International Journal of Advances in Engineering and Management (IJAEM)
Volume 3, Issue 10 Oct 2021, pp: 788-793 www.ijaem.net ISSN: 2395-5252

Experiment & Analysis on the Effect of Concrete with Partial Replacement of Fine Aggregate by BKD

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Submitted: 05-10-2021 Revised: 18-10-2021 Accepted: 20-10-2021

ABSTRACT
Sustainable resources management and development have been at the forefront of important issue concerning the construction industry for the past several years. Specifically, the use of sustainable building materials and reuse waste materials is gaining importance and becoming common place in many areas. As one of the most commonly used construction materials in the world, concrete composed of natural aggregate, natural sand, cement and water, out of these raw material for concrete, cement can be manufactured in industries but natural aggregates are non renewable resources and depleting at an alarming rate, results in scarcity of good quality natural occurring aggregates (coarse and finer one).

Notwithstanding this India is the second biggest maker of dirt terminated blocks, representing in excess of 10 percent of worldwide generation. India is evaluated to have in excess of 100,000 block ovens, creating around 150-200 billion blocks every year. Due to the manufacturing defects in shape of bricks, the brick specimens is discarded and considered as a waste also the broken pieces of bricks during handling and transportation are of no use in construction work and considered as waste material and are dumped as waste, causing land scarcity and environmental pollution. Using these types of waste material for concrete is a bigger step towards sustainable infrastructure development.

So far, a very limited quantity of research work has been done on the application of bricks kiln dust in structural grade concrete. Hence, the present research would lead to a stronger and durable bricks kiln dust Concrete, which can be recommended for Structural applications.

In the present study the hardened properties like compressive strength, split tensile strength test were carried out on Brick kiln dust concrete. The percentage of bricks kiln dust that partially and fully replaced by fine aggregates by weights were 0%, 10%, 20%, 30%, 40% and 50% with M25 Grade. Examinations were led for both Ordinary Concrete and blocks furnace clean Concrete with various rates of BKD.

It is seen from the exploratory outcomes and its examination that the compressive quality of concrete, part rigidity of solid increments with expansion of low Percentage of blocks furnace tidy. The outcomes demonstrate that the ideal substitution of reused blocks oven tidy with fine totals was 30%. Up to 30% replacement, it is possible to gain the same strength as conventional concrete. Beyond 30% replacement the strength results following a decreasing trend.

I. INTRODUCTION

- Concrete is the most ordinarily utilized man-made development material on the planet, and is second just to water as the most used substance on earth.
- It is fundamentally made out of two parts glue and aggregate. The glue contains concrete and water and some of the time different cementious and synthetic admixtures, while the aggregate contains sand and rock or squashed stone.
- The glue ties the aggregates together. The aggregates are generally inactive filler materials which involve 70% to 80% of the concrete and in this manner expected to have impact on its properties.
- The extent of these segments for example glues and the aggregate is constrained by the

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quality and toughness of the ideal concrete, alongside the usefulness of the new concrete.

- Concrete which is one of the parts of concrete assumes an extraordinary job, however is the most costly and ecologically disagreeable material.
- Common Portland concrete is perceived as a significant development material all through the world, it is second most devoured material in the nation, next just to water.
- As Bricks kiln dust (BKD) begin to be acknowledged and accepted as a viable alternative to Fine Aggregates (FA), it is important to understand how bricks kiln dust (BKD) performs compared with conventional concrete. A correct mix design and the introduction of differently shaped bricks kiln dust can influence structural concretes performance and provide it with strengths similar to the corresponding natural fine aggregates concrete (NFAC), or even a possible enhancement, making it a feasible solution for the construction industry.

INGREDIENT OF CONCRETE

- CEMENT
- SAND
- WATER, AND
- AGGRREGATE
- BRICK KILN DUST (BKD)

In this study of different waste material have been used.

Brick Kiln Dust

Then again Brick oven clean (BKD) is a waste item acquired from various block furnaces and tile industrial facilities. There are various block oven which have become throughout the decades in a spontaneous route in various piece of the nation. Huge amounts of waste items like block tidy or broken pieces or drops of blocks (brickbat) turn out from these ovens and industrial facilities. Up until this point, such materials have been utilized only to fill low lying territories or are dumped as waste material causing land shortage and natural contamination. Utilizing these sorts of waste material for concrete is a greater advance towards supportable framework improvement.

As Bricks kiln dust (BKD) begin to be acknowledged and accepted as a viable alternative to Fine Aggregates (FA), it is important to understand how bricks kiln dust (BKD) performs compared with conventional concrete

Challenges with BKD

The volume of brick kiln dust generated from all over the world, is increasing day by day. The cost of disposal is continuing to grow day-by-day in our society due to the scarcity of land. It has the following challenges to the environment-

Its bulk which is carried over long distances for just dumping.

It is occupying significant space at landfill sites.

Its presence spoiling processing of bio-degradable as well recyclable waste.

It produces lots of dust and causes air pollution.

Brick Kiln Dust has potential use after processing and grading. Utilization of BKD is quite common in industrialized countries but in India so far no organized effort has been made.

Advantages of Brick Kiln Dust

Opens a value added use option for utilization of BKD.

Helps in sustainable development by reducing demand of new landfills.

Uniform finer particle size is useful in manufacturing of self-consolidating concrete and high-performance concrete.

Improves corrosion resistance of reinforcing steel in concrete.

Potential Applications of Brick Kiln Dust

- It has been observed from the last practices that BKD is use for non structural applications. Some of its non structural applications are presented below-
- Stabilization of sludge, wastes, and contaminated soils
- Soil stabilization
- Land reclamation
- Agricultural applications (fertilizer, liming agent)
- Livestock feed ingredient
- Construction applications (use as a road base material)
- Sanitary landfill daily cover
- Mineral filler
- Lightweight aggregate

II. OBJECTIVE OF THE THESIS

To investigate the quality and sturdiness properties of BKD as substitution of fine total in solid blend is a subject important to numerous scientists everywhere throughout the world and BKD have been seen to enhance the quality and solidness properties of cement. In the present work, the effect of addition of BKD on strength, sorptivity, surface absorption characteristics of concrete are investigated. The percentage of bricks

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kiln dust that partially and fully replaced by fine aggregates by weights were 0%, 10%, 20%, 30%, 40% and 50% with M25 Grade.

The precise objectives of the study are follows

Specific objectives

- To carry out the literature review in the area of the study.
- To get the thoroughness with the existing mix design procedures for BKD concrete by varying the replacement of BKD with fine sand, in concrete mix.
- To carry out the study to check the hardened properties of BKD concrete and mortar (compressive and split tensile strength).
- To carry out the study to check the durability properties of BKD concrete

III. LITERATURE REVIEW

Kunal (2014) examined on Cement oven tidy (CKD), a waste material, is created amid assembling of concrete clinker and have cementitious qualities as of bond. In this examination, endeavors are made in using the bacterial (Bacillus sp.) regarded bond furnace clean as halfway substitution of Portland concrete (10, 20 and 30% w/w) and its impact on the typical consistency, setting times and hydration procedure of mixed concrete glues, and on compressive quality (at 7, 28 and 91 days) of mixed concrete mortars. Test outcomes indicate increment in water consistency with CKD focus where as setting time is diminished up to 10% CKD expansion, above which setting time increments because of lessened hydration process. At later curing age's hydration procedure increments up to 10% bacterial treated CKD bond glue which later on diminishes as CKD content increments.

Nitesh Bhardwaj 2020 have studied about Study of the effect of partial replacement of fine aggregates by jhama brick powder in conventional concrete. This exploration paper centres around the impact of fractional supplanting of fine aggregate with jhama brick powder on primary properties of fresh and hard concrete. In this investigation distinctive cement blends were set up by supplanting sand with jhama brick powder from 10% to 30%. The evaluation of cement utilized in this examination is M25 according to IS arrangement. Different tests are conducted on fresh and hardened cement concrete, for example, slump test, compressive strength test, split tensile test and flexural strength test at 7 days and 28 days of curing regime. The fundamental goal behind this work is to utilise squander material for casting concrete specimen and decrease the utilization of normally accessible sand for sustainable and waste management of resources

TamilSelvi (2020) Investigate about Effect of Partial Replacement of Fine Aggregate With Soil on the Strength Properties of Concrete. River sand is the major part in the concrete, nowadays river sand availability is reduced due to over usage for concrete, therefore it results in environmental effects such as ground water decrease, soil erosion and many others. Local soil is present, and the paper discusses the use of fine aggregates in the construction of concrete instead of using river sand historically. Instead, recycling of this waste soil was proposed in the development of useful building material. This work examines the possibility of using soil as partial replacement of fine aggregate for new concrete. In this study soil was partially replaced as 25%, and 50%. Concrete are made for M25 mix and tested for its compressive strength, up to 7, 28, days of age and compared with conventional concrete.

IV. METHODOLOGY

- all cubes beams and cylinders are casted with traditional method for M 25 grade of concrete.
- Later same are casted by replacing Fine aggregate with 10%, 20%, 30%, 40% and 50% BKD.
- The studied were carried out with the compressive strength & split tensile strength and workability test with M25grades of concrete
- The behavior of the specimen has to be studied and compared with each other.

❖ **There are four type of mix ingredients, three cubes, cylinder and beams are cast for each mix.**

➢ **Mix 1. All mix samples were prepared for M25 grade of concrete.**

1. Nominal mix (M25) i.e. water + cement + fine aggregate + coarse aggregate(60% 20mm and 40% 10mm coarse aggregate).

2. Special mix 1 (M25) i.e. water + cement + fine aggregate + coarse aggregate (60% 20mm and 40% 10mm coarse aggregate) + BKD(10%/kg fine aggregate)

3. 2. Special mix 2 (M25) i.e. water + cement + fine aggregate + coarse aggregate (60% 20mm and 40% 10mm coarse aggregate) + BKD(20%/kg fine aggregate)

3. Special mix 3 (M25) i.e. water + cement + fine aggregate + coarse aggregate (60% 20mm and 40%

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10mm coarse aggregate) + BKD(30%/kg fine aggregate)
4. Special mix 4 (M25) i.e. water + cement + fine aggregate + coarse aggregate (60% 20mm and 40% 10mm coarse aggregate) + BKD(40%/kg fine aggregate)
5. Special mix 5 (M25) i.e. water + cement + fine aggregate + coarse aggregate (60% 20mm and 40% 10mm coarse aggregate) + BKD(50%/kg fine aggregate)
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Mix Design

Design of M 25 Grade

Concrete mixtures were prepared with different proportions of BKD. The proportions (by weight) BKD added to concrete mixtures were as follows: 0% (for the control mix), 10%, 20%, 30%, 40% and 50%. The mix proportion chosen for this study is M25 grade with water-cement ratio of 0.42-.40.

Nominal w/c ratio	Water(kg/m^3) effective w/c ratio	Cement(kg/m^3)	Fine aggregate (kg/m^3)	Coarse aggregate (kg/m^3)
0.45	174	438	631	1087
0.45	0.40	1.0	1.44	2.48

V. IMPLEMENTATION

Consistency of Cement Test

The basic aim is to find out the water content required to produce a cement paste of standard consistency as specified by the IS: 4031 (Part 4) – 1988. The principle is that standard consistency of cement is that consistency at which the Vicat plunger penetrates to a point 5-7mm from the bottom of Vicat mould. The control paste had normal consistency of 32%.

Initial and Final Setting time of Cement pastes

The Indian standard confines the initial setting time of concrete not to be under 30 minutes and the last setting time not to surpass 10 hrs. The outcomes for the setting time

Initial setting time 48 Min

Final setting time 575 Min

Workability Test

The inward surface of form was cleaned altogether and free from dampness and any solid before initiating the test. The form was set on inflexible, level and non-retentive surface. The shape filled in 4 layers, each around one fourth of tallness of the form. Each layer might be messed with 25 strokes. In the wake of leveling the best, the shape was expelled from concrete instantly by bringing it gradually up in a vertical bearing. This enables the solid to die down and droop should be estimated by estimating distinction between the statures of form and most astounding purpose of example being tried.

Workability of Concrete Containing BKD(M-25)

Mix no.	Description	Slump (mm)
1	100%FA+0%BKD	120
2	90%FA+10%BKD	130
3	80%FA+20%BKD	145
4	70%FA+30%BKD	150
5	60%FA+40%BKD	160
6	50%FA+50%BKD	180

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FA = Fine Aggregate
BKD = Brick Kiln Dust
Slump shows that the workability increases with the increase in the percentages of contain BKD. All investigated containing BKD mixtures had height slump values and acceptable workability.

COMPRESSIVE STRENGTH

The Compressive strength of concrete material is tested by creating cylinders of size 150mm x 150mm x 150mm is continuously cured for 7, 14, 28, 56 & 90 days testing. Totally 90 cube were casted for M25 grade and for 10%, 20%, 30%, 40% and 50% by weight partial replacement of BKD for sand. Three samples are tested and the average values are taken as tensile strength of concrete. The values of split tensile strengths are shown in table.

Mix no.	**Description**	**7 days**	**14 days**	**28 days**	**56 days**	**90 days**
1	100%FA+0%BKD	19.00	22.00	25.00	28.00	39.40
2	90%FA+10%BKD	16.65	18.00	26.60	29.00	39.67
3	80%FA+20%BKD	17.82	19.2	25.70	24.40	31.80
4	70%FA+30%BKD	18.90	21.50	29.10	31.12	37.20
5	60%FA+40%BKD	22.50	22.80	27.50	32.30	38.30
6	50%FA+50%BKD	16.20	20.10	24.50	26.8	31.50

Most concrete structures are designed assuming that concrete processes sufficient compressive strength. The compressive force is the major criteria for the rationale of structural design. To study the strength development of concrete in comparison to Conventional concrete, compressive strength tests were conducted at the ages of 7, 14, 28 & 56 & 90 days. Graphs show compressive strength variations when replace with of fine aggregates and BKD. It shows that addition of BKD 50% replacement by weight of fine aggregate shows decrease in compressive strength at 28 days concrete compared with control mix of concrete. It can also be observed that the maximum compressive strength at 28 days of curing was obtained for a mix containing 70%FA+30%BKD. The value of compressive strength obtained for concrete mix with 60%FA+40%BKD was 27.50 at 28 days of curing respectively. Beyond the 40% addition of BKD the compressive strength of concrete mixes was found to be decreased at 28 days of curing. The low value of compressive strength of concrete in 50%FA+50%BKD was 24.50 at 28 days of curing respectively. The later age strength of BKD mixes also show promising results and in some cases more than the control mix. It may be due to slow rate of hydration due to increase in the BKD percentage in the concrete mix.

Split tensile strength

The split tensile strength of concrete material is tested by creating cylinders of size 150mm x 300mm and is continuously cured for 7, 14, 28, 56 & 90 days testing. Totally 90 cylinders were casted for M25 grade and for 10%, 20%, 30%, 40% and 50% by weight partial replacement of BKD for sand. Three samples are tested and the

average values are taken as tensile strength of concrete. The values of split tensile strengths are shown in table.

It shows that the splitting tensile strength test results of bricks kiln dust concrete shows

The maximum value of splitting tensile strength obtained for content 30%BKD mix & 40%BKD replacement shows higher strength comparison to other mix.

After 50%replacement of BKD with FA is showing lower strength with irregular behavior in split tensile strength values.

So bricks kiln dust concrete performed better with less than 50% replacement in the initial stages.

VI. CONCLUSION

In the current investigation, bricks kiln dust (BKD) were used to examine the strength. The experimental data obtained has been analyzed and discussed in Chapter-4, to fulfill to the best of ability, the objectives set forth for the present investigation. This chapter gives the broad conclusions that are drawn from the investigation.

Based on the scope of work carried out in this investigation, following conclusions are drawn.

- The study is based on the strength parameter and these are the governing criteria of research work there are basically three main strength parameters consider and the expected out are based on compressive strength, splite tensile strength test, flexure strength test.
- The basic aim is to find out the water content required to produce a cement paste of standard consistency as specified by the IS: 4031 (Part 4) – 1988. The principle is that standard consistency of cement is that consistency at which the Vicat plunger penetrates to a point 5-7mm from the bottom of Vicat mould. The control paste had normal consistency of 33%.
- Slump shows that the workability increases with the increase in the percentages of contain BKD. All investigated containing BKD mixtures had height slump values and acceptable workability.
- Brick kiln dust can be efficiently used to produce good quality concrete and mortar with satisfactory slump and setting times. The test results shows that results are within the permissible limits prescribed by the IS Standards.
- All concretes mixes using brick kiln dust fulfilled the performance criteria for fresh and hardened properties.
- Under certain conditions, substitution of fine total by block furnace tidy of seems to expand the quality of cement and mortar.