INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 4)
Available online at: www.ijariit.com

Effect on properties of concrete using Bricks Kiln Dust (BKD)

Himanshu Pratap Singh
himanshusinghf.hs@gmail.com
LNCT University, Bhopal, Madhya Pradesh

Ram Bharosh
ram.kumarnit9893@gmail.com
LNCT University, Bhopal, Madhya Pradesh

ABSTRACT

Sustainable resources management and development have been at the forefront of the important issue concerning the construction industry for the past several years. Specifically, the use of sustainable building materials and reuse of waste materials is gaining importance and becoming commonplace 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 this 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). In the present study the hardened properties like compressive strength, split tensile strength, and also durability properties like ISAT, 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%, 20%, 40%, 60%, 80% and 100%. Experiments were conducted for both Ordinary Concrete and bricks kiln dust Concrete with different percentages of BKD. It is observed from the experimental results and its analysis, that the compressive strength of concrete, splitting tensile strength of concrete increases with the addition of low Percentage of bricks kiln dust. The results show that the optimum replacement of recycled bricks kiln dust with fine aggregates was 20%. Up to 20% replacement, it is possible to gain the same strength as conventional concrete. Beyond 20% replacement the strength results following a decreasing trend.

Keywords— *BKD, Workability, Compressive strength, Split tensile strength, Initial surface absorption test, Acid attack*

1. INTRODUCTION

A sustainable construction has become a great concern over construction practice at the expense of the future of our planet. Due to the development and modernization of cities, lots of construction activities are going on all over the world. Concrete is the most widely used construction material in the field of civil engineering, consumed rapidly by the construction industries. A study reveals that 10-12 billion ton of concrete consumes annually. Such huge consumption of concrete requires a huge volume of naturally occurring aggregates. These aggregates are nonrenewable resources and depleting at an alarming rate which results in the depletion of good quality of natural aggregates. Therefore it is the responsibility of civil engineers and builders to find out a sustainable solution to the problem 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.

2. MATERIALS USED

2.1 Cement

Ordinary Portland cement (OPC) from a single lot was used throughout the course of the investigation. The physical properties of the cement are determined from various tests, conforming to Indian Standard IS: 1489-1991(Part-1) are listed in Table 3.1. All the tests were carried out as per the recommendations of IS: 4031-1988. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture.

2.2 Course aggregate

Crushed angular granite metal from a local source was used as coarse aggregate. The specific gravity was 2.67; the coarse aggregate is defined as that retained on 4.75 mm IS sieve. To increase the density of the resulting concrete mix, the coarse aggregate is frequently used in 20mm sizes

2.3 Fine Aggregate

IS 383-1970 defines the fine aggregate, as the one passing 4.75 mm IS sieve. The fine aggregate is often termed as a sand size aggregate. Locally available riverbed sand was used in the present study. The sand conforms to grading Zone – III as per IS 383 – 1970 respectively. The specific gravity was 1.78.

2.4 Brick Kiln Dust

Brick dust is a waste product obtained from different brick kilns and tile factories. There is numerous brick kiln which has grown over the decades in an unplanned way in different part of the country. Tons of waste products like brick dust or broken pieces or flakes of bricks (brickbat) come out from these kilns and factories. So far, such materials have been used just for filling low lying areas or are dumped as waste material. The specific gravity was 2.50. The bricks kiln dust conforms to grading Zone – III as per IS 383 – 1970 respectively.

2.5 Mix proportions

Table 1: Mix details for mortar and concrete

MIX	SAND (%)	BKD (%)
M1	100%	0%
M2	80%	20%
M3	60%	40%
M4	40%	60%
M5	20%	80%
M6	0%	100%

3. RESULT AND DISCUSSION ON EXPERIMENTAL TESTS

3.1 Workability of Concrete Mixes

The workability of concrete mixes was found out by slump test as per procedure is given in chapter 3. w/c ratio was kept constant at 0.45 for all the concrete mixes. The workability results of different concrete mixes were shown in Table 2.

Table 2: Workability values for different concrete mixes

Mix no.	Description	Slump (mm)
1	100%FA+0%BKD	120
2	80%FA+20%BKD	114
3	60%FA+40%BKD	105
4	40%FA+60%BKD	100
5	20%FA+80%BKD	100
6	0%FA+100%BKD	90

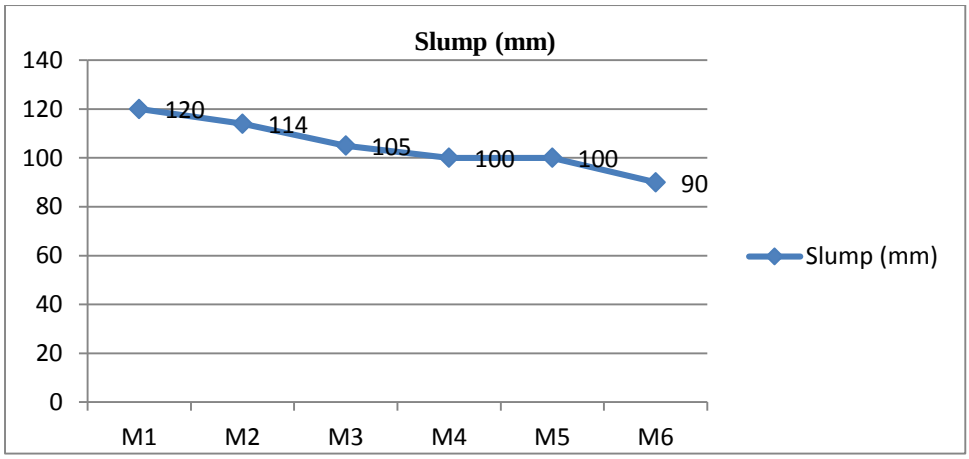

Fig. 1: Workability of concrete different mixes

* FA = Fine Aggregate
* BKD = Brick Kiln Dust

Table 2 shows that as the addition of bricks kiln dust to concrete mix increases, the workability of the concrete mix was found to decrease as compared to control mix. The addition of bricks kiln dust into the concrete mix further decreases the workability. The lowest value of slump was obtained with mix 0%FA+100%BKD and the highest value was obtained with 100%FA+0%BKD. The mix with the combination 80%FA+20%BKD show nearly equivalent workability compared to control mix.

3.2 Compressive Strength

The results of the compressive strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The compressive strength test was conducted at curing ages of 7, 14, 28, 56 and 90 days. The compressive strength test results of all the mixes at different curing ages are shown in Table 3. Variation of compressive strength of all the mixes cured at 7,14,28,56 and 90 days are also shown in Figure 2.

Table 3: Compressive strength (MPa) results of all mixes of concrete at different curing ages

Mix no.	Description	7 days	14 days	28 days	56 days	90 days
1	100%FA+0%BKD	20.10	23.00	33.00	35.00	39.40
2	80%FA+20%BKD	19.65	22.00	32.60	34.50	39.67
3	60%FA+40%BKD	18.82	20.21	31.70	34.40	36.80
4	40%FA+60%BKD	17.90	20.50	30.10	33.12	35.20
5	20%FA+80%BKD	17.50	19.80	29.50	32.30	32.30
6	0%OFA+100%BKD	16.20	18.10	28.52	31.80	31.50

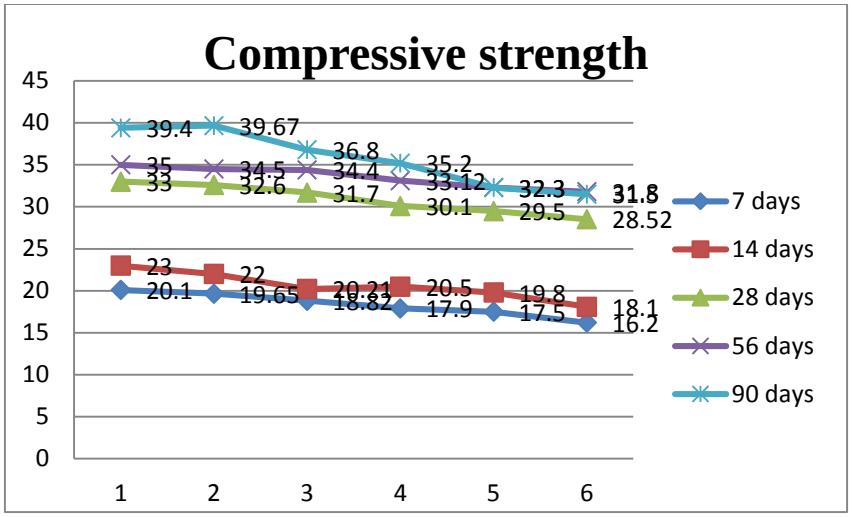

Fig. 2: Variation of compressive strength of concrete with age

Table 3 shows that addition of BKD 100% replacement by weight of fine aggregate shows a decrease in compressive strength at 28 days concrete compared with control mix of concrete. It can also be observed from the Fig 2 that the maximum compressive strength at 28 days of curing was obtained for a mix containing 80%FA+20%BKD. At 100% BKD addition, the compressive strength of the concrete mix was found to decrease in 28, days of curing compared with control mix of concrete. The maximum value of compressive strength obtained for concrete mix with 80%FA+20%BKD was 32.60 at 28 days of curing respectively. It was observed that increasing the percentage of BKD when decreasing compressive strength as well as tensile strength.

3.3 Split Tensile Strength Test Results

The results of the splitting tensile strength tests conducted on concrete specimens of different mixes cured at different ages are presented and discussed in this section. The splitting tensile strength test was conducted at curing ages of 7, 14, 28, 56 and 90 days. The splitting tensile strength test results of all the mixes at different curing ages are shown in Table 4. Variation of splitting tensile strength of all the mixes cured at 7, 14, 28, 56 and 90 days is also shown in Figure 3. Shows the variation of splitting tensile strength of concrete mixes w.r.t control mix (100%FA+0%BKD) after 7, 14, 28, 56 and 90 days respectively.

Table 4: Splitting tensile strength (MPa) results of all mixes of concrete at different curing ages

Mix no.	Description	7 days	14 days	28 days	56 days	90 days
1	100%FA+0%BKD	3.50	3.70	4.88	5.23	5.28
2	80%FA+20%BKD	3.32	3.65	4.87	4.50	4.38
3	60%FA+40%BKD	3.18	3.62	4.20	3.99	4.33
4	40%FA+60%BKD	3.12	3.55	3.58	3.85	4.23
5	20%FA+80%BKD	3.09	3.40	3.51	3.82	4.19
6	0%FA+100%BKD	2.92	3.30	3.24	3.70	4.00

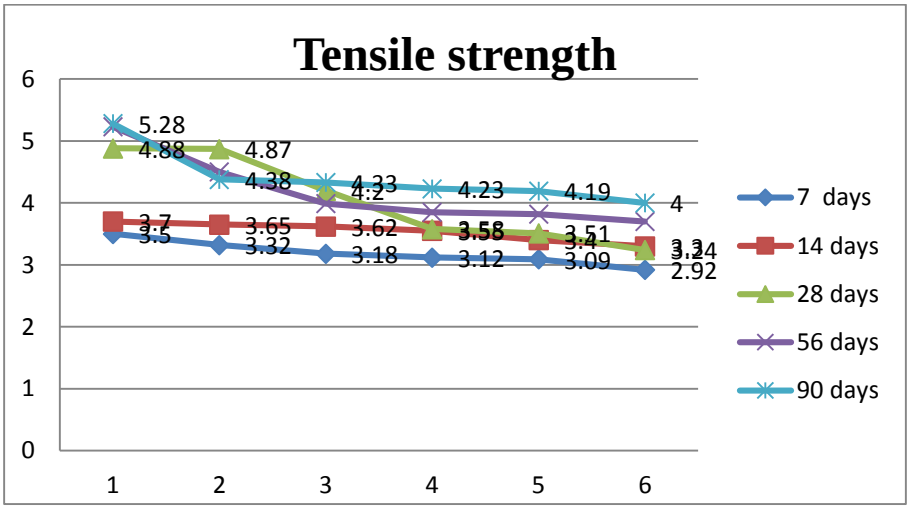

Fig. 3: shows that the splitting tensile strength test results of bricks kiln dust concrete show

The maximum value of splitting tensile strength obtained for content 80%FA+20%BKD mix was 4.87MPa and 5.28MPa at 28 and 90 days respectively. The lowest split tensile strength was obtained by 100%BKD, mix which is 3.24 and 4.00MPa at 28 and 90 days respectively which is 28% and 38% less than 100%FA+0%BKD mix. It was observed that mix 0%FA+100%BKD less value is 1.53MPa and 1.28MPa at 56 days and 90 days from comparing to the control mix. Further, In view of these results the strength at 28 days the same value in mix 80%FA+20%BKD and at 28 days. It was observed that increasing the percentage of BKD when decreasing compressive strength as well as tensile strength.

4. DURABILITY

4.1 Acid Resistance Tests

The concrete cubes of 150 mm size were cast for finding the mass loss due to the acid and base attack. The prepared cubes were cured in water for 56 days after which they were immersed in 1% H2SO4 solutions, as shown in Figure 4. The initial mass and the mass of concrete specimens after the immersion period of 28 and 56 days were measured for finding the mass loss due to the deterioration of concrete specimens. The average value of three specimens was considered for assessment.

Table 5: Durability test

S. No	Description	Before compressive strength	After compressive strength	Between difference
1	100%FA+0%BKD	33.00	28.01	-4.99
2	80%FA+20%BKD	32.60	27.20	-5.40
3	60%FA+40%BKD	31.70	25.50	-6.20
4	40%FA+60%BKD	30.10	23.41	-6.69
5	20%FA+80%BKD	29.50	22.65	-6.85
6	0%FA+100%BKD	28.52	22.02	-6.20

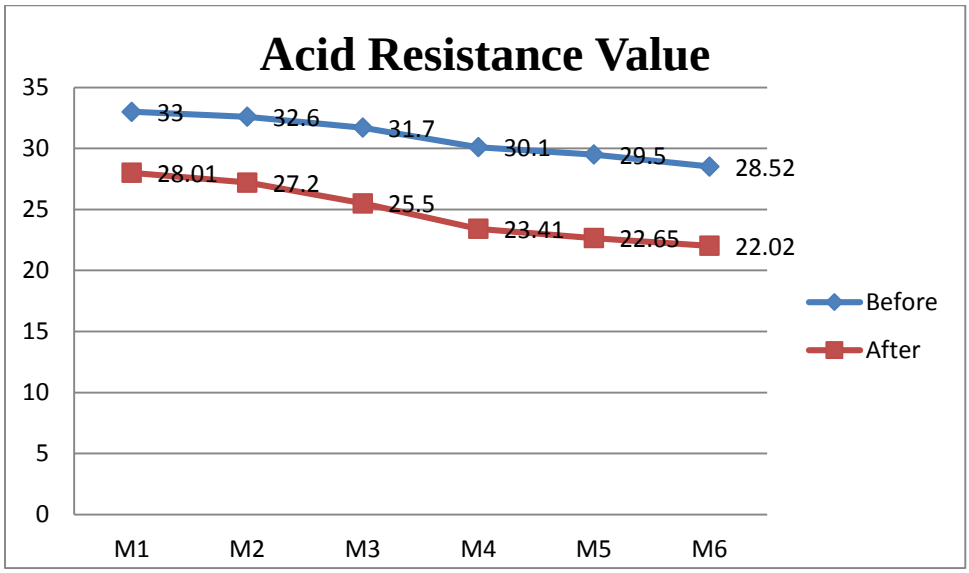

Fig. 4: Variation of compressive strength due to the acid attack of concrete with age

5. CONCLUSIONS

In the current investigation, bricks kiln dust (BKD) was used to examine the strength and water absorption characteristics using the Initial Surface Absorption Test as per BS-1881 208. 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, the following conclusions are drawn:

- Brick kiln dust can be efficiently used to produce good quality concrete with the satisfactory slump and setting times. The test results show that results are within the permissible limits prescribed by the IS Standards.
- All concrete mixes using brick kiln dust fulfilled the performance criteria for fresh and hardened properties.
- Under certain conditions, replacement of fine aggregate by brick kiln dust of appears to increase the strength of concrete.
- Good hardened properties were achieved for the concretes with 20% bricks kiln dust which can be considered as the optimum content for high compressive strength.
- BKD mortar mix having various sand replacement level up to 50% exhibited satisfactory results for both compressive and tensile strength.
- The compressive strength of a concrete increase in containing 80%FA+20%BKD.
- All the concrete mixes the rate of initial surface absorption increase with increasing quantity of BKD.
- It was observed that after the obtained result of the acid solution when increasing the percentage of BKD as well as increasing efficiency of concrete by the above acid solution.

6. REFERENCES

[1] Ali, S., Harthy, A., Taha, A., Faisal, M., (2003) Effect of cement kiln dust (CKD) on the mortar and concrete mixtures. *Construction and Building Materials 17 (2003) 353–36.*

[2] ASTM C 1585 -04 (2007) Standard test method for measurement of the rate of absorption of water by hydraulic-cement concretes.

[3] Brahim, I., rkmen, T., (2003) Influence of different curing conditions on the physical and mechanical properties of concretes with admixtures of silica fume and blast furnace slag. *Materials Letters 57 (2003) 4560–4569* Indian Standard IS: 516-1959, Bureau of India standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[4] Corinaldesi, V., Moriconi, G., Tarun Naik, R., (2010). Characterization of marble powder for its use in mortar and concrete. *Construction and Building Materials 24 (2010) 113–117.*

[5] Cachim, B., (2009) Mechanical properties of brick aggregate concrete. *Construction and Building Materials 23 (2009) 1292–1297.*

[6] Ghrici, S., Kenai, M., Mansour, S., (2007) Mechanical properties and durability of mortar and concrete containing natural pozzolana and limestone blended cement. *Cement & Concrete Composites 29 (2007) 542–549.*

[7] Indian Standard IS 383-1970, Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[8] Indian Standard IS 383-1970, Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[9] Indian Standard IS 10262-2009, Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[10] Indian Standard IS 4031-1988, Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[11] Indian Standard IS: 1489-1991(Part-1), Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[12] Indian Standard IS 456-2000, Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[13] Indian Standard IS: 269-1976, Bureau of India Standards, Manak Bhawan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[14] Konstantinos, G., Trezos, a., Michael, F., (2013). The durability of similar self-compacting concrete batches produced in two different EU laboratories. *Construction and Building Materials 40 (2013) 207–216.*

[15] Khalid, B., Zaher, N., Mahmod, S., Khaliq, A., (2014) Experimental investigation on using Cement Kiln Dust (CKD) as a cement replacement material in producing modified cement mortar. *Construction and Building Materials 55 (2014) 5–12.*

