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EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT WITH BRICK POWDER AND FINE AGGREGATE WITH SAW DUST

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ABSTRACT

This paper reports the study of compressive strength of concrete involving brick powder and saw dust in different proportions of M-20 grade of concrete was taken for experimental study. Brick powder content was used 10 % partial replacement of cement and saw dust were used from 10% by replacing the fine aggregate. Brick powder were obtained by brick. The compressive strength of concrete was checked at 14 days and 28 days of curing period. The results show that concrete samples having saw dust and brick powder showed better strength as compared to controlled concrete samples. In the most recent decade, the use of waste materials in concrete production, particularly in addition to concrete has turn into an essential part. Brick powder is one of these waste materials which are produced after lavishing working operation process. This paper presents an overview of the work carried out on the use of brick powder as partial replacement of cement and saw dust as partial replacement of fine aggregate in concrete. The compressive strength of the concrete with 10% brick powder has been increased significantly, and for up to 10% replacement of cement could be beneficially replaced by brick powder without adversely affecting the strength. In this study it was observed that addition of 10% brick powder with cement and 10% saw dust with partial replacement of fine aggregate to the concrete, gives the more compressive strength as of normal concrete. The results were compared to control sample and the viability of adding brick powder and saw dust to concrete has to be verified by experimental investigation.

Keywords: *Compressive strength, brick powder, saw dust.*

INTRODUCTION

Today's world's leading towards advancement, eager for more comfort has led to innovations and revolutions in each and every field of life. But on the other hand it has put some negative impacts on environment, as natural resources get depleted. As concrete is most commonly used building material across the world and consumes most of the natural resources in the form of coarse and fine aggregates. After studying all these research papers we concluded that if we can use some materials other than basic ingredients of concrete which do not have negative impacts, rather have positive effects on various fresh and hardened properties of concrete, partial replacement of these ingredients of concrete with waste material will largely impact environment and will lead to pollution free and soothing environment. This waste creates air pollution and land pollution by dumping and also causes water

pollution so by using this material in concrete we can save our atmosphere and land. Our ultimate goal is to produce economical and eco-friendly concrete which will possess strength and other desired properties which one achieves by basic concrete ingredients.

By using locally available waste like brick powder as partial replacement, it may prove more economical than traditional concrete and dumping of such waste produced by brick industries is also solved. Also construction cost is very high by using conventional materials due to unavailability of natural materials. We have the only option of partially replacing its ingredients by locally available waste materials. Over 3.3 billion tons of cement was consumed globally in 2010 based on survey of world coal association and also cement production emits CO2 in to the atmosphere which is harmful to the nature. Also for producing 1 kg of cement we require 372 Kilo joules of energy while we require only 19 kilo joules of energy to produce 1 kg of brick powder (surkhi). If we can partially replace the cement with the material with desirable properties then we can save natural material, reduce emission of CO2 in to the atmosphere and save the energy for the coming generations. The industrial waste dumping to the nearest site which spoils the land and atmosphere as well as it also affects aesthetics of urban environment so use of this waste material in concrete is economical as well as environment friendly way to disposal of waste.

This Use of brick powder or surkhi has been used as pozzolana in India for many years. This material is used as a partial replacement of cement to produce mortar or concrete, which results in improved concrete properties which include reduction of permeability and resistance to sulphate attack and alkali-aggregate reaction. It has been used in Europe since ancient times, where powdered brick was mixed with hydrated lime to produce mortars. There are many examples across Europe of Roman buildings bearing the fact that these mortars have been used since long time in past and hence, the fact that these materials are durable is proved. So potential use for ground brick powder is possible, not only for repair of important historic buildings where compatibility of materials is important, but this can also be used for the production of durable and impermeable concrete or mortars. The pozzolanicity of brick powder depends upon the burning or calcining temperature of clay. The most reactive state of clay is when the burning temperature results in loss of hydroxyl and a collapsed and distorted clay structure, the burning temperature to produce this active state is usually in the range of 600-900°C.

OBJECTIVES:

The following parameters are proposed to be investigated:

- Brick powder as a replacement of cement & saw dust as replacement of fine aggregate.
- To study the effect of brick powder on the properties of concrete.
- To study the effect of sawdust on the properties of concrete.
- To find compressive strength, and flexure test after 7days 14 days, and 28 days, and check as per I.S code

EXPERIMENTAL STUDY

MATERIAL AND METHODS:

CEMENT:

Portland cement is hydraulic cement that is made by finely beating the clinker created by calcining to nascent combination a blend of calcareous and argillaceous materials. This is fine grey powder, which is the essential

elements of concrete; consequently the name is cementing concrete. In contact under air or water, when the cement goes through a synthetic response with the water and the cement sets. Normal crude materials used to make bond are limestone (CaCO3), stale mud (SiO2, Al2O3, Fe2O3), and iron mineral (Fe2O3). Along these lines the synthetic parts of concrete are calcium (Ca), silicon (Si), aluminum (Al), and iron (Fe). Calcareous part, lime (CaO), limestone, chalk, marble and so forth. Argillaceous fixing (SiO2, Al2O3, Fe2O3), is got from mud and shale.

Cement selected for current study is Ordinary Portland Cement of 43 grades. Properties of cement have been tested in accordance with Indian Standard (IS8112-1989).

Table 1: Properties of Cement

Specific gravity	3.15
Standard consistency (%)	33
Initial setting time	35(minutes)
Final setting time	575(minutes)

FINE AGGREGATES (FA)

The aggregates most of which pass through 4.75 mm IS sieve are termed as fine aggregates. The fine aggregate may be of following types:

1. Natural sand, i.e. fine aggregate resulting from natural disintegration of rocks.

2. Crushed stone sand, i.e. fine aggregate produced by crushing hard stone.

3. Crushed gravel sand, i.e. fine aggregate produced by crushing natural gravel.

Fine aggregate (natural sand) confirming to IS 383:1970 used in this study was locally procured. Physical properties of this sand are given in table 2 below.

Table 2: Properties of fine aggregate

Sr.No.	Characteristics	Value
1.	Specific gravity	2.34
2.	Bulk density(kg/m3)	1.3
3.	Fineness modulus	2.62
4.	Water absorption	0.88

COARSE AGGREGATES (CA)

The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. The coarse aggregates may be of following types:-

1. Crushed graves or stone obtained by crushing of gravel or hard stone.

2. Uncrushed gravel or stone resulting from the natural disintegration of rock

3. Partially crushed gravel obtained as product of blending of above two types.

The normal maximum size is gradually 10-20 mm; however particle sizes up to 40 mm or more have been used in Self Compacting Concrete. Locally available coarse aggregate having the maximum size of 20 mm was used in this work. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383-1970. Specific gravity and other properties of coarse aggregates are given in Table 3. The sieve analysis of coarse aggregate was done. Proportioning of coarse aggregates was done and fineness modulus was obtained.

Table 3: Properties of coarse aggregate

Sr.No.	Characteristics	Value
1.	Color	Grey
2.	Size	20mm
3.	Shape	Angular
4.	Specific gravity	2.74

BRICK POWDER

About 1-5% of waste bricks are generally produced in all brick companies, which add to quantity of waste materials considerably. This varies from 50,000 tons for a large scale company to 100 tons for a small scale company. Recycling of these waste bricks is one of the most challenging problems worldwide with the extraordinary growth of the world population. The waste from these companies is crushed and sold as low grade aggregate at prices varying between Rupees 129 to 430 Rupees per ton. Although this is a much lower cost than cement (4300 Rupees per ton) however there will be added cost of crushing if this is to be used as cement replacement. It is the waste material produced from brick kilns which is of no use adds to the waste to environment, which is to be landfilled. The landfilling of this material degrades the quality of soil and also contaminates the ground water of that area. It is finely ground bricks, orange in color and Sp. gravity 2.52. Particle size of brick powder is about 20 to 60 microns. Calcination temperature of bricks ranges from 900 to 1000 degree Celsius. The SiO2 content in brick powder is about 54.8% and Al2O3 content is about 19.1%.

Table 4: Properties of brick powder

Properties	Values obtained
Specific gravity	2.54
Fineness	3.8%

SAW DUST

Sawdust is obtained from wood. The saw dust consist of chippings from various hardwoods. It was sundried and kept in waterproof bags .The sawdust is sieved through 1.18 mm.

Table 5: Properties of saw dust

Properties	Values obtained
Specific gravity	0.97
Water Absorption	47%

CONCRETE MIXES

Mix design for M20 grade of concrete was carried out using the guidelines prescribed by IS: 10262- 1982. The concrete mix for M20 served as basic control mix (CM). The cube combinations of various percentages are as follows:

C0: Cube with 0% brick powder as a partial replacement of cement and 0% saw dust as a partial replacement of fine aggregate

C1: Cube with 5% brick powder as a partial replacement of cement and 0% saw dust as a partial replacement of fine aggregate

C2: Cube with 0% brick powder as a partial replacement of cement and 5% saw dust as a partial replacement of fine aggregate

C3: Cube with 5% brick powder as a partial replacement of cement and 5% saw dust as a partial replacement of fine aggregate

C4: Cube with 10% brick powder as a partial replacement of cement and 0% saw dust as a partial replacement of fine aggregate

C5: Cube with 0% brick powder as a partial replacement of cement and 10% saw dust as a partial replacement of fine aggregate

C6: Cube with 10% brick powder as a partial replacement of cement and 10% saw dust as a partial replacement of fine aggregate

C7: Cube with 10% brick powder as a partial replacement of cement and 5% saw dust as a partial replacement of fine aggregate

C8: Cube with 5% brick powder as a partial replacement of cement and 10% saw dust as a partial replacement of fine aggregate.

Batching, mixing, and curing:-

The concrete ingredients viz. cement, sand and coarse aggregate were weighed according to M20 and are dry mixed on a platform. To this the calculated quantity of brick powder and saw dust was added and dry mixed thoroughly. The required quantity of water was added to the dry mix and homogenously mixed. The homogeneous concrete mix was placed layer by layer in moulds kept on the vibrating table. The specimens are given the required compaction both manually and through table vibrator. After through compaction the specimens were finished smooth. After 24 hours of casting, the specimens were demoded and transferred to curing tank wherein they were immersed in water for the desired period of curing.

RESULT AND DISCUSSION:-

The compressive strength of casted cube after 7 days, 14 days and 28 days are as follows:

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Table 6: Compressive Strength Test after 7 days

S.N0	SAMPLE	BRICK POWDER	SAW DUST	COMPRESSIVE STRENGTH N/MM2	AVERAGE COMPRESSIVE STRENGTH N/MM2
1: C0	1 2 3	0%	0%	13.33 13.35 13.2	13.29
2: C1	1 2 3	5%	0%	10.03 10.92 11.50	10.83
3: C2	1 2 3	0%	5%	11.20 10.35 10.85	10.80
4:C3	1 2 3	5%	5%	12.30 12.70 12.95	12.65
5:C4	1 2 3	10%	0%	11.9 11.97 12.05	11.97
6:C5	1 2 3	0%	10%	11.95 11.7 11.65	11.76
7:C6	1 2 3	10%	10%	13.45 13.50 13.03	13.41
8:C7	1 2 3	10%	5%	12.9 12.95 12.87	12.9
9:C8	1 2 3	5%	10%	12.86 12.76 12.9	12.84

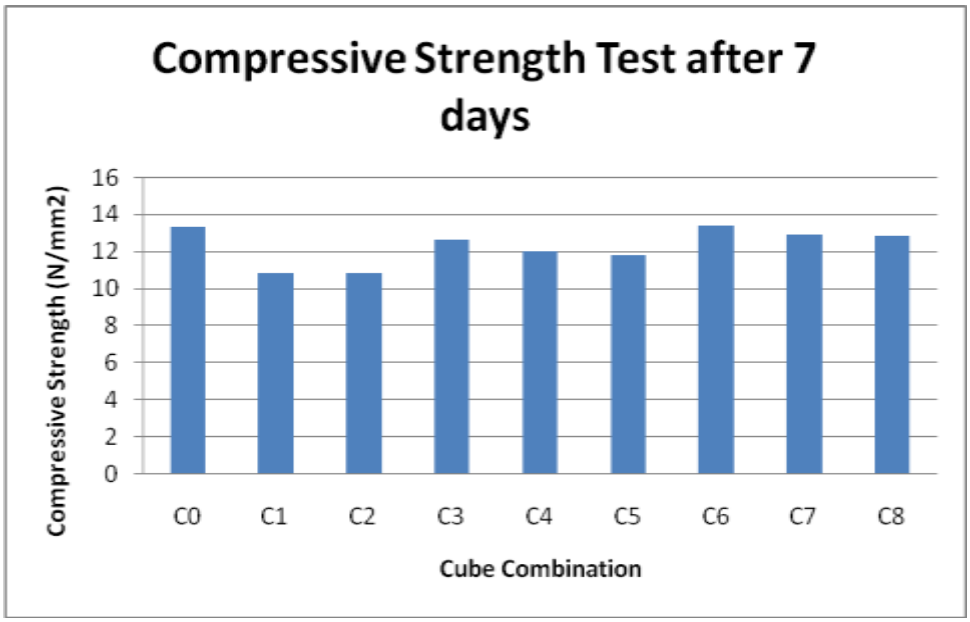


Table 7: Compressive Strength Test after 14 days

S.N0	SAMPLE	BRICK POWDER	SAW DUST	COMPRESSIVE STRENGTH N/MM2	AVERAGE COMPRESSIVE STRENGTH N/MM2
1: C0	1 2 3	0%	0%	17.6 17.65 17.55	17.6
2: C1	1 2 3	5%	0%	15.55 15.5 15.45	15.5
3: C2	1 2 3	0%	5%	14.85 15.0 14.95	14.95
4:C3	1 2 3	5%	5%	15.50 15.10 15.3	15.3
5:C4	1 2 3	10%	0%	15.25 15.55 15.85	15.55
6:C5	1 2	0%	10%	15.05 15.0	15.02

	3			15.0	
7:C6	1 2 3	10%	10%	18.0 17.95 17.90	17.95
8:C7	1 2 3	10%	5%	17.45 17.3 17.15	17.3
9:C8	1 2 3	5%	10%	17.65 18.0 17.3	17.65

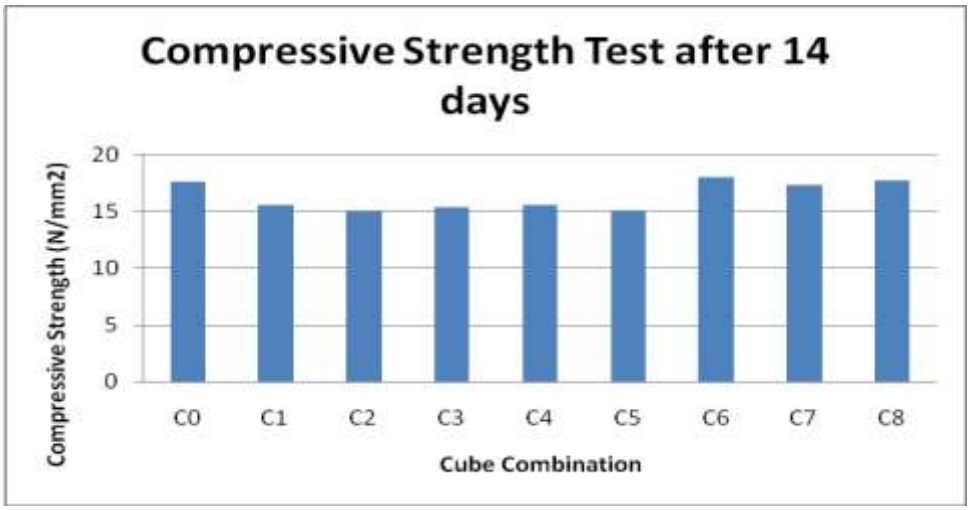
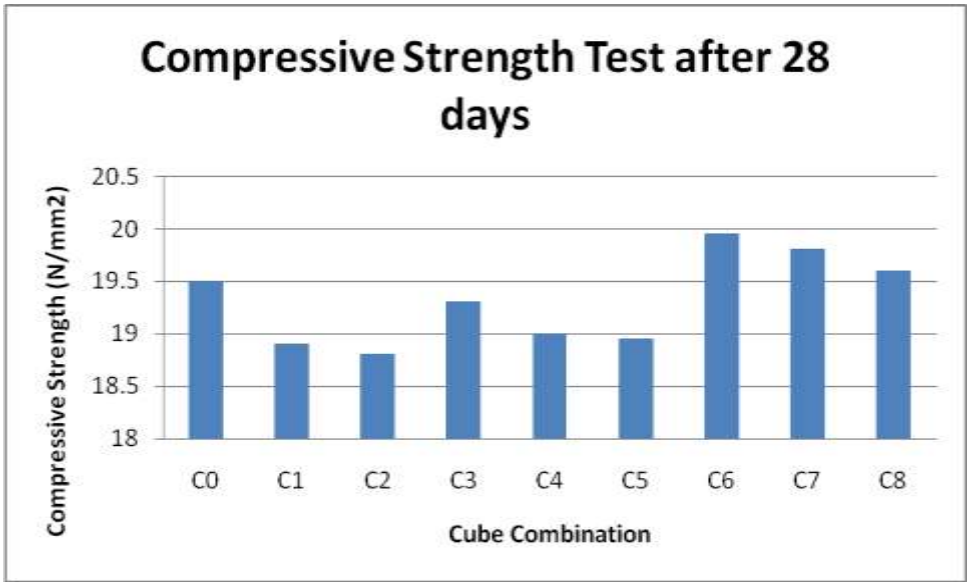


Table 8: Compressive Strength Test after 28 days

S.N0	SAMPLE	BRICK POWDER	SAW DUST	COMPRESSIVE STRENGTH N/MM2	AVERAGE COMPRESSIVE STRENGTH N/MM2
1: C0	1 2 3	0%	0%	19.2 19.5 19.8	19.5
2: C1	1 2 3	5%	0%	19 18.9 18.8	18.9
3: C2	1 2 3	0%	5%	18.8 18.7 18.9	18.8

4:C3	1 2 3	5%	5%	18.9 19.7 19.3	19.3
5:C4	1 2 3	10%	0%	18.9 19.7 19.3	19.0
6:C5	1 2 3	0%	10%	18.65 19.25 18.95	18.95
7:C6	1 2 3	10%	10%	20 19.95 19.90	19.95
8:C7	1 2 3	10%	5%	19.6 19.8 20	19.8
9:C8	1 2 3	5%	10%	19.3 19.9 19.6	19.6



CONCLUSION

From the experimental study of partial replacement of cement by brick powder and partial replacement of fine aggregate by saw dust in concrete, following conclusions were obtained.

- The compressive strength of concrete made by partial replacement of cement with brick powder and partial replacement of fine aggregate with saw dust is increased by sufficient amount.

- Compressive strength decreased at 15% partial replacement of cement with brick powder.
- After the curing of the concrete, it was found that the concrete got a reddish colour which increased the aesthetical view of the concrete.

  The experimental results have shown that the use of brick powder obtained from the demolished buildings in the replacement of cement and use of saw dust in concrete can provide an alternative solution to minimize the environmental pollution due to unscientific disposal of these wastes. So the replacement of cement with brick powder and egg shell powder in concrete is really advisable.

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