Partial Substitution of Sand & Cement with Brick Kiln Powder & Rice Husk Ash in High Strength Concrete

Tanveer Ahmad Rather

M.Tech Scholar
Department of Civil Engineering
Structural Engineering, Swami Devi Dyal College of Engg & Tech /Kurukshetra University Haryana, India

Abstract: **Concrete is a unnatural building material that is acquired by mixing cement, fine aggregate, water and some other inert materials.It is used largerly for erection of roads, heavy structural members-like columns, gravity dams,etc and also for foundations. In this project two waste materials were used rice husk ash and brick dust powder to study the combined effect by partial replacement of cement and fine aggreate in High strength concrete containing glass fibre and admixture sodium silicate. The combined proportions started from 8% Rice Husk Ash (RHA) by partial replacement of cement and 4% of Brick kiln Powder with replacement of fine aggregate in concrete mix.In mix two RHA was was gradually increased by 15% by weight of cement and Brick dust kilin increased by 8% by weight of fine aggregate .Last porportion was taken 35% of Rice husk ash and 20% of Brick kiln Powder. The tests on hardned concrete were destructive in nature which includes compressive test on cubes, Flexural strength on beams, split tensile strength on cylinder after curing.The experiment presented in this paper reports the effects on the behavior of concrete produced from cement with combination of Rice husk ash and Brick kiln Powder at different proportions on the mechanical properties of concrete such as Compressive strength, Flexural strength, and Split Tensile strength. Investigation reported that compressive strength increases by 17.5%in compared with targeted strength and reduces by 2% compared with control concrtete at 28 days, flexural strength increases by 2.86% compared with control concrete at 28 days, split tensile strength decreases by 11% compared with control concrete at 28 days, were obtained at combination of 15% Rice husk ash and 8% Brick kiln Powder by Partial replacement of Rice husk ash and Brick kiln Powder reduces the environmental effects, produced economically and ecofriendly concrete.**

Keywords: **Cement and fine aggregate replacement, High strength concrete (HSC), Rice husk ash (Rha), Brick kiln Powder (Bkp), Glass Fiber, Admixture (Sodium Silicate), Compressive strength, Flexural Strength, Split Tensile Strength.**

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1 INTRODUCTION

Concrete is a building material made from mixture of broken stone or gravel, sand, cement, and water, which can be poured into mould and forms a stone like mass on hardening the admixtures may be added in concrete in order to enhance some of the properties desired specially. In its simplest form, concrete is a mixture of paste and aggregates. In this research work various materials are added such as Rice husk ash, brick dust kilin, glass fiber,, and admixture to obtain High strength concrete of desired property.High Strength concrete is a concrete mixture, which possess high durability and high strength when compared to conventional concrete. It comprises of the same materials as that of the conventional cement concrete. The use of some mineral and chemical admixtures like sodium silicate, silica fume and Super plasticizer enhance the strength, durability and workability qualities to a very high extent. High strength concrete works out to be economical, even though it's initial cost is higher than that of conventional concrete because the use of high strength concrete in construction enhances the service life of the structure and the structure suffers less damage which would reduce overall costs.RHA is bye-product of paddy industry. Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. Brick kiln Powder is finely divided produced by crushing old bricks and also produced in brick kilin by burning sun dried brick at high temperature.. During the late 20th century, there has been an increase in the consumption of mineral admixture by the cement and concrete is met by partial cement replacement.If the waste cannot be disposed properly it will lead to social and environmental problem. Rice husk ash is hazardous to environment if not dispose properly

2 LITERATURE REVIEW

Le Anh-tuan Bui 2012)[1] Investigated strength and durability properties of concrete with or without three types of rice husk ash (RHA), namely, amorphous, partial crystalline, and crystalline RHA. The three types of RHA were added into concrete at a 20% replacement level. His findings show that the pozzolanic reactivity of amorphous RHA was higher than that of partial crystalline and crystalline RHA. Concrete added with amorphous RHA showed excellent characteristics in its mechanical and durability properties. Findings shows that higher the amount of crystalline silica in RHA, the lower than that of the control concrete. The incorporation of these kinds of RHA significantly reduced chloride penetration

(Maurice E. Ephraim G. A., 2012)[2] Investigated the effects of partially replacing Ordinary Portland cement (OPC) with our local additive Rice Husk Ash (RHA) which is known to be super pozzolanic in concrete at optimum replacement percentage which will help to reduce the cost of housing. The specific gravity of RHA was found to be 1.55, the density of RHA concrete was found to be 2.043, 1.912 and 1.932kg/m3 at 10%, 20% and 25% replacement percentages respectively. His findings show that RHA concrete was very workable with a slump value of over 100mm. The incorporation of RHA in concrete resulted in increase water demand and enhanced strength. The compressive strength values at 28days were found to be 38.4, 36.5 and 33N/mm2 at the same replacement percentages above. These compressive strength values compared favorably with the controlled concrete strength of 37N/mm2at a mix ratio of 1:1.5:3.

(Hemraj R. Kumavat)[3] Investigated brick waste for its use as a replacement of cement and sand in cement mortar as it behaves as a pozzoloana. It may make animportant contribution towards decreasing the adverse effect of the production, disposal and the dumping of brick waste on the environment. His findings show that richer mixes gives lower value of bulk density and higher values of compressive strength for sand replacement with brick waste up to 40%. It also presents useful data for the brick manufacturing industry, builders and mortar manufacturing companies in terms of minimizing the impact of brick waste and using eco-efficient materials.

3 MIXTURE PROPORTIONING

The mix proportion was done as per the IS 10262- 1982.The target mean strength was 53.25 Mpa (M45) for the OPC control mixture The concrete cubes, beams, cylinder moulds were cured in the tank for 7,and 28 days for compression test, Flexural strength test and tensile strength test.

Table 3.1 Concrete mix proportioning for M45 design mix per m^3

Design Mix Ratio For M45 Grade	Ingredients	Surface Dried Weights
1	Cement	454.76 kg
1.52	Fine Aggregates	691.99 kg
2.35	Coarse ggregates	1067.44 kg
	Water	154 litre.
	Admixture	4.05 kg
	Water cement ratio	0.34

4 EXPERIMENTAL METHODOLOGY

Tests performed on Fresh Concrete (Workability Test)

Fresh concrete was tested using slump cone test to find the workability of control concrete and concrete of combination of Rice husk ash and Brick kiln powder

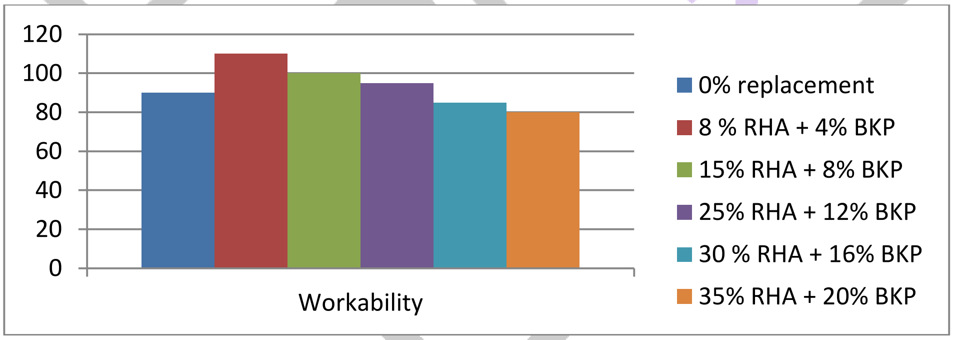

fig 4.1 shows the variation of slumps with different mix proportioning

In the Histogram above along Y-axis is Different Slump values of Different mixes and along X- Workability

Figure 4.1 shows the comparative effects of addition of Rice husk ash and Brick dust Kilin on workability of concrete. It was observed that increases the workability of concrete upto 20% as compared to control concrete. Gradual increase of RHA and gradual decrease Rice Husk ash shows gradual decrease in workability upto 30.% as compared to compared concrete.Addition of FA increases in workability because it has very low binding property and addition of RHA decreases workability due to water absorbent property because it has high specific surface area

4.1 TEST ON HARDNED CONCRETE

Tests were done as per following codes of Bureau of Indian Standards. The test for compressive strength on cubes were measured at 7, and 28 days of curing as per IS : 516 1959[14], test for flexural strength on beam was measured at7, 28 days of curing as per IS : 516 1959 and test for split tensile strength on cylinder was measured at 28 days of curing as per IS : 5 816 1999

4.1.1 Compressive Strength Test

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M45 grade of concrete. The moulds were filled with different proportions of cement, Rice Husk Ash and Brick dust kilin. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank where in they were allowed to cure for 7, and,28,days. After 7 and 28 days curing, these cubes were tested on manual compression testing machine as per I.S. 516 1959. The failure load was noted. In each category, three cubes were tested and their average value is reported.

The compressive strength was calculated as follows:

Compressive strength (MPa) = Failure load / cross sectional area.

4.1.2 Flexural Strength Test.

The standard sizes of beam specimen were 15x15x70 cm. The beam moulds conform to IS:10086 1982 uring: The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days.. Test specimens shall be stored in water at a temperature of 24^0 34 ^{0}c for 48 hours before testing. These specimens were tested under flexural testing machine The specimens shall be tested immediately on removal from the water while they are still in the wet condition.: Flexural strength is calculated by $fb=pl/bd^2$

4.1.3 Tensile Strength Test.

For tensile strength test, cylinder specimens of dimension 150 mm diameter and 300 mm length were cast. The specimens were demoulded after 24 hours of casting and were transferred to curing tank where in they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category, three cylinders were tested and their average value was reported

Tensile strength was calculated as follows as split tensile strength:

Tensile strength (MPa)=2P/π DL Where, P = failure load, D = diameter of cylinder, L = length of cylinder.

5 EXPERIMENTAL RESULTS

Results of M45 grade of OPC concrete filled with various proportions of Rice Husk Ash and Brick kiln Powder for compressive strength, split tensile strength also for flexural strength test are shown in table below

Table 5.1 Results of Compressive Strength Test After 7 and 28 Days of Curing

Mix Design	Mix proportion of Rice Husk ash And Brick kiln Powder		Compressive Strength in N/mm^2	
	%RHA by weight of cement	%BKP by weight of fine aggregate	7 Days	28 Days
Control Mix	0%	0%	32	63.25
Mix 1	8%	4%	31.10	61.14
Mix 2	15%	8%	29.13	62.32
Mix 3	25%	12%	27.14	58.17
Mix 4	30%	16%	24.18	55.66
Mix 5	35%	20%	20.00	52.10

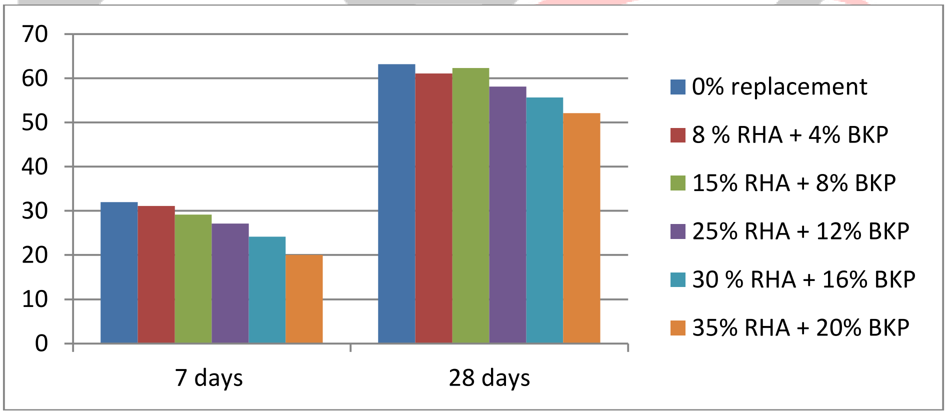

Fig 5.1Comparison of 7 and 28 days of compressive strength

In the Histogram above along Y-axis is Compressive Strength and along X-axis is mixes with different period of curing such as 7,, 28 days respectively.

Figure 5.1 indicates the comparison of results of compressive strength using cube specimen of M45 grade of concrete for different percentage of cement, RHA and BKP. Target strength of M45 concrete was 53.25N/mm^2but convention concrete gives 62.32 Mpa compressive strength at 28 days of curing. Comparative work shows maximum compressive strength obtained at combination of 15% RHA and 8% BKP which was less than strength of control concrete but greater than target strength. It was observed that 17.50% strength was increase as compared to target strength and 2% strength decreases as compared to control concrete at 28 days of curing.

Table 5.2 Results of Flexural Strength Test After 28 Days Of Curing

Mix Design	Mix proportion of Rice Husk ash And Brick kiln Powder		Flexural Strength in N/mm^2
	%RHA by weight of Cement	%BDK by weight of Fine Aggregate	28 Days
Control	0%	0%	9.76
Mix 1	8%	4%	8.56
Mix 2	15%	8%	9.96
Mix 3	25%	12%	8.23
Mix 4	30%	16%	7.11
Mix 5	35%	20%	7.00

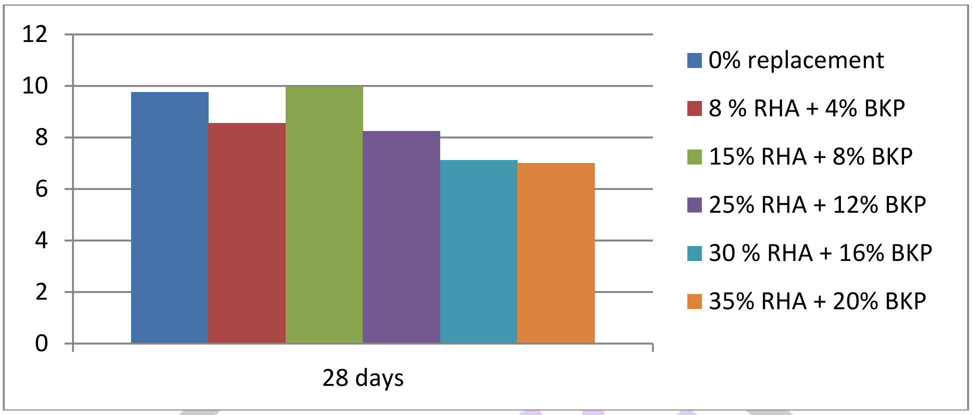

Fig 5.2 Flexural Strength aftere 28 of Curing

In the Histogram above along Y-axis is Flexural Strength and along X-axis is mixes after 28 days of curing.

Figure 5.2 indicates the comparison of result of flexural tensile strength using beam specimens of M45 grade of concrete Beams were tested after 28 days of curing for Flexural Strength. It was observed that maximum flexural strength wa obtained at combination of 15% RHA and 8% BDK and strength was increase by 2.86% as compared to control concrete at 28 days of curing.

Table 5.3 Results of Tensile Strength Test after 28 Days of Curing

Mix Design	Mix proportion of Rice Husk ash And Brick kiln Powder		Tensile Strength in N/mm^2
	%RHA by weight of cement	%BDK by weight of fine aggregate	28 Days
Control Mix	0%	0%	6.42
Mix 1	8%	4%	6.33
Mix 2	15%	8%	5.90
Mix 3	25%	12%	4.86
Mix 4	30%	16%	4.11
Mix 5	35%	20%	2.50

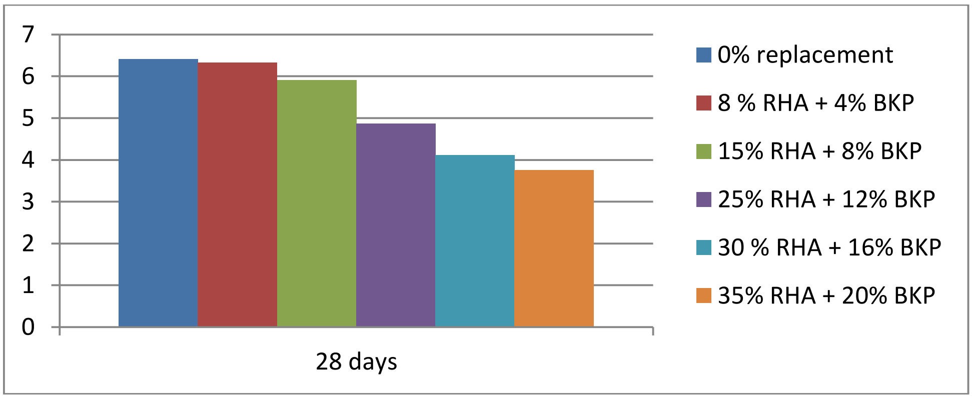

Fig 5.3 Split Tensile strength after 28 Days of curing

In the Histogram above along Y-axis is Split Tensile Strength and along X-axis is mixes after 28 days of curing.

Figure 5.3 indicates the comparison of result of splitting tensile strength using cylindrical specimens of M45 grade of concrete It was observed that split tensile strength at the combination of 15% RHA and 8% BDK decreases by 11% as compared to control concrete at 28 days of curing.

6 CONCLUSIONS

1) In this research work it was investigated that Rice husk ash and Brick kilin powder is found to be superior to other waste materials like fly ash, and silica fume. In this work it was observed that with increase in percentage of Rice husk ash upto **15%** and brick dust kilin upto **8%** can be used to achieve the desired strength.The gradual increases of Rice husk ash and Brick kilin dust more than above percentage decreases the workability of fresh concrete becauses these waste materials have very high water absorbent property but on the other side they are light in weight and thus reduces the mass per unit volume hence reduces the dead weight of the structure.
2) Concrete prepared with Brick dust kilin by replacement with fine aggregate shows good resistance to chemical attack especially sulphate attack and it also shows better pore refinement after long period.
3) The percentage of water cement ratio is reliant on quantity of Rice husk ash used in concrete. Because Rice husk ash is a highly porous material.
Cement is costly material, so the partial replacements of the cement by Rice husk ash reduces the cost of concrete.
4) Compressive strength increases with the increase in the percentage of and Rice Husk Ash and Brick kilin powder up to replacement (**15%**Rice husk ash and **8%** Brick dust kilin) in Concrete mix proportions.On the other side it was observed that strength commence to decreases gradually by partial replacement upto (**35%** Rice husk ash and **20%** Brick dust kilin) as compared to other mix proportioning.It concludes that we can replace cement only upto 35% with rice husk ash and fine aggregate with brick kiln powder upto 20% as the gradual decrease in strength takes place.

5) The maximum **28** days split tensile strength was obtained with combination of **15%** Rice Husk ash and **8%** Brick dust kilin mix in all combinations which was less than control concrete.
6) The maximum **28** days flexural strength was obtained with combination of **15%** Rice husk ash and **8%** Brick dust kilin mix.

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