

Durability Studies on Concrete with Crushed Sand as A Partial Replacement of Fine Aggregate in Hydrochloric acid Solution

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Abstract

The most broadly utilized material in this world is concrete. After water, concrete is set in second position. The utilization of regular sand in traditional cement has happened to essential significance which is rare to get. Sand is fundamental solid making development material required in huge amounts. Produced sand is one among such materials to supplant waterway sand which can be utilized as an elective fine total in mortars and cement.

An endeavor had been made in the present examination to talk about the properties of cement, for example, usefulness and compressive quality of solid which is set up by supplanting characteristic sand with counterfeit sand at various substitution levels (0%, to 100%). The outcomes have anticipated that supplanting of normal sand with made sand arranged by 60% will create cement of attractive usefulness and compressive quality.

Sturdiness of the solid is likewise tried by submerging the blocks in 5% hydrochloric corrosive arrangement. The examples are contemplated for M40 and M50 evaluations of cement for supplanting of characteristic sand with made sand when drenched in hydrochloric corrosive, the quality consequences of the examples that are inundated in hydrochloric corrosive arrangement is discovered.

Keywords: - Natural sand, Crushed sand, Durability, Compressive strength

I. INTRODUCTION

Cement is widely noted to be most expensive constituents of concrete. Due to its durability to cost ratio it is one of the widely used material. Due to severe environmental conditions its durability declines. Degradation of concrete structures by corrosion is a serious problem and has major economic implications. Cement used in concrete is a mixture of complex Compounds. Due to these reactions setting and hardening occurs when this type of water is used. No longer is concrete made with cement, aggregates and water only. It is the material which is used more than any other man made material for construction works. Cement can be used as an extensive building material. With the rise in demand and use of cement and in backdrop of waste management, scientists and researchers all over the world are always in search for cultivating additive binders like mineral additives which are found in various forms in nature including blast furnace slag, fly ash and silica fume. The addition of these products in the production of concrete has positive environmental effects, while minimizing problems associated with its disposal. Silica fume is one of the most used mineral admixtures because it contains high percentage of amorphous silica which is having high durability.

Manufactured Sand

It is acquired by pounding stone, rock or slag which is utilized for total material under 4.75mm that is prepared from smashed stone or rock and proposed for development use. Aside from this, made sand is of high caliber in connection to non-refined from coarse total generation. The real objective of the present work was to reliably consider the usefulness, quality, strength of cement with made sand and rate supplanting of fabricated sand with common sand by 0% to 100% separately. The investigation was done on M40 review concrete with 0.5 water/bond proportion and M50 review concrete with 0.35 water/bond proportion which results in expanded compressive quality from 10% to 30%, the flexural quality was expanded from 1% to 5% and coefficient of penetrability was diminished altogether.

The elements which are in charge of sturdiness might be expected to enduring conditions like temperature, and dampness changes, or because of scraped spot, assault by normal or mechanical fluids and gases, or organic specialists. The accompanying toughness issues are caused because of ecological conditions like steel consumption, delamination, splitting, carbonation, sulfate assault, substance assault, scaling, spalling, scraped area and cavitation's.



I. EXPERIMENTAL WORK

2.1 MATERIALS AND THEIR PROPERTIES:

The properties of various materials used in making the concrete are discussed in the following sections.

Cement:

OPC Cement of 53 Grade was used for making the cubes in the experimental work.

Natural Sand:

The fineness modulus of the natural river sand is 2.44, conforming to zone II as per IS: 383-1970 was used for the experimentation after washing it with clean water. The specific gravity of the natural sand is 2.62. The water absorption and moisture content values obtained for the sand used was found to be 1.52% and 0.8% respectively.

Crushed sand

The crushed sand having fineness modulus of 2.62 and conforming to zone II as per IS: 383-1970 was used for the experimentation after washing it with clean water. The specific gravity of the artificial sand was found to be 2.52. The water absorption and moisture content values obtained for the sand used was found to be 2.54% and 0.92% respectively.

Coarse Aggregate

Crushed stone aggregates of 20mm size obtained were used for the experimentation. The fineness modulus of coarse aggregates was 6.65 with a specific gravity of 2.62. The water absorption and moisture content values obtained for the sand used was found to be 2.5% and 0.5% respectively.

Hydrochloric Acid:

HCL concentration of 5%

Water:

Portable fresh water, free from concentration of acid or organic substances was used for mixing concrete.

Table 1 Physical properties of Fine Aggregate –Manufacturing Sand (IS 383, IS 2386 PART III)

	Properties	Value
1	Grading of sand	Zone II as per IS 383
2	Bulk Density(Kg/m ³) a) loose b) compacted	1652 kg/m ³ 1824 kg/m ³
3	Water absorption	1.52 %
4	Specific gravity	2.62
5	Silt content	5 %
6	Surface Moisture	0.45%
7	Fineness Modulus	2.85

Table 2 Chemical composition of Crushed Sand:

As manufactured sand is a product from the coarse aggregate industry it will have the same chemical properties of coarse aggregate

Constituent	Crushed sand (%)	Natural sand	Test method
SiO ₂	72.54	82.15	IS : 4032-1968
Al ₂ O ₃	19.72	11.54	
Fe ₂ O ₃	6.52	1.85	
CaO	4.52	3.24	
MgO	2.54	0.67	
NNa ₂ O	Nil	1.54	
K ₂ O	3.24	1.34	
Ti O ₂	1.22	Nil	
Loss of ignition	0.54	0.42	

Mix Proportions Adopted:

The concrete of M 40 grade and M 50 grade were designed using the IS Code method (IS: 10262-1982) of mix design and proportions were obtained after applying necessary corrections to suit field conditions. The final mix ratio for M 40 was expressed as parts of water: cement: fine aggregate: coarse aggregate **0.4: 1: 1.65: 2.92** and for M 50 as **0.35: 1: 1.472: 3.043**

Acid attack study:

The resistance of the concrete to chemical attack is found out by immersing them in acid solution. After 28 days period of curing fifteen specimens each of two grades M 40 and M 50 grade concrete. Five specimens were immersed in 1-5 % HCL solution. To make 50 liters solution of 1- 5% concentrated HCL the stock solution required is 2.52 liters. After 28 days of immersion, change in average compressive strength, split tensile strength and flexural strength were observed.

I. LABORATORY TESTS AND RESULTS

Different tests were completed in the research center for finding the quality and sturdiness and other essential properties of the solid utilized amid the investigation. Droop cone test, Compaction test, Vee-honey bee test, compressive quality, split elasticity and flexural quality were led by utilizing distinctive rates of produced sand as a substitution of regular sand. The subtleties of these tests are given in the accompanying areas.

Workability Tests:

a) Slump Cone Test: According to Indian Standard Specifications 1199-1959 This test is performed to check the consistency of new concrete. It is a term which is utilized to characterize the condition of crisp cement. It alludes to the absence of trouble with which solid streams. It is utilized to demonstrate the level of wetness. The test is performed on a droop cone. The inner surface of the shape is cleaned altogether and loaded up with cement in four layers. Each layer is compacted multiple times with a packing pole. The best layer is leveled by utilizing a trowel and the form is expelled from the solid quickly by raising it gradually. The distinction in level between the stature of form and the tallness of most noteworthy purpose of the died down cement is estimated. The distinction in the tallness gives the droop an incentive in mm.



I.

COMPRESSIVE STRENGTH

Compressive quality test was directed in the research facility according to IS Code (IS: IS 516-1959). Different rates of smashed sand was supplanted with normal sand and the outcomes were displayed. The concrete, sand, coarse total, produced sand blended completely. About 25% of water required is included and altogether blended with a plan to acquire uniform blend. After that equalization of 75% water was included and blended altogether with a view to get uniform blend.

Pressure test on the block is led on the 600T compressive machine. The 3D squares were thrown in the 3D shape molds with inward components of 150x150x150mm. The diagram was plotted between No. of days and compressive quality. The variety of 28 days compressive quality with increment in rates of made sand for M20 and M30 is expanded by 60% which gives more quality than some other trade for both the evaluations.

Figure: Variation of 28 days Compressive strength for M 40 Grade

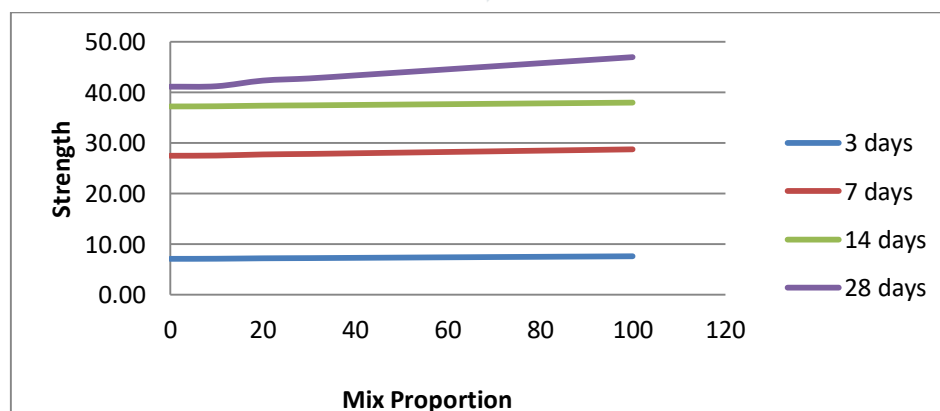
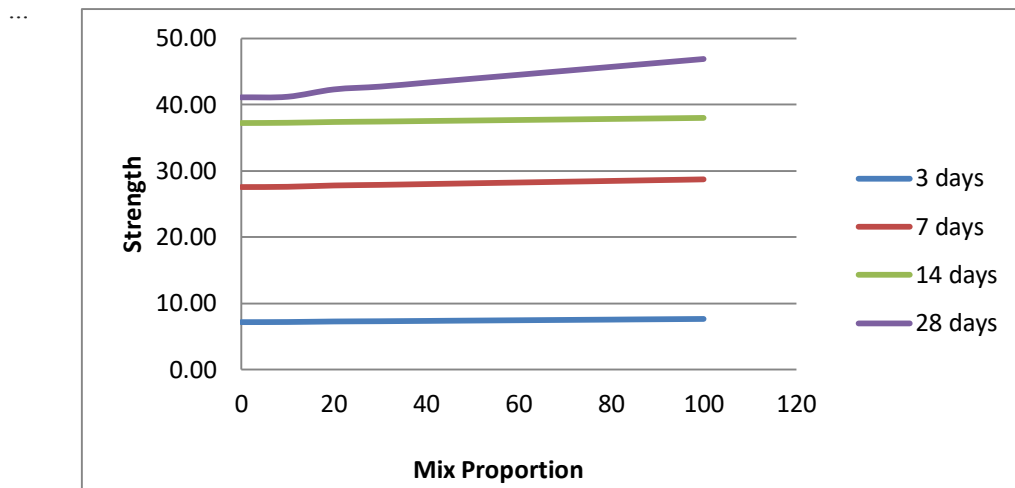


Figure: Variation of 28 days Compressive strength for M 50 Grade



I. SPLIT TENSILE STRENGTH:

The Split tensile strength tests were directed in the research facility according to IS Code (IS: IS 516-1959). Different rates of smashed sand was supplanted with normal sand and the outcomes were displayed. The concrete, sand, coarse total, produced sand blended completely. About 25% of water required is included and altogether blended with a plan to acquire uniform blend. After that equalization of 75% water was included and blended altogether with a view to get uniform blend.

Pressure test on the block is led on the 600T compressive machine. The 3D squares were thrown in the 3D shape molds with inward components of 150x150x150mm. The diagram was plotted between No. of days and compressive quality. The variety of 28 days compressive quality with increment in rates of made sand for M20 and M30 is expanded by 60% which gives more quality than some other trade for both the evaluations.

FLEXURAL STRENGTH:

The Flexural strength tests were conducted in the laboratory as per IS Code (IS: IS 516-1959) Different percentages of crushed sand sand was replaced with natural sand and result were inferred in the results.

This test is conducted on 10T Universal testing machine. The flexural beams were cast in steel moulds with inner dimensions of 500x100x100mm. The graph was plotted between No. of days and flexural strength. The variation of 28 days flexural strength with increase in percentage of manufactured sand for M 40 and M 50 is increase 65% which gives more strength than any other replacement for both the grades.

Acid attack test:

It has been observed that in specimens immersed in 5% hydrochloric acid were taken after 28 days from the curing tank and these specimens were tested for compressive strength, split tensile strength and flexural strength. The decrease in the compressive strength, split tensile strength and flexural strength after treating specimens with hydrochloric acid for 28 days of M 40 and M 50 grade concrete for replacement of natural sand by manufactured sand in proportions of 0 %, to 100% are as follows :

Figure: Comparison of 28 Days Acid Treated Compressive Strength M 40 Grade concrete

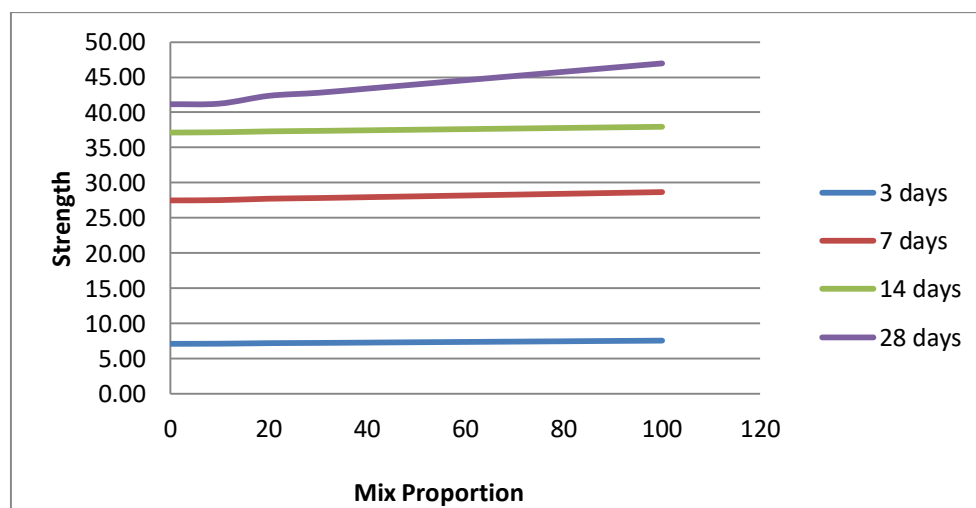
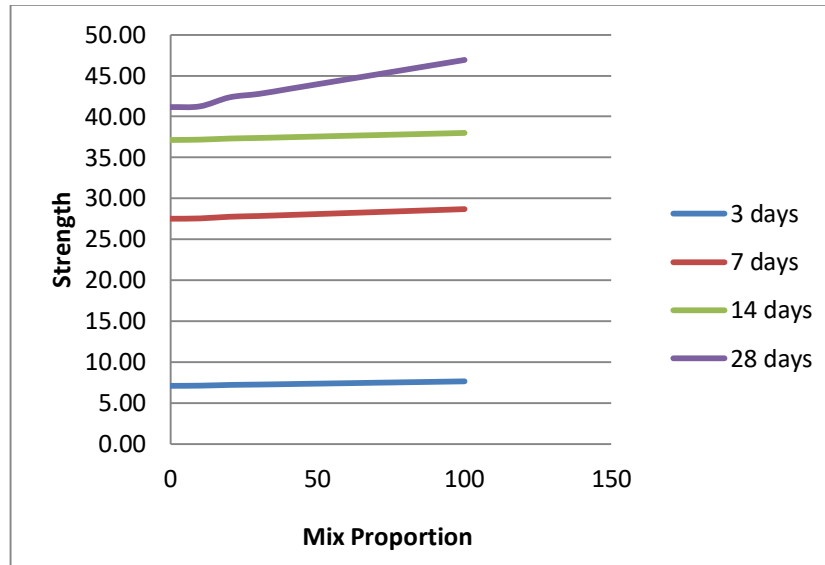


Figure: Comparison of 28 days and Acid Treated Compressive Strength M 50 Grade

IV. RESULTS & CONCLUSIONS

Results were dissected to infer valuable ends in regards to the functionality, solidness qualities of cement with supplanting of normal sand with fabricated sand utilized in various extents for M20 and M30 Grades.

The expansion in the compressive quality, split elasticity and flexural quality of M 40 review concrete for the substitution of characteristic sand by produced sand in the extents of 0%, to 100% is of request 0%, to 20%, for compressive quality 0%, to 12 % for split rigidity and 0%, to 15 % for flexural quality separately.

The expansion in compressive quality, split rigidity and flexural quality of M 50 review concrete for substitution of common sand by produced sand in extents of 0%, to 100% is of request 0 - 15 %, for compressive quality 0 to 16% for split elasticity , 0%, to 14% for flexural quality individually.

The expansion in the compressive quality , split rigidity and flexural quality in the wake of treating examples with hydrochloric corrosive for 28 days of M 40 review concrete for substitution of normal sand by fabricated sand in extents of 0%, to, 100% is of request 0 to 12 % for compressive quality ,

The expansion in compressive, split, flexural quality with treating examples with hydrochloric corrosive for 28 days of M50 Grade concrete for substitution of common sand by fabricated sand in extents of 0%, to 100% arranged by 0 to 12%, for compressive quality 0 to 12% for split elasticity of 0 to 12 % for flexural quality individually.

V. CONCLUSIONS

1. The usefulness and quality properties of cement had expanded by supplanting characteristic sand with 100% of produced sand. Notwithstanding, for more than 100 % substitution of characteristic sand by counterfeit sand causes decrease in compressive quality of cement blends.
2. The supplanting of characteristic sand with fabricated sand will help in saving the regular asset like sand and furthermore keeps up the biological parity of the nature.
3. The decline in the normal compressive quality and rate of decline is more in M 50 review M 40 review than that of in M 50 review solid when inundated in hydrochloric corrosive arrangements.

VI. References

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