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Feasability Studies of Partial Replacement of Cement by Brick Powder & Sand by Quarry Dust

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Abstract

To increase emphasis on live cycle cost analysis of building project requires new attention to be focused on service life and durability of concrete structures. Durability is the ability to resist weathering action, chemical attack of any other process of deterioration of concrete. Concrete is the great versatility and relative economy infilling wide range needs has made it competitive building materials. This involves massive quarrying of raw materials (lime stone, clay)as it takes 1.7tones produced in one ton of clinker ,as well as emission of greenhouse gasses and other gasses (NO_x,SO_2,CO_2)in to the atmosphere it around 850 kg's of CO_2emmited per one ton of clinker produced. River sand is most commonly used as fine aggregate in the production of concrete posses the problem of acute shortage in many areas ,whose continuous use has started posing serious problem with respect to its availability ,cost and environmental impact. This project report results of an experimental study the mechanical properties of (OPC) cement by brick powder and sand by quarry dust in the range of 0%, 10%, 15%, and 20% by weight of cement .concrete mixtures were produced ,tested and compared in terms of compressive strength, split tensile strength to the conventional concrete .These tests were carried out to evaluate the properties for 7,28,56and 90 days curing .the moulds were prepared are as follows 150mmX150mmX150mm cubes for each concrete mix. The aim of investigation is to study the behaviour of M25grade of concrete while replacing of brick powder and quarry dust by cement and sand with different proportions in concrete. These tests carry out to evaluate the mechanical properties of test results of 7days, 28days, 56days&90 days for compressive strength in normal water curing and in H2SO4 solutions of 1%&2&.Also durability aspect for brick powder and quarry dust in cement concrete for sulphate attack, percentage of weight reduction was tested.
Keywords: Quarry Dust, Brick Powder, Conventional Concrete, Deterioration

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I. INTRODUCTION

To meet the requirements of globalization, in the construction of buildings and other structures concrete plays the major rightful role and a large quantum of concrete is being utilized. The constituent materials of concrete include cement, sand, coarse aggregate and water. For better performance and to meet the requirements additives or sometimes super plasticizers are used.

Portland cement clinker production consumes large amounts of energy (850 kcal per kg of clinker) and has a considerable environmental impact. This involves massive quarrying for raw materials (limestone, clay, etc.), as it takes 1.7 tones to produce 1 ton of clinker, as well as the emission of greenhouse and other gases (NO_x, SO_2, CO_2) into the atmosphere. Around 850 kg of CO_2 are emitted per ton of clinker produced

River sand is most commonly used fine aggregate in the production of concrete poses the problem of acute shortage in many areas. Whose continued use has started posing serious problems with respect to its availability, cost and environmental impact?

In the backdrop of such a bleak atmosphere, there is large demand for alternative materials from waste. Secondary cementing materials like Brick Powder can be used to partially replace cement because of pozzolonic nature. Materials like quarry dust best suites to sand due to its physical and chemical properties, fineness etc. Also these materials are known to increase durability, resistance to sulphate attack and Alkali-Silica reaction (ASR)

Our main aim of study is to examine changes in mechanical properties, weight loss and chemical resistance. On completing the required tests we are presenting our experimental program and the results obtained.

II. LITERATURE REVIEW

A. Asian Journal of Civil Engineering (Bhrc) Vol. 14, No. 5 (2013) By A.Heidari and B.Hasanpour

The mixture is designed according to ACI-211-89. A concrete without brick powder material, with a resistance f_{ck} of 33MPa and maximum aggregate size of 25 mm, was used as a control. In the mixture design, binder content 320 kg/m^3, and water–cement ratio 0.5 were chosen as constant. Concrete mixes were made with waste bricks powder replacing 10, 15, 20, 25, 30 and 40 percent by weight of the cement as pozzolan and with the same amount of aggregates and water as in the reference

The test specimens were cast in steel cubic moulds 15×15×15 (cm) and compacted on a vibrating table. For each mix, cubic samples were tested to determine compressive strengths respectively, at 7, 28, 56 and 90 days of curing .All samples had a plastic consistency. The results obtained indicate, as expected, large differences in early curing ages and smaller differences at long curing ages.

For long curing age concrete mixtures with 10, 15 and 20 percent cement replacement has minor the strength loss. Compressive strengths of samples decrease with increasing the bricks content, especially at early ages. But results show that concrete with bricks waste powder has minor strength loss and brick powder exhibit very good pozzolanic reactivity and can be used as cement replacement.

For less than 20 percent use of the pozzolan, the average use of pozzolan is 15 percent, although the average decrease in resistance in 7 and 90 days curing is 18 and 2.43 percent in order. This results show, less than 20 percent use of pozzolan, has no considerable effect on resistance

III. EXPERIMENTAL RESULTS AND DISCUSSIONS

A. Compressive Strength Studies:

1) Compression Test for 7 Days Curing

Table – 6
(i)Compression Test for 7 Days Curing

MIX	CAC	CB10Q0	CB10Q10	CB10Q15	CB10Q20	CB15Q0	CB15Q10	CB15Q15	CB15Q20
WATERCURING	22.9	32.2	33.8	41.8	37.5	34.6	31.7	37.8	30.0
ACID CURING	23.8	24.6	36.3	42.7	36.7	40.87	30	28	27.1

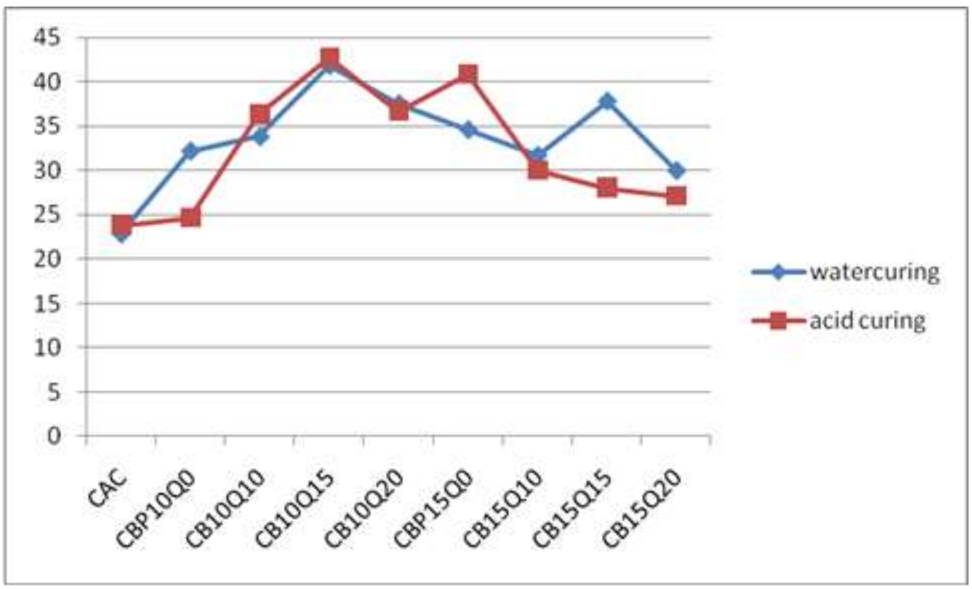

Fig. 1: compression test for 7 days curing

2) Compression Test for 28 Days Curing

Table – 6
(ii) Compression Test for 28 Days Curing

MIX	CAC	CB10Q0	CB10Q10	CB10Q15	CB10Q20	CB15Q0	CB15Q10	CB15Q15	CB15Q20
WATERCURING	35.2	37.4	36.0	39.50	41	26.8	29.0	32.4	27.5
ACID CURING	38.3	39.1	36.1	35.8	38.5	36.27	3.85	33.05	32

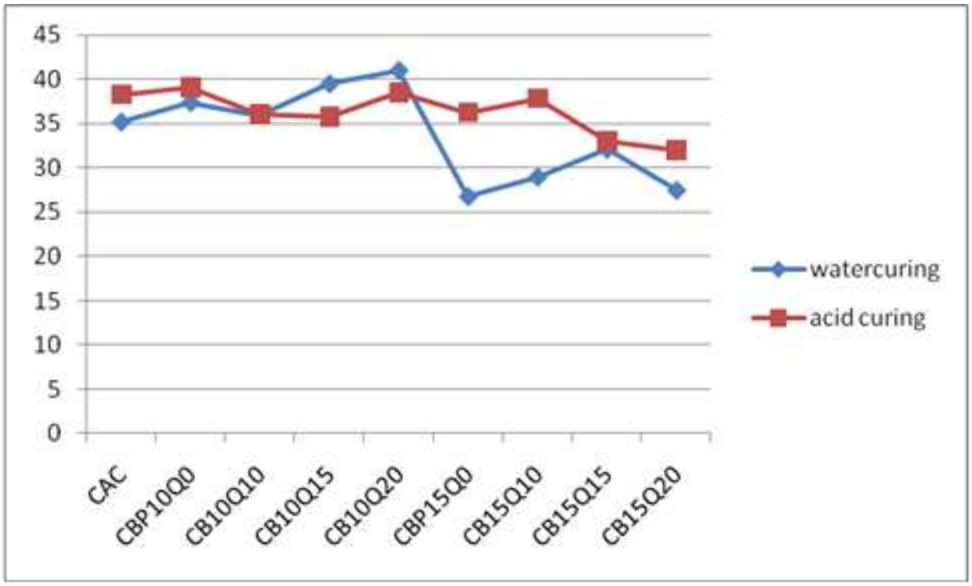

Fig. 2: compression test for 28 days curing

3) *Compression Test for 56 Days Curing*

Table – 6
(iii) Compression Test for 56 Days Curing

MIX	*CAC*	*CB10Q0*	*CB10Q10*	*CB10Q15*	*CB10Q20*	*CB15Q0*	*CB15Q10*	*CB15Q15*	*CB15Q20*
WATERCURING	*36.0*	*38.2*	*37.2*	*39.7*	*40*	*28.5*	*30.7*	*35.57*	*28.43*
ACID CURING	*38.8*	*39.2*	*36.8*	*36.1*	*38.83*	*34.1*	*38.0*	*30.5*	*31.1*

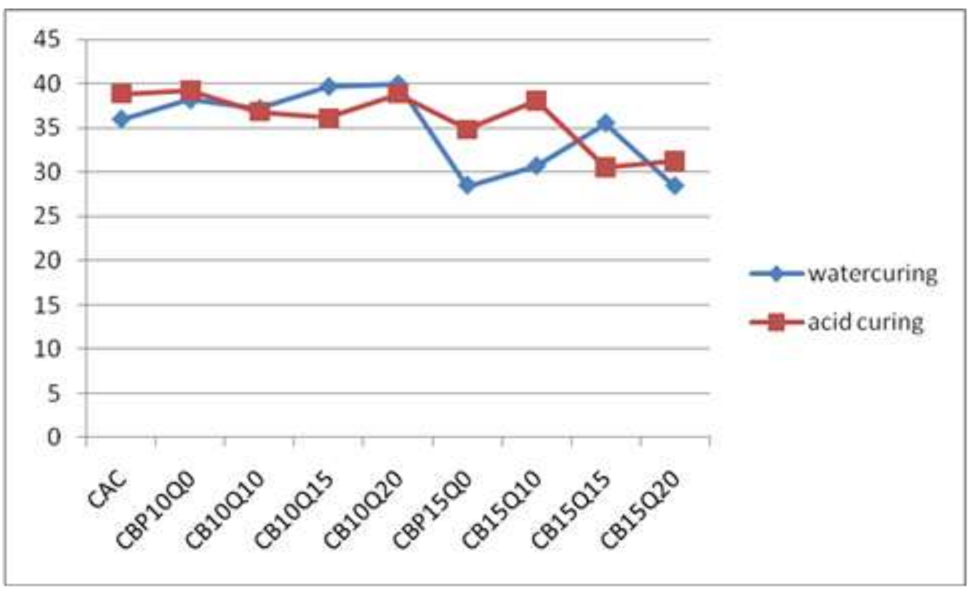

Fig. 3: compression test for 56 days curing

4) *Compression Test for 90 Days Curing*

Table – 6
(iv) Compression Test for 90 Days Curing

MIX	*CAC*	*CB10Q0*	*CB10Q10*	*CB10Q15*	*CB10Q20*	*CB15Q0*	*CB15Q10*	*CB15Q15*	*CB15Q20*
WATERCURING	*36.9*	*38.7*	*38.2*	*40.1*	*40.63*	*29*	*32.5*	*35.0*	*29.0*
ACID CURING	*39.2*	*39.77*	*37.6*	*37.02*	*39.253*	*35.09*	*35.33*	*31.1*	*31.1*

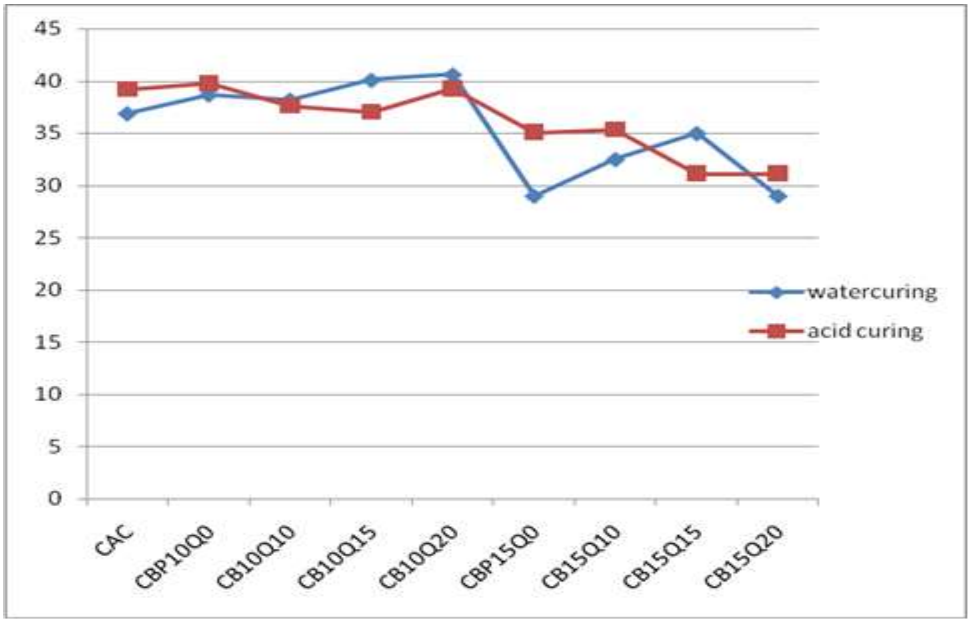

Fig. 4: compression test for 90 days curing

B. Split Tensile Test Results For 28 Days Curing

Table – 7
Split Tensile Test Results For 28 Days Curing

MIX	CAC	CBP_{10}	$CB_{10}Q_{10}$	$CB_{10}Q_{15}$	$CB_{10}Q_{20}$	CBP_{15}	$CB_{15}Q_{10}$	$CB_{15}Q_{15}$	$CB_{15}Q_{20}$
WATER	3.26	3.3	3.6	3.9	3.7	2.9	3.1	3.1	3.4
ACID	4.5	3.8	3.7	3.2	3.5	3.3	3.8	3.5	3.7

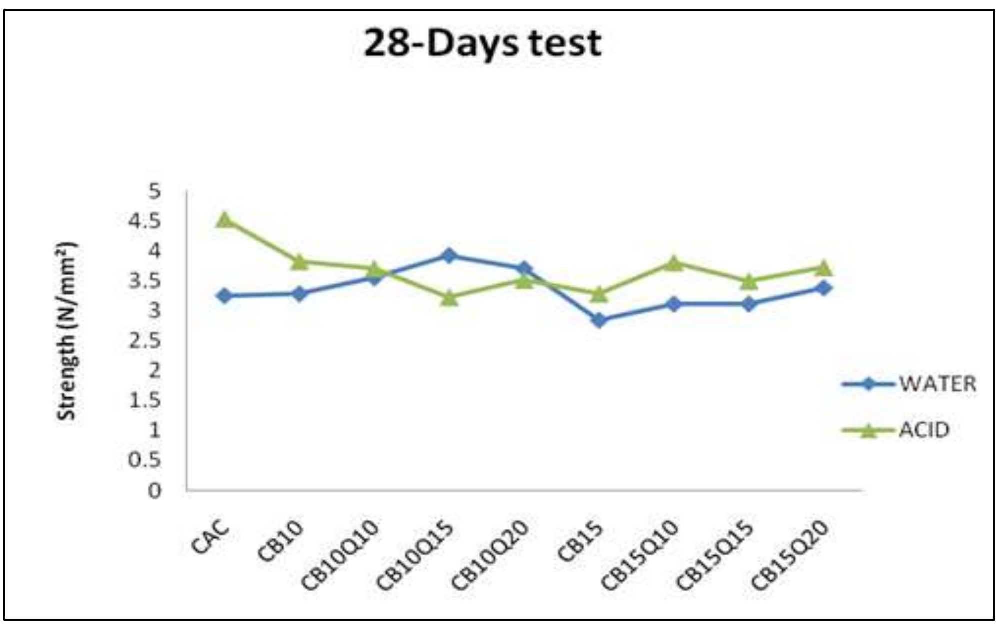

Fig. 5: Split Tensile Test Results For 28 Days Curing

C. Weight Loss

1) % Weight Loss for 7 Days Curing

Table – 8
(i) % Weight Loss for 7 Days Curing

MIX	CAC	CBP_{10}	$CB_{10}Q_{10}$	$CB_{10}Q_{15}$	$CB_{10}Q_{20}$	CBP_{15}	$CB_{15}Q_{10}$	$CB_{15}Q_{15}$	$CB_{15}Q_{20}$
INITIAL WEIGHT	8.25	8.3	8.35	8.4	8.41	8.43	8.45	8.3	8.5
FINAL WEIGHT	8.06	8.10	8.14	8.1	8.19	8..198	8.22	8.09	8.30
% WEIGHT LOSS	2.3	2.4	2.42	2.45	2.5	2.74	2.72	2.5	2.35

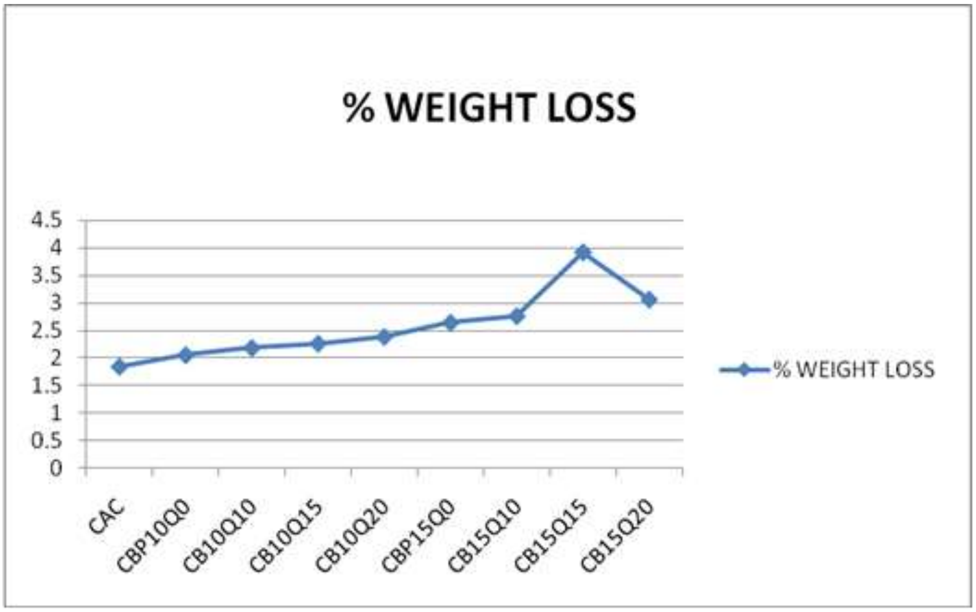

Fig. 6: Effect of Sulphuric acid (7 days)

D. *% Weight Loss for 28 Days Curing*

Table – 8
(ii) % Weight Loss for 28 Days Curing

MIX	*CAC*	*CBP_{10}*	*$CB_{10}Q_{10}$*	*$CB_{10}Q_{15}$*	*$CB_{10}Q_{20}$*	*CBP_{15}*	*$CB_{15}Q_{10}$*	*$CB_{15}Q_{15}$*	*$CB_{15}Q_{20}$*
INITIAL WEIGHT	*8.25*	*8.15*	*8.35*	*8.18*	*8.3*	*8.28*	*8.32*	*8.18*	*8.26*
FINAL WEIGHT	*8.1*	*8.01*	*8.13*	*8.09*	*8.1*	*7.96*	*8.11*	*7.91*	*7.99*
% WEIGHT LOSS	*1.84*	*2.05*	*2.18*	*2.26*	*2.38*	*2.64*	*2.76*	*3.92*	*3.06*

Fig. 7: Effect of Sulphurics acid (28 days)

IV. CHAPTER-7 DISCUSSIONS & CONCLUSIONS

A. *Discussions:*

1) In case of compressive strength test for all type of mixes considered always an increase in strength in seen both 7days and 28 days curing
2) Also acid curing gains more strength than normal curing.
3) In case of compressive strength for all mixes considered always an small incremental strength in 56and 90 days curing

4) In case of split tensile strength in water curing improved up to CB10Q20 and then it gradually falling down.
5) For acid curing conventional concrete exhibit high tensile strength and then better strength is seen at CB10Q0.
6) There is a significant decrease the cost of construction when compared to conventional aggregate
7) The chosen material are good in resisting the sulphate attack

B. *Conclusions:*

1) In case of compressive strength for normal curing the optimum value can be obtained by replacing cement with 10% brick powder and sand with 20% of quarry dust and is found more durable.
2) In case of split tensile strength for normal curing the optimum value can be obtained by replacing cement with 15% brick powder and sand with 20% of quarry dust.
3) In case of split tensile strength for acid curing the optimum value can be obtained by replacing cement with 10%brick powder and is found more durable.
4) In case of weight loss reduction in acid curing the optimum percentage of weight deducted at cement replacing 15%of quarry dust and sand replacing with15% of quarry dust.

C. *Future scope*

– The results show the scope for further replacement levels to know maximum range of replacement.

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