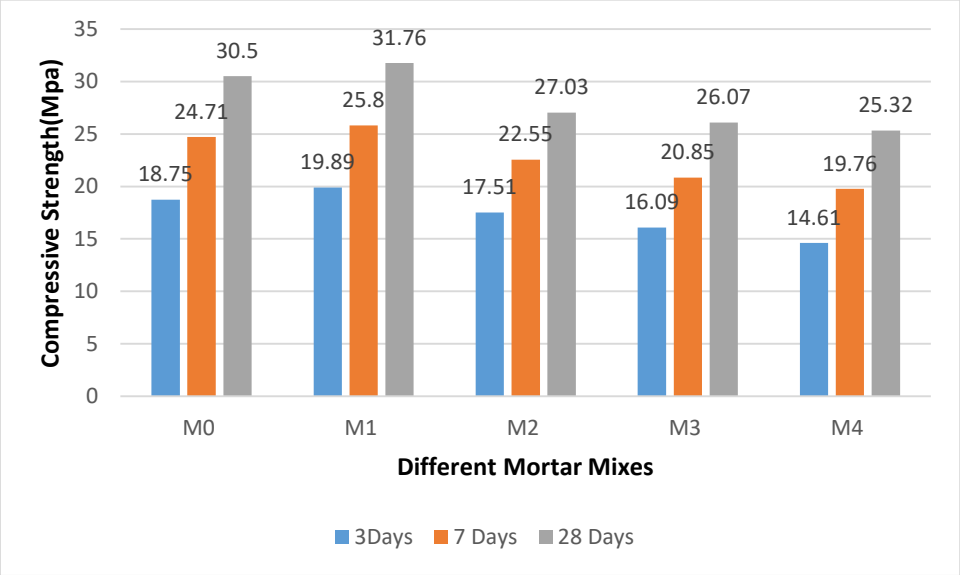

Fig. 2. Compressive strength of hardened mortar with different proportions at different ages

The results obtained from the tests performed in the laboratory indicated that the addition of RHA and WGP beyond the proportion of 10% and 5% respectively in cement mortar decrease the compressive strength of cement mortar on 3days, 7days and 28days. Based on the experimental findings 10% of RHA and 5% of WGP is considered as optimum dosage in mortar mix which gives maximum compressive strength as compared to the control mix at the age of 3days, 7days and 28days.

IV. CONCLUSION

Based on conducted research, it can be concluded that:

- With the increase in dosage of RHA and WGP, flowability of mortar decreased.

- With the increase in dosage of RHA and WGP, compressive strength of mortar increased from (0-15%) as compared to normal mortar mix. Maximum compressive strength with inclusion of RHA and WGP is achieved at 15% replacement of cement with RHA and WGP i.e., 19.89 MPa, 25.80 MPa and 31.76 MPa at 3, 7 and 28 days respectively.
- It is concluded from conducted research that 10% replacement of cement with RHA and 5% replacement of WGP is optimum.

For the future study it is recommended that flexural strength and durability related properties of concrete may be carried out with inclusion of RHA and WGP as the replacement of RHA and WGP gave desired results in mortar mixes.

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