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ENVIRONMENT FRIENDLY CONSTRUCTION TECHNIQUES USING SUNFLOWER HUSK, RICE HUSK AND THEIR ASHES

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Global worries of sustainability in construction engineering and to extend the use of bushed aggregates in concrete production contribute towards bettering are minimizing the problems. Pakistan is rich in sunflower and rice production. Cement was replaced with different levels of rice husk, sunflower seed husk and their ashes with the proportions 10%, 20% and 30% of each. The aim of this research work was to find the workability properties of concrete and mortar by using rice husk and sunflower seed husk and their ashes in the respect of low cost and environment friendly structures for the rural areas of Pakistan and to workout strength properties and the variation pattern due to mixing in different proportions for different tests such as slump test, compressive and tensile strength were performed after 7, 14, 21 and 28 days curing. The results showed that when 10% of rice husk ash and sunflower seed husk ash was used the compressive and tensile strength of concrete and mortar increased with increase of curing time. While at 20% and 30% proportions there was decrease in strength and, when rice husk and sunflower seed husk was used there was a descending trend in strength along with decease in weight. However, the cost was reduced more in 20% and 30% replacement of ashes but their strength and workability was also decreased. Such construction material might be used in lightweight constructions like farm structures.
Keywords: Sunflower husk, Rice husk, Environment friendly, Strength, Concrete, Workability, Variation pattern

INTRODUCTION

The impact of cement/concrete industry on environment is significant. With the growing environmental concerns, public awareness has been increased together with its pressure on the industry. More and more sustainable approaches are being researched and implemented. Recycling waste material or industrial by-products in concrete is one of the well-known applications. Instead of using natural resources, recycled aggregate obtained from old concrete and demolished masonry are used in concrete, even in structural applications. Additionally, by products of industries such as fly ash, ground granulated blast furnace slag, and ground waste clay brick are replaced by more energy-intensive Portland cement (Mehta and Monteiro, 2006). These supplementary cementations materials also improve concrete durability. Along with these aggregates, agro waste and their ash are also used for the production of concrete as an aggregate.

Pakistan is an agricultural country, and along with the production of agricultural products, a large amount of agro waste is also generated from the agro industries. Pakistan is producing with an average of 25000 tons of sunflower and 6102000 tons of rice annually (Economic Survey, 2013-14). Along with their production rice husk and sunflower husk are also produced. Approximately, 20 Kg of rice husk are obtained for 100 Kg of rice, which is an agro waste material. This waste is used generally as forage and fuel. Besides these uses of sunflower husk and rice husk, they can also be used in concrete to produce lightweight and low cost concrete because of their fiber structure. And after burning their ash can be used in mortar as a replacement of cement due to their pozzolanic behavior.

In Pakistan, serious problem faced by cement industry is taxation. Cement demand is also increasing with passage of time. In 2008-2009 Domestic demand was 20 million tons for housing 40% of total demand needed and for Government development demand is one third of total consumption. In Pakistan cement demand is 117 Kg per capita andincreasing day by day due to urbanization and growth rate which is increasing 3% per year, there for cement demand is increasing 7% per year (Economic Survey, 2013-14). For manufacturing of cement electricity and furnace oil is used and their prices also high, furthermore as results the excess quantity of CO2 is also produce that contribute 4% of total CO2 emission in global.During production of one ton of cement one ton CO_2 is emitted, half of the CO_2 is from the chemical process of cement production, 40% from burning fuel, and the remaining 10% is split between transportation and electricity use.

A study was conducted in accordance with the British

Standards i.e., BS 812, 1990; BS 1881 and BS 1996 by (Acheampong *et al*., 2013). He used palm kernel shells as lightweight coarse aggregate in palm kernel shell concrete (PKSC) and granite was used as aggregates for the normal weight concrete (NWC), and were tested for their compressive as well as tensile strength. Similarly, a study was conducted by (Pinto *et al.,* 2012) used corn cob, which is an agricultural waste for concrete material to check its effect on strength and weight of the concrete aggregate as compared to expanded clay concrete and resulted that the corn cob is lightweight agro-industrial waste which can be used as compared to clay concrete.

Sisman and Gezer., (2013) performed an experiment to evaluate the effect of sunflower seed waste in concrete production to decrease the weight of concrete. They produced concretes with 5, 10, 20 and 30 % sunflower seed waste in 300 and 400 kg/m^3 cement. They observed that with the dosage of 300 kg/m^3 unit weight of the concrete sample ranged 1710 to 2300 kg/m^3 while with the dosage of 400 kg/m^3 unit weight of the concrete sample ranged 1880 to 2270 seed husk can said to be lightweight as compared to the unit weight of concrete. The splitting tensile strength for the 300kg/m^3 and 400kg/m^3 dosages ranged 31.27 to3.33 MPa and for 2.06 to 4.61 MPa respectively. The effects of sunflower seed husk on the splitting tensile strength of the concrete were similar to their effects on compressive strength (Sisman *et al.,* 2014).

A study was conducted by Rao *et al*., (2014) and investigated the feasibility to use rice husk ash in concrete as partial replacement of cement and prepare different samples with level of 5%, 7.5%, 10%, 12.5% and 15% of rice husk ash as a partial replacement of cement. The samples were cured for a large range of curing periods starting from 3 days, 7days, 28 days and 56days. There was a gradual increase in compressive strength from 3 days to 7 days for all the cement replacement samples of rice husk ash. But there was a significant increase in compressive strength from 7 days to 28 days followed by gradual increase from 28 days to 56 days.

Habeeb and Mahmud., (2010) used rice husk ash (RHA) as a replacement of cement. And they concluded that 10% of RHA give excellent improvement in strength, and up to 20% of RHA could be used as valuable replacement of cement without affecting the strength of concrete. They also compared slump of RHA concrete with high workability concrete (200-240mm slump), and they found that the concrete produced by using 5% , 10%, 15% and 20% RHA had slump 200, 210,220 and 220 respectively which was very close to the concrete produced by using 0% RHA concrete slump 230mm.

MATERIALS AND METHODS

Cement, sand and gravel was used with different compositions of sun flower husk, rice husk and their ashes with different proportions and combinations. The compressive strength, tensile strength and workability was measure according to the procedures mentioned in(Ahmed Eisa, 2014). Slump test as slump loss was used for the checking of workability and all the data statistically analyzed under complete randomize design (CRD) and their means compared by using Duncan's Multiple Range DMR test (Steel *et al.,* 1997).

Research methodology was based on the Table 1 and 2 shown below with different combinations used for concrete and mortar. Rice husk (RH), sunflower husk (SH), rise husk ash (RHA) and sunflower husk ash (SHA) was used with sand, cement and gravel for concrete with different proportions by volume whereas the combination of rice husk ash and sunflower husk ash with cement and sand only used for the mortar preparation as partial replacement of cement.

Table 1: %age proportions of admixture in concrete by volume.

Treat.	OPC*	Sand	Gravel	SHA[1]	RHA[2]	RH[3]	SH[4]
T_0	20	30	50	-	-	-	-
T_1	20	30	40	-	-	10	-
T_2	20	25	35	-	-	20	-
T_3	20	20	30	-	-	30	-
T_4	20	30	40	-	-	-	10
T_5	20	25	35	-	-	-	20
T_6	20	20	30	-	-	-	30
T_7	18	30	50	2	-	-	-
T_8	16	30	50	4	-	-	-
T_9	14	30	50	6	-	-	-
T_{10}	16	30	50	-	2	-	-
T_{11}	18	30	50	-	4	-	-
T_{12}	14	30	50	-	6	-	-

*OPC ~ Ordinary Portland Cement
[1] SHA ~ Sunflower Husk Ash
[2] RHA ~ Rice Husk Ash
[3] SH ~ Sunflower Husk
[4] RH ~ Rice Husk

Table 2: %age proportions of admixtures in mortar by volume.

Treatments	OPC	Sand	RHA	SHA
T_0	25	75		-
T_1	22.5	75	2.5	-
T_2	20	75	5	-
T_3	17.5	75	7.5	-
T_4	22.5	-	-	2.5
T_5	20	-	-	5
T_6	17.5	-	-	7.5

Samples of above mentioned treatments of concrete were analyzed for compressive stress by making concrete blocks and cured for the time span of 7 days, 14 days, 21 days and 28 days. Whereas the mortar briquettes were analyzed only

for the tensile stress only with the same time span. Slump loss (slump test) was measure immediately after making concrete blocks in cone.

RESULTS AND DISCUSSIONS

Statistically concrete analysis for the compressive strength shows highly significant results for the treatment of T_1(10% Rice Husk of total aggregates), T_4(10% Sunflower Husk of total aggregates), T_7(10% Sunflower Husk Ash as partial replacement of cement) and T_{10}(10% Rice Husk Ash as partial replacement of cement). Whereas other treatments show non-significant behavior. The average values of T_1, T_4, T_7 and T_{10} at curing interval of 28 days were 29.38 MPa, 22.46 MPa, 39.31 MPa and 37.1 MPa respectively(Sisman and Gezer, 2013). As compare to the control treatment T_0 which has 36,4 MPa compressive strength T_7 and T_{10} showed best results with 39.31 MPa and 37.1 MPa (Ahmed Eisa, 2014). However, the behavior of all treatments increased the compressive strength from 7days to 28 days interval. The (Fig.1) shows the average compressive strength values of all treatment with different curing times. On the other hand, the workability was found more in T9 (30% Sunflower Husk Ash as partial replacement of cement) and T12 (30% Rice Husk Ash as partial replacement of cement) which is 3.5 cm and 3 cm respectively than T0 (Cement, Sand and Gravel) 5 cm but the compressive strength reduced beyond the limit. T7 and T10 showed more workability than TO which was 4.4 cm and 4.5 cm respectively (Yijin *et al*.,1995). Slump loss values was shown the (Fig.2).

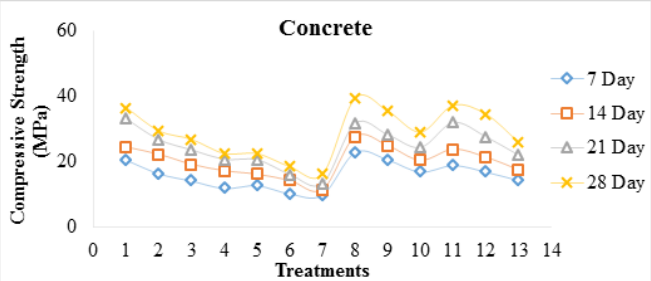

Figure 1: Compressive strength of all treatments

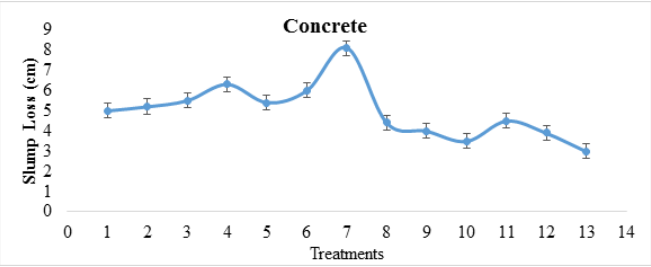

Figure 2: Slump loss values

Tensile strength was measure only for six treatments of mortar which was prepared only by using Rice husk ash and sunflower husk ash. Tensile strength was found more as the curing time increases in all treatments. T1 (10% Rice Husk Ash as partial replacement of cement) and T4 (10% Sunflower Husk Ash as partial replacement of cement) showed tensile stress 2.56 MPa and 2.70 MPa respectivelywhich is more as compare to the control treatment T0 (Sand and Cement 3:1) 2.4 MPa. On curing interval of 21 days T0 and T1 showed the same results of tensile stress 2.19 MPa whereas the T4 showed 2,39 MPa (Sisman *et al*., 2014). T4 achieves the 2.39 MPa after 21 days of curing which is approximately equal to 2.4 MPa of T0 at 28 days of curing interval. The (Fig.3). shows the tensile stress of all treatments.

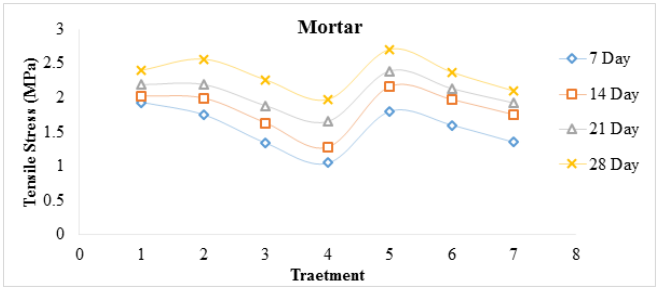

Figure 3: Tensile Stress for mortar

Conclusion:The experimental results concluded that the compressive strength and tensile stress increases as curing time increases. Rice husk and sunflower husk with their ashes show better compressive strength up to a certain limit but as we cross the compressive and tensile strength starts reducing however the structures becomes lighter and less costly. Sunflower husk ash at 10% Partial replacement of cement showed excellent results its compressive strength in concrete, slump loss (workability) and tensile strength in mortar was much better than all other treatments.

As the rice husk and its ash production is more than sunflower seed husk and its ash, rice husk and its ash is more economical and reliable for partial replacement of cement and aggregates. However, the results showed sunflower seed husk ash showed better results than the rice husk ash.

RECOMMENDATIONS

Use of rice husk ash and sunflower seed husk ash as a partial replacement of cement is environmental friendly. Such a material can be used for light weight constructions, especially in rural areas and farm structures.

REFERENCES

Acheampong A., M. A. Asamoah, J. Ayarkwa and R. O. Afrifa. 2013. Comparative Study of the Physical Properties of Palm Kernel Shells Concrete and Normal

Weight Concrete in Ghana. J. Scien. Multidisplinary Res. 5: 129-146.

Ahmed Eisa. 2014. Properties of concrete incorporating recycled post-consumer environmental wastes. Inter. J. Conc. Stru. Mater. 8: 251-258.

Economic Survey of Pakistan 2013-14. Government of Pakistan.

Habeeb. G. A. and H. B. Mahmud. 2010. Study on Properties of Rice Husk Ash and Its Use as Cement Replacement Material. Mater. Res. 13: 185- 190.

Mehta, P.K. and P.J.M. Monteiro. (2006). Concrete—Microstructure, Properties, and Materials.New York, NY: McGraw Hill,

Pinto, J., B. Vieira, H. Pereira, C. Jacinto, P. Vilela, A. Paiva, S. Pereira and H. Vorum. 2012. Corn cob lightweight aggregate in concrete for non-structural applications. Constr. Build. Mater. 34: 346-351.

Rao. P. P., A. P. Kumar and B. B. Sing. 2014.A Study on Use of Rice Husk Ash in Concrete. Inter. J. Edu. Appl. Res. 4: 75-81.

Sisman, C.B. and E. Gezer. 2013. Sunflower seed waste as lightweight aggregate in concrete production. Int. J. Environ. Waste Manag. 12: 203-212.

Sisman, C.B., E. Gezer and H. C. Kurc. 2014. Effects of rice husk on the lightweight concrete properties produced by natural zeolite for agricultural buildings. Asian J. Applied. Sci. 2: 156-160.

Steel, R.G.D., J.H. Torrie and D.A. Dickey. 1997. Principles and Procedures of Statistics. A Biometric Approach. Ed. 3rd, McGraw-Hill, Boston.

Yijin, L., Z. Shiqiong., Y. Jian and G. Yingli. 1995. The effect of fly ash on the fluidity of cement paste, mortar and concrete. International Workshop on Sustainable Development and Concrete Technology. 339-345.