

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 6, June 2018

A Survey on Partial Replacement of Sand with Crushed Brick Powder in Concrete

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ABSTRACT: Concrete is the most important material being used in infrastructure development throughout the world. Sand is a prime material used for preparation of mortar and concrete and which plays a major role in mix design. Natural or River sand are weathered and worn out particles of rocks and are of various grades or sizes depending upon the amount of wearing. Now-a-days good sand is not readily available, it is transported from a long distance. Those resources are also exhausting very rapidly. The non-availability or shortage of river sand will affect the construction industry; hence there is a need to find the new alternative material to replace the river sand, such that excess river erosion and harm to environment is prevented. Many researchers are finding different materials to replace sand. This study aimed to investigate the suitability of using crushed brick in concrete. Crushed brick originated from demolished masonry was crushed in the laboratory and added partial sand replacement. Five replacement levels, 10%, 20%, 30%, 40%, 50%, were compared with the control. The tests on concrete showed that the mechanical properties (compressive strengths) of concrete containing crushed brick were well comparable to those of the concrete without ground brick.

KEYWORDS: Compressive strength, Crushed brick, Sand.

I. INTRODUCTION

Concrete is one of the oldest and the most widely used construction material in today's world. It is easily obtainable, relatively cheap, strong, and durable. On the other hand, the concrete industry is one of the major consumers of the natural resources. The annual concrete production is estimated as 11 billion metric tons, 70–75% of the number is aggregate (mostly natural rock); 15% is water; and 10–15% is cementations binder. The demand for aggregate is enormous in liberalization, privatization and globalization, and in the construction of important infrastructure projects like Expressways, Airports, nuclear plants etc. The increased extraction of coarse and fine aggregate from the natural resources is required to meet this high demand. The increasing use of natural fine aggregate creates an ecological imbalance. Thus, partial replacement of fine aggregate is vital in construction industries.

Researcher and Engineers have come out with their own ideas to decrease or fully replace the use of river sand and use recent innovations such as M-Sand (manufactured sand), robot silica or sand, stone crusher dust, filtered sand, treated and sieved silt removed from reservoirs as well as dams besides sand from other water bodies Now a days sustainable infrastructural growth requires the alternative material that should satisfy technical requisites of fine aggregate as well as it should be available locally with large amount.

II. RELATED WORK

Concrete is a versatile Engineering composite material made with Cement, Aggregate and Admixtures in some cases. Due to development in construction field, the consumption of natural aggregate is very high and at the same time the

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production of brick powder and demolitions waste of brick and is also very high. Therefore extreme use of concrete, leads to scarcity of natural aggregates. Because of this reason the utilization of brick powder came into picture.

Marek, C. R. Gallaway, B. M. and Long, R. E [1] Investigated that the (recycling is a process to change materials waste) into new products to prevent waste of potentially useful materials. **Khan and Choudhry [2]** studied on Economic conditions and lack of suitable natural aggregates seems to have resulted in brick being used as aggregate in developing nations before being used in developed ones. **Hansen T.C[3]** studied on the use of recycling of concrete as aggregate & found that the density, compressive strength and modulus of elasticity of recycled concrete is less than normal concrete. **K.M Brook[4]** Concluded that the Clean broken brick of good quality can provide satisfactory aggregates, the strength and density of concrete depending on the type of brick; engineering and allied bricks when crushed make quite good concrete of medium strength (Leonard John Murdock 1991).

III. METHODOLOGY

In this experimental study M20 grade concrete is designed as per the code IS10262:2009. The materials used are fine aggregates, coarse aggregates, cement and Brick powder with control concrete i.e, 10%, 20%, 30%, 40% and 50% of concrete is partially replaced with the brick powder in normal fine aggregates. The moulds are casted for both conventional concrete and replaced concrete and casted specimens are cured in water for 3, 7, 28days respectively. After curing, compressive strength test is conducted at 3, 7, 28 days. Two specimens are tested for each designation and average of two results will be taken.

A.MATERIALS

Cement:

Cement is a fine powder, which when mixed with water and allowed to set and harden, is capable of uniting fragments or masses of solid matter together to produce a mechanically strong material. The most common cement used is ordinary Portland cement of 53grade conforming to IS: 12269. Out of the total production, ordinary Portland cement accounts for about 80-90 percent. It is a basic ingredient for concrete, mortar and plaster. It consists of a mixture of oxides of calcium silicon and aluminum. Cement kilns are extremely large, complex, and inherently dirty industrial installations, and have many undesirable emissions. Many tests were conducted to cement some of them are specific gravity tests, consistency tests, setting tests etc.

Fine Aggregate:

Locally available free of debris and nearly river bed sand is used as fine aggregate. The sand particles should also pack to give minimum void ratio, higher voids content leads to requirement of more mixing water. In the present study the sand confirms to zone 1 as per Indian Standards. The Specific gravity sand is 2.65. Those fractions from 4.75mm to 150 micron are termed as fine aggregate.

Coarse Aggregates:

The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standard sand results are within the permissible limit. The specific gravity of coarse aggregate is 2.68.

Brick powder (Surkhi):

Surkhi is a crushed powder of a burnt clay brick. It is crushed to a 4.75mm down size using hammer and sieved through 4.75mm IS: Sieve. The various tests were conducted on the Surkhi are Specific gravity, water absorption and impact test.

Water:

Water available from the local sources conforming to the requirements of water for concreting and curing as per IS: 456-2000.

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Fig1. Composition of Materials

Figure 1 shows the different materials that are used for the preparation of concrete.

B. MATERIALS PROPERTY

Table -3.1: Physical properties of cement

SL.no	Particulars	Obtained values
01	Specific gravity	3.16
02	Setting time of cement	
	a. Initial setting time	35 min
	b. final setting time	420 min

The table 3.1 shows the physical properties such as specific gravity, Setting time of cement- initial and final setting time of Ordinary Portland Cement (OPC 53 grade).

Table -3.2: Physical properties of Fine aggregates

SL.no	Particulars	Obtained values
01	Fineness modulus	2.68
02	Maximum size	2.36mm
03	Specific gravity	2.58

Table 3.2 shows the physical properties such as specific gravity, fineness modulus and Maximum size of fine aggregates (sand).

Table -3.3: Physical properties of coarse aggregates

SL.no	Particulars	Obtained values
01	Fineness modulus	4.406
02	Maximum size	20mm
03	Specific gravity	2.66

Table 3.3 shows the physical properties such as specific gravity, fineness modulus and Maximum size of coarse aggregates.

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Table -3.4: Physical properties of brick powder

SL.no	Particulars	Obtained values
01	Fineness modulus	2.9
02	Maximum size	2.36mm
03	Specific gravity	2.48

Table 3.4 shows the physical properties such as specific gravity, fineness modulus and Maximum size of Brick powder.

IV. SIMULATION AND RESULTS

MIX PROPORTION BY VOLUME = 1: 1.88: 2.87

1= CEMENT

1.88= FINE AGGREGATE

2.87= COARSE AGGREGATE

0.5= WATER CEMENT

Table 4.1: Test results of M₂₀ grade concrete with 0%,10%, 20%,30%,40%and 50% replacement of brick powder with fine aggregate for 3, 7 and 28 days.

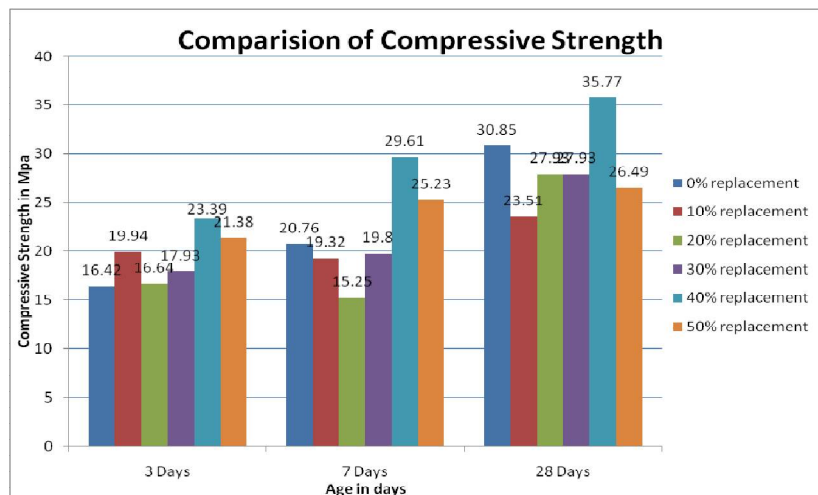
SL. NO	Grade	% Replacement of brick powder	Age in days	3	7	28
			Compressive strength in Mpa			
1	M ₂₀	0%		16.42	20.76	30.85
2	M ₂₀	10%		19.94	19.32	23.51
3	M ₂₀	20%		16.64	15.25	27.94
4	M ₂₀	30%		17.93	19.80	27.93
5	M ₂₀	40%		23.39	29.61	35.77
6	M ₂₀	50%		21.38	25.23	26.49

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The above graph indicates the variation of Compressive Strength of concrete at 3, 7 and 28 days of curing for M20 grade concrete with different percentages of brick powder replacing in normal aggregates. It was observed that, strength of concrete varies gradually with increases in percentage of replacement upto 30% and for 40% of replacement the maximum compressive strength is obtained.

V. CONCLUSION

Based on the compression strength test, the following are the conclusions obtained after performing the above experiment,

- The maximum compression strength is obtained when 40% of brick powder was replaced with fine aggregate.
- The compressive strength for 10% and 20% replacement of brick powder is not increased. There is little variation in the strength when compared with normal concrete. The optimum result is obtained for 40% replacement of brick powder with fine aggregate.
- This concrete can be used in the construction of hydraulic structures.

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