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Research Article

Some Studies on Characteristics Properties of Concrete Replacing Natural Sand by Manufactured Sand Subjected to Alternate Wetting and Drying

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Abstract

The performance of concrete mainly depends on its durability. Therefore durability of concrete is important factor to be considered, which directly influence the efficiency of concrete. Alternate wetting and drying of concrete is one of the major factors that are measured in terms of durability of concrete. Due to deficiency of natural sand, to replace this, some alternatives are found, which is manufactured or crushed artificial sand. And natural is very expensive and apart from this, it requires additional treatment to remove undesirable substance. Hence to overcome all these, manufactured sand is the suitable alternative. In this present project work an attempt will be made to study the various characteristic, properties of concrete by supplanting N sand with M sand subjected to alternate wetting and drying of concrete. Initially the concrete mix design is carried out for M25 mix after conducting the various tests on all components of concrete. MS-sand is replaced at various percentages 0%, 20%, 40%, 60%, 80% & 100%. After subjected to alternate wetting and drying of concrete the various strength characteristics, like compressive strength, flexural strength, shear strength and split tensile strength are evaluated.

Keywords: *Manufactured-sand, Alternate wetting and drying, Natural sand,*

1. Introduction

Concrete is a composite material consisting of binding material such as mixture of Portland cement and water, in which embedded particles or fragments of aggregate, normally combination of fine and coarse aggregate. Concrete is a versatile material and its usage worldwide is unimaginable. To satisfy wide range of performance specifications it can be engineered, unlike various other building materials such as natural stone or steel, which normally are used as they are. Concrete has got higher compressive strength and lower tensile strength, because of this reason reinforcing steel bars are used and it is called as reinforced concrete**.** When we consider building, the word concrete takes the meaning of stone made by mixing sand, stone, Portland cement and water. This combination is cast into desired form of shape and size, finally which hardens into a stone like mass called concrete. Portland cement was well developed in the 19th century. Concrete versatility, durability, sustainability and economy are the important factors which makes it world's most widely used construction material. On an average 4 tons of concrete are produced per person per year worldwide and about 1.7 tons per person in United States of America. Concrete may also contain supplementary cementing materials such as slag cement, fly ash and chemical admixtures. To produce good quality concrete understanding fundamentals is very important. The vast usage of concrete is in the developing industry and infrastructure whole worldwide. In compostion of concrete major element is sand, which is derived from the natural riverbed. Due to erosion of sand in the river bed natural resources are being harmed and its consequences were restriction in the use of natural riverbed sand and because of this cost of sand got expensive. (Radhakrishna *et al*. 2014)

This led to the research of fine aggregate other than natural sand, which can be used effectively for construction purpose. Manufactured sand was the supplementary for the natural sand after the research studies. Interest for manufactured sand is growing day by day and studies are conducted for that to check durability properties for betterment in construction industry**.**

In this study one cycle of alternate wetting and drying, concrete is subjected to wetness for one day and dryness for one day. The dry – wet cycle is one of the destructive environmental conditions undergone by concrete. When concrete undergoes wetting, a fast

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acceleration in the interior humidity takes place in less time and the relative humidity reaches a stable level, which depends on strength of the concrete or water-cement ratio of the concrete. In contrast, as concrete is exposed to dryness sudden decrease in the relative humidity is not found but it reduces gradually. Shrinkage characteristic of concrete in dry-wet cycle is periodically changed, showing shrinkage on drying and expansion on wetting.

There is increase in the expansion cracks in the internal structure of the concrete when concrete is exposed to the dry-wet cycle and subjected to sulfate attack. Lastly it leads to the concrete spalling, stone exposure and structural disintegration.

In this present work an attempt is made to study the durability properties of concrete by substituting natural sand with manufactured sand subjected to alternate wetting and drying cycles condition for 46 days (23 cycles) after curing specimens for 28days. Firstly mix design is carried out for M25 grade after conducting various tests on concrete. Natural sand is replaced with M-sand in proportions like 0%, 20%, 40%, 60%, 80% and 100%. For workability slump test is carried out. After subjecting to alternate wetting and drying various strength characteristics like compressive strength, flexural strength, shear strength and split tensile strength is computed. The values are analysed and M- sand suitability is observed.

2. Materials and Methods

Ordinary Portland cement of 43grade (IS 8112 *et al*.1989) with specific gravity 3.01 was used in making the concrete. The fine aggregate used was sand of zone II and its specific gravity was 2.58 (IS: 383 *et al*.1970). Course aggregates used in experimentation were 20m and down size and their specific gravity was found to be 3.1 (IS: 383 *et al*.1970). Manufactured sand was obtained from local industry in Belagavi. The size of manufactured sand (M-Snd) is less than 4.75mm M sand is produced by crushing hard granite. M sand was used in place o natural sand for different proportions. The specific gravity is 2.60 (IS: 383 *et al*.1970). FOSROC CONOPLAST SP430 DIS super plasticiser is utilized to get good workability of the concrete mix. A dosage of 125 ml/ 50kg of cement was used.The concrete constituents which are cement, sand and coarse aggregate and their proportion for M25 grade concrete is (1:1.76:2.76) with w/c = 0.45 (IS 10262 *et al*.2009). Our aim is to look for the effect of M-sand in concrete structures which is replaced by natural river sand. The replacement of N-sand by M-sand in percentages of 0%, 20%, 40%, 60%, 80%, 100%. Materials were dry mixed thoroughly. The water cement ratio is 0.5, based on this required quantity of water was calculated and added to the dry mix.

After casting the specimens they are taken away in the laboratory free from vibration and in the moist air and room temperature for 24 hours. After 24 hours specimens are kept in clean and fresh water for 28 days curing. Totally there were 6 proportions of replacement of natural sand by m-sand. For each proportion 3 specimens were casted and average of those values was taken. Totally 144 specimens were casted. Out of total, 72 specimens were cured for 28 days and subjected alternate wetting and drying for 46 days (i.e 28+46=74 days) after normal curing. Rest were continued for normal curing. The test specimens for compressive strength were of size 150 x 150 x 150 mm. Specimens for split tensile strength were of dimensions 150 mm diameter and height 300 mm. Flexural strength test specimen were 100 x 100 x 500 mm. Specimens for Shear strength of size 90*60*150mm.After 28 days of curing specimens were subjected to alternate wetting and drying cycles. The specimens were weighed before subjecting to alternate wetting and drying condition. Then tests were carried out for respective strengths (IS: 516 *et al*.1959, IS: 5816 *et al*.1999).

3. Results and Discussions

The variation in compressive strength, tensile strength, and flexural strength and shear strength is represented in the form of graph as shown.

1) It is observed from fig.1 that concrete compressive-strength obtained by substituting N-sand by M-sand without experiencing alternate wetting & drying is increasing up to 60% substitution and then decreasing afterwards. In other words, the higher Compressive-strength is achieved at 60% substitution of N-sand by M-sand level without subjected to alternate wetting & drying. Also there is an increase in compressive-strength percentage wich is compared to reference mix is 16.75% at 60% substitution level. In 60% substitution of N sand by M sand, concrete shows good reaction with N sand because there is maximum filling of voids.
2) It is observed from fig.2 same behaviour in compressive-strength of concrete as like the concrete with alternate wetting & drying. Concrete compressive-strength obtained by substituting N-sand by M-sand when subjected to the alternate wetting & drying is linearly goes on increasing up to 60% substitution. Then there is decrease in the Compressive-strength for 80% and 100% substitution. In other words, at 60%substitution compressive strength achieved maximum value when the concrete is subjected to the alternate wetting & drying.
3) It is observed from fig.3 that concrete tensile strength obtained by replacing N-sand by M-sand subjected alternate wetting & drying is increasing up to 60% substitution. In other words, the higher tensile strength is achieved at 60% substitution of N-sand by M sand level subjected to alternate wetting & drying.
4) It is observed from fig.4 that similar behaviour in tensile strength of concrete as like the earlier one. Concrete Spilit tensile-strength obtained by replacing N-sand by M-sand without alternate wetting and drying is linearly goes on increasing with 0%,20%,40%,60% substitution. In other

words at 60% substitution tensile-strength achieved maximum value when the concrete is subjected without alternate wetting and drying.

5) It is observed from fig.5 that concrete flexural strength obtained by supplanting N-sand by M-sand without subjected to alternate wetting and drying is increasing upto 60% substitution and decrease afterwards. In other words, the higher flexural strength is achieved at 60% substitution of N-sand by M-sand level without subjected to alternate wetting and drying. Concrete shows the optimum reaction with N-sand, with properly combined grading these are going to fill maximum voids in the concrete at 60% substitution of N-sand by M-sand so that at 60% substitution, the concrete will take maximum load compared with reference mix, which is produced with 100% N-sand.
6) It is observed from fig.6 flexural strength obtained by supplanting N-sand by M sand when subjected to the alternate wetting and drying is linearly goes on increasing with 0%, 20%, 40% and up to 60% substitution. There onwards the flexural strength decreases at 80% and 100% substitution. In other words, at 60% substitution flexural strength achieved maximum value when the concrete is subjected to the alternate wetting and drying.
7) It is observed from fig.7 that concrete shear strength obtained by replacing N-sand by M-sand without subjected to alternate wetting and drying is increasing upto 60% substitution and decrease afterwards. In other words, the higher flexural strength is achieved at 60% substitution of N-sand by M-sand level without subjected to alternate wetting and drying.
8) It is observed from fig.8 Shear strength obtained by replacing N-sand by M-sand when subjected to the alternate wetting and drying is linearly goes on increasing with 0%, 20%,40% & 60% substitution. There onwards the Shear strength decreases at 80% and 100% substitution. In other words, at 60% substitution shear strength achieved maximum value when the concrete is subjected to the alternate wetting and drying.

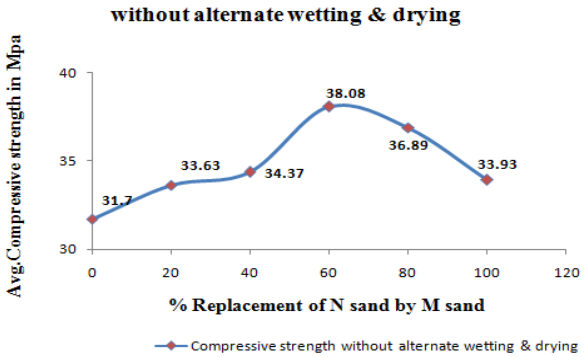

Fig. 1 Variation of overall Compressive strength of N sand by M sand without subjecting to alternate wetting and drying

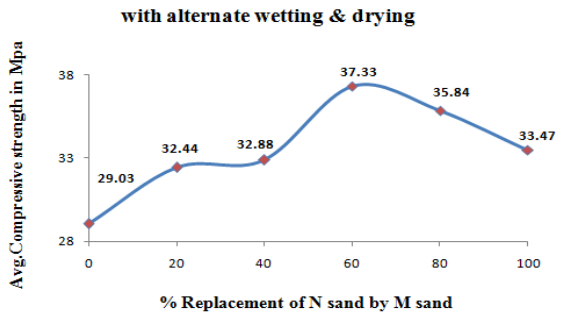

Fig.2 Variation of overall Compressive strength of N sand by M sand subjecting to alternate wetting and drying

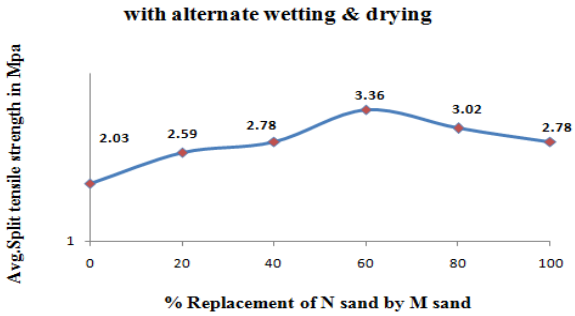

Fig.3 Variation of overall Split tensile strength of N sand by M sand subjecting to alternate wetting and drying

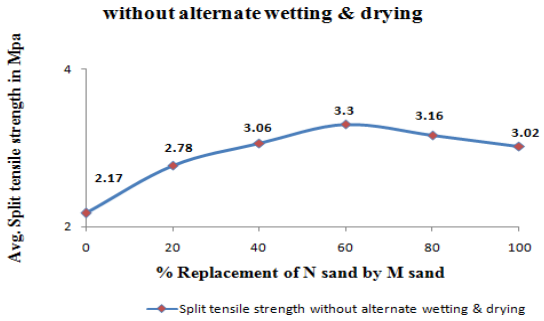

Fig.4 Variation of overall Split tensile strength of N sand by M sand without subjecting to alternate wetting and drying

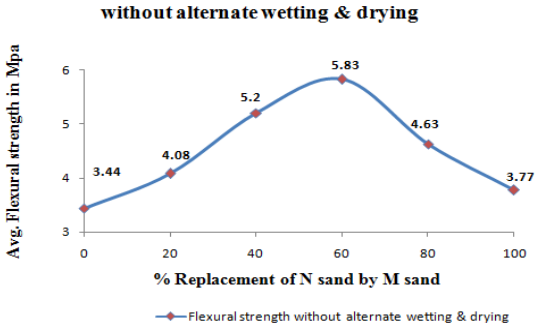

Fig.5 Variation of overall Flexural strength of N sand by M sand without subjecting to alternate wetting and drying

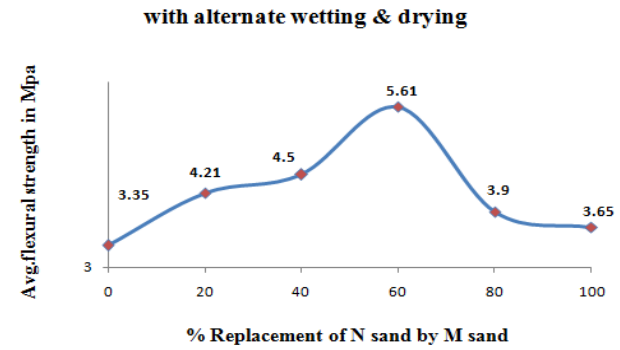

Fig.6 Variation of overall Flexural strength of N sand by M sand subjecting to alternate wetting and drying

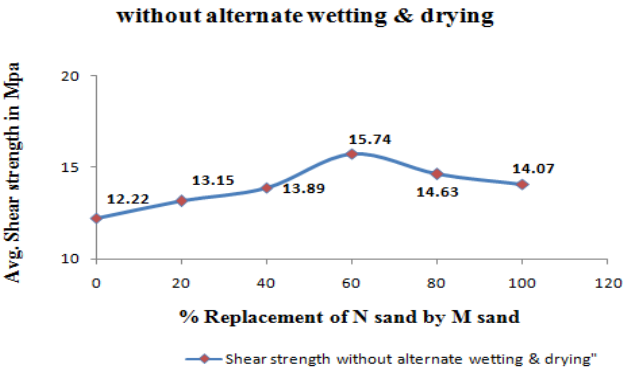

Fig.7 Variation of overall shear strength of N sand by M sand without subjecting to alternate wetting and drying

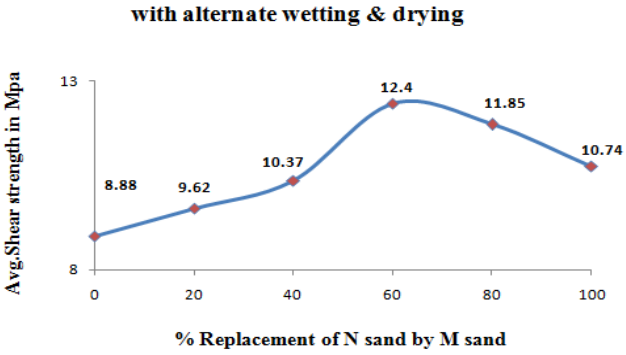

Fig.8 Variation of overall Shear strength of N sand by M sand subjecting to alternate wetting and drying

Conclusions

The following conclusions are derived from the results reported in the paper.

1) Compressive strength property of concrete gives higher strength at 60% substitution of natural sand by manufactured sand. After that 60% substitution strength went on decreasing when specimens were subjected without alternate wetting and drying.
2) Similar behaviour is seen when concrete is subjected to alternate wetting and drying. i.e At 60% substitution there is increase in compressive strength.
3) Split tensile strength of concrete gives higher strength at 60% substitution of N sand by M sand without subjecting to alternate wetting and drying. Similar behavior is observed when concrete is subjected to alternate wetting and drying for tensile strength.
4) Flexural strength property of concrete gives higher strength at 60% substitution of N sand without subjecting to alternate wetting and drying. For flexural strength of concrete subjected to alternate wetting and drying of concrete gave higher value at 60% substitution.
5) Shear strength of concrete gives higher strength at 60% substitution of N sand when concrete is not subjected to alternate wetting and drying.
6) Shear strength of concrete gives higher strength value at 60% substitution of N sand by M sand when it is subjected to alternate wetting and drying.

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