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An Experimental Study on Performance of Cement Mortar Concrete with Partial Replacement of Cement with Clay Brick Powder

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A B S T R A C T

Cement is a good binding substance that is widely used in building, however the amount of CO2 emitted in the making of cement is increasing every day. We must rely on alternative binding materials to reduce CO2 emissions. However, no other material has yet to meet the needs of cement. As a result, scientists, research researchers, institutions, and others are working to identify alternative materials to cement in the construction business. In this context, we look into the possibility of using brick powder as a partial replacement for cement in mortar and concrete. The performance of brick powder in the manufacture of cement mortar, as well as the evaluation of workability and some mechanical properties of concrete as a partial replacement material, is demonstrated in this experimental investigation.

Keywords: Cement, CO2, Brickpowder, Workability, Mechanical Properties

1.INTRODUCTION

Cement is a common name for a low-cost, sturdy, and long-lasting building material. In 2005, global cement production [9] was 2.3 billion tons, about four times what it was in 1970. CO2 and waste materials such as cement clinker dust are released in greater quantities during cement manufacture, and these pollutants pollute the environment. As a result, alternative cement materials are required in this case to protect the environment. Introduce the paper and, if necessary, include a nomenclature in a box with the same font size as the remainder of the document. The paragraphs continue from here, with just headings, subheadings, photos, and equations separating them. The section titles are numbered, bold, and 9.5 pt in size. Here are some further guidelines for authors.

A. Objectives of Study

- . The chemical reaction results in mineral hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack.
- The first form of cement invented, non-hydraulic cement is less convenient and less practical in most applications. This type of cement includes lime, gypsum plasters and oxychloride, which means that it does not begin to harden when exposed to water.
- Due to its lack of versatility and the fact it relies on such controlled conditions in order to set and harden, the use of non-hydraulic cement is becoming less and less common. It’s still used for brick and mortar use, and stonework, but is typically found indoors as it needs dry conditions to achieve it’ s best structural strength.

II. LITERATURE REVIEW

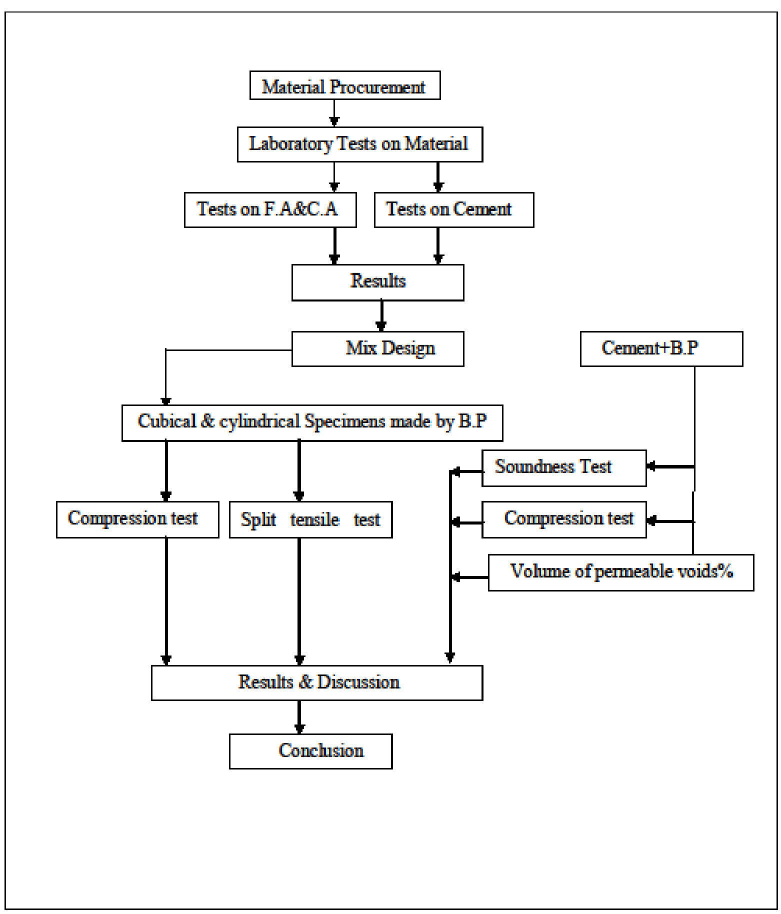
This study by R. Veerakumar et al. (2018) examines the suitability of employing brick debris in concrete instead of fine aggregate. The brick debris came from demolished masonry walls that were crushed in the lab and used as a partial replacement for fine aggregate. The control was compared to four degrees of replacement: 5%, 10%, 15%, and 20%. The mechanical properties (compressive strength test) of concrete including brick debris were comparable to those of concrete without ground brick in the tests on concrete.

According to Ramesh et al., (2017), disposal of brick dust and other waste brick particles, flakes, and other materials not only takes up space but also causes environmental issues. The difficulties may be greatly lessened if these waste elements were used in cement concrete. The primary goal of this research is to see if waste brick powder can be used as a partial replacement for cement in concrete. Waste brick powder is used to replace cement in various quantities up to 20% by weight. Brick dust is utilized for a variety of reasons, including cost savings and a reduction in the overall amount of cement required in concrete.

Recently, Satyapriya et al. (2017) investigated pozzolonic materials as a partial alternative for cement. Rice husk ash is one such pozzolonic substance (RHA). The goal of this experiment is to determine the optimal amount of RHA that can be used to partially replace cement. Our study began with material testing of materials such as cement, sand, and RHA. Normal consistency, initial setting time, final setting time, and bulk density test of sand were all completed. We used cement mortar in our experiment to demonstrate the strength variation of cement by partially replacing cement with RHA. Cubic molds with a diameter of 70.6 mm were employed.

According to P.V. Rambabu et al., (2016), the pozzolanic activity of bagasse when reacted with cement provides additional strength and results to a reduction in cement use. As a result, the use of bagasse as a cement replacement material has been expanding day by day, with a percentage by weight that provides more strength than conventional mortars. And this project is about comparing the strength of conventional cement to sugarcane bagasse-replaced cement with 5 percent, 10%, 15%, 20%, 25%, and 25% by weight in four grades of cement: OPC-53, OPC-43, PPC, PSC, and cured for 3 days, 7 days, 14 days, 28 days, and 56 days, respectively. After 56 days of strength testing, the results of the experiment revealed that the optimum percentage of sugarcane bagasse for achieving maximum strength is 10% for OPC-53 Grade cement and 5% for OPC-43, PPC, and PSC Grade cements.

III. METHODOLOGY



IV.LABORATORY TESTS

4.1 Tests on Cement

Ordinary Portland Cement of 53 grade was used in this study. The details of tests conducted on cement described below.

4.1.1 Determination of fineness of Cement Objective:

To determine the normal consistency of a given sample of cement Reference: IS: 4031 (Part 1) - 1988,

Theory:

The fineness of cement has a significant impact on the rate of hydration and, as a result, on the rate of strength growth as well as the rate of heat evolution. The fineness of grinding has grown throughout the years, providing a larger surface area for hydration and thus a faster development of strength. However, it has now practically reached a state of equilibrium. Different types of cement are ground to various finenesses. The particle size fraction below 3 microns has the greatest impact on one-day strength, while the 3-25 micron fraction has a significant impact on 28-day strength. The drying shrinkage of cement is shown to rise as the fineness of the cement increases

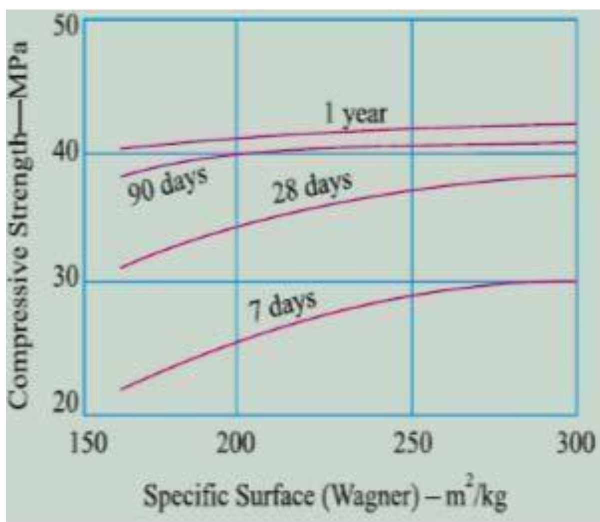


Figure 4.1 Compressive strength of cement

Table 4.1: Observations of fineness of cement

S.No	Sample	Initial Weight (gms)	Passing weight (gms)	Fineness Passing (%)	Fineness Retained (%)
1.	Sample 1	300	287	95.66	4.33
2.	Sample 2	300	285	95.00	5.00

Calculations:

For sample 1

Weight of cement taken (w1) =300 grams Weight of cement after passing = 287 grams

Percentage of Passing = 287 X100

300

= 95.66%

For sample 2

Weight of cement taken (w1) =300 grams Weight of cement after passing = 285 grams

Percentage of Passing = 285 X100

300

= 95.00%

Table: 4.2: Observations of consistency of cement

S.No	Sample	Wt. of cement (gms)	Quantity of water added to cement (ml)	Penetration (mm)	Consistency Of cement (%)
1.	Sample 1	300	84	4	28
2.	Sample 2	300	87	6	29
3.	Sample 3	300	90	7	30

For Sample 1
` Wt. of cement taken = 300 gms Quantity of water added= 84 ml Depth of penetration = 4 mm
Standard Consistency=
= 84
300
X 100
= 28 %
For Sample 2
` Wt. of cement taken = 300 gms Quantity of water added= 87 ml Depth of penetration = 6 mm
Standard Consistency=
For Sample 3
87 X 100
300
= 29 %
` Wt. of cement taken = 300 gms Quantity of water added= 90 ml Depth of penetration = 7 mm
Standard Consistency=
= 90
300
X 100
=30 %
Result: The average % of water added for 30%

Figure: 4.3 Bulking of fine aggregate

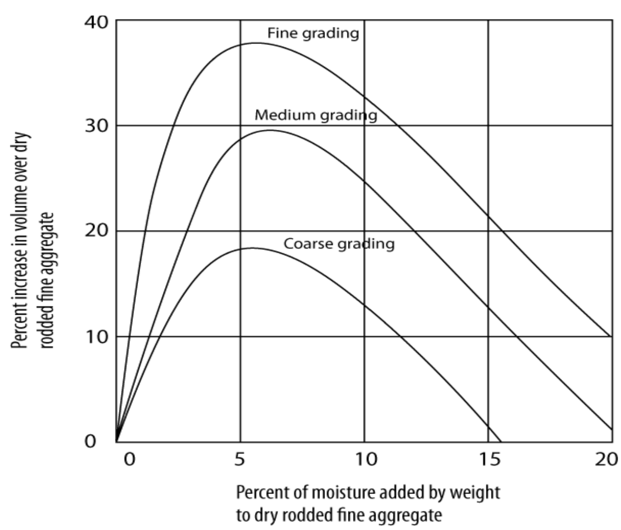


Table 4.8: Observations of gradation of fine aggregate

Sieve Size	Wt. retained on sieve in (gms)	% of weight retained	Cumulative % Wt. retained (y)	% of passing (100-y)
4.75 mm	4.7	0.47	0.47	99.53
2.36 mm	2.6	0.26	0.73	99.27
1.18 mm	5.1	0.51	1.24	98.76
600 microns	48.4	4.84	6.08	93.92
300 microns	768.5	76.85	82.93	17.07
150 microns	135.3	13.53	96.46	3.54
TOTAL		187.91		

VI. CONCLUION & RECOMMENDATIONS

A. Concluion

1. Based on the foregoing talks, it was determined that a 15% replacement of B.P in place of cement in concrete preparation produced adequate compressive strength. When compared to a control specimen, compressive and split tensile strengths are raised by 7% and 9%, respectively. As a result, up to 15% B.P can be used as a cement substitute ingredient in concrete production.
2. Because the compressive strength of the mortar mix is nearly the same when 20 percent B.P is substituted for the control mix, 20 percent B.P is acceptable for mortar preparation

B) Recommendations

1. For a definitive judgment, durability tests are recommended.
2. Determining the size of brick powder particles in concrete can lead to more accurate findings.
3. Because the temperature of brick powder might affect the hydration process, this is a topic worth investigating.
4. In the hydration process, the chemical reaction between B.P. and cement will result in appropriate results.

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