

“Use of M-Sand in Concrete Manufacturing, Mix Design & Quality expectations from the User Industry”

R.Padmanaban, Research Scholar, Anna University, Chennai
S.Ashik Ahamed, M.Tech (CEM), Chennai

ABSTRACT

Manufactured sand is one of the fine aggregate used in production of concrete as an alternate to natural river sand or any other sand used for construction. Manufactured sand differs from natural sand in its physical and mineralogical properties. The physical characteristic of M-Sand influences the workability, High concrete strength and durability of concrete. Even though the compressive strength and flexural strength of concrete made by M-sand exceeds that of made by natural sand, there must be a requirement of adequate and strict quality control in manufacturing process of M-Sand. Using M-Sand in concrete is most economical also. This paper presents use of M-Sand in concrete manufacturing, Mix design and quality expectations from the user industry.

KEY WORDS: *M-Sand, Workability, High concrete strength, Durability, depletion, Quality requirements,*

Date of Submission: 14-07-2020

Date of Acceptance: 29-07-2020

I. INTRODUCTION

The “Construction industry of India” is an important indicator of the development as it creates investment opportunities across various related sectors. It is the second largest industry next to agriculture and contributing a share of around 19 % to the national Gross domestic product (GDP). Now India is planning for a large scale of urbanization which requires large scale infrastructures like roads, highways, ports, railways, power and communication ect,. As we all know concrete is a construction material which is taking a major role interms of volume in these project construction. Around 45 % of the volume of concrete is being constituted by fine aggregate which represents 1. Natural sand 2. Crushed sand (Crushed stone sand or Crushed gravel sand) 3. Mixed sand or 4. Manufactured Sand.

II. M-SAND - MANUFACTURED SAND

Manufactured Sand is one of the “Fine aggregate” used in production of concrete, manufactured from other than natural sources, by processing materials, using thermal or other process such as separation, washing, crushing and scrubbing. Manufactured sand is generally produced by crushing the hard granite stones. It is of cubical in shape with grounded edges, washed and graded to as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm.

III. WHY MANUFACTURED SAND IS USED?

We used the natural sand mostly river sand alone as a fine aggregate in concrete over our last decades as the quality was so good, available in plenty and most economical on those days. But due to fast growing construction industry, the concrete production is increased tremendously, in turn the demand for fine aggregate is also been increased, causing deficiency of suitable river sand in most part of our country. Added to this the river sand mining causes more environmental issues mainly depletion of ground water, increased pollution and threat to the structures constructed in water bodies. So it is being banned by the government. So, in recent years, considerable emphasis has been made by the experts in the construction industry to use Manufactured Sand and commercially called as M-sand in the market. It has also been proved that Good quality M-sand can be used as an alternative construction material to River sand.

IV. M-SAND IN CONCRETE PRODUCTION & MIX DESIGN

Now a day the construction industry needs very good quality and strength of concrete depending on the structure. The quality of concrete mainly depends on the quality of input ingredients. So M-Sand also plays a vital role in the concrete production. Some of the basic parameters of concrete quality requirements are

4.1 Workability of Concrete

Workability is a property of raw or fresh concrete mixture which means the ease of placement and the concrete which can be placed and can be compacted easily without any segregation. Workability is a vital property of concrete and related with compaction as well as strength. Size, shape, texture play an important role in workability of concrete. A good quality control over the physical properties of manufacturing sand make the concrete with higher workability with less amount of water. The less use of water also helps in increasing the strength of concrete, less effort for mixing and placement of concrete, and thus increases productivity of construction activities at site.

4.2 Higher Concrete Strength

The quality of concrete is judged largely on the strength of that concrete. When we ask what affects the strength of concrete, the answer is just about everything. Among the various factors some of the important are, type, quality and amount of cement; quality, cleanness and grading of the aggregate; quality and amount of water. So again the physical properties of the manufactured sand such as gradation of fines, shape, smooth surface textures and consistency plays a vital role in getting a higher strength to the concrete by reducing segregation, bleeding, honeycombing, voids and capillary. A good quality Manufactured Sand helps the concrete by filling voids between coarse aggregates and makes concrete more compact and dense, thus increasing the strength of concrete.

4.3 Durability of Concrete

Durability of concrete may be defined as the ability of concrete to resist weathering action, chemical attack, and abrasion while maintaining its desired engineering properties. The durability of concrete is vital with regards to a structure's lifespan. One of the main factors affecting the durability of concrete is quality of fine aggregate in the concrete. A Manufactured sand (M-Sand) processed from selected quality of granite, with balanced physical and chemical properties will help in reducing permeability, moisture ingress, freeze-thaw effect thus increases the durability of concrete.

4.4 Reduction of Construction defects

Due to the excellent fineness and optimum initial and final setting time properties with M-Sand reduces the segregation, bleeding, honeycombing, voids and capillarity in concrete during placement and post-concreting. This will reduce the construction defects and help in obtaining good quality of concrete.

V. QUALITY REQUIREMENTS OF M-SAND

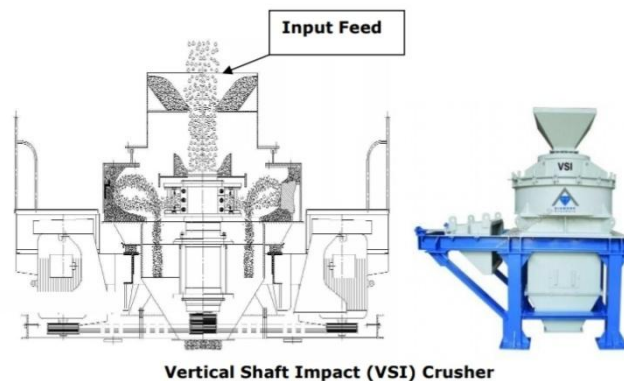
As the use of M-Sand in concrete production and its properties mainly depends on its quality only and hence a strict quality control procedures are to be maintained in manufacturing. The quality and property requirements are specified in Indian Standard code IS 383: 2016. Now Government of Tamilnadu also monitoring and controlling the M-Sand manufacturing within our state through Public Works Department (PWD) and they issued a guidelines vide “Technical Circular No. AEE / T10 / 57017, dated 12.07.2017 by the ENGINEER-IN-CHIEF (BUILDINGS).

VI. MANUFACTURING PROCESS OF M-SAND

The good quality of the final product of M-Sand depends on the raw materials quality and subsequent process that it goes. The secondary process carried out by vertical shaft impact (VSI) crusher will fetch a good physical properties to M-Sand. VSI crusher carries out a combined process of reducing coarse particles into finer particles and shaping the fine particles by removing the flaky and weak edges.



Manufacturing Process



VII. GENERAL REQUIREMENTS

- a) All the M -Sand particles should have higher crushing strength which mainly depends on quality of raw material.
- b) The surface texture of the particles should be smooth
- c) edges of the particles should be grounded
- d) There should not be any organic impurities
- e) Silt in M -Sand should not be more than 2%, for crushed sand
- f) The ratio of fines below 600 microns in M -Sand should not be less than 30%
- g) In M -Sand the permissible limit of fines below 75 microns shall not exceed 15%

VIII. QUALITY CHECKS ON M-SAND

1. Carrying out Simple field tests for certain parameters.
2. Testing at the Laboratories shall be in accordance with IS Bureau of Indian Standards.
3. Inspection of M-Sand production unit to ensure that the unit has the five stage processes established and practiced.

IX. FIELD TESTS ON M-SAND

Keeping in hand the Crushed Stone Sand taken from a heap and just by visual observation and rubbing it in between fingers, excess presence of quarry dust , flakiness ,gradation , texture of crushed stone sand etc., is verified and quality can be ensured based on the experience.

9.1 Shape test by visual observation

Particles retained on 4.75mm and 2.36 mm can be verified visually for the particle shape.

Additionally, an image taken with the help of Mobile camera that has resolution of 8 MP and more can be zoomed to verify the shape.



Testing of CS-Sand by “visual observation” and “rubbing with hand” to assess the presence of Quarry dust

X. LABORATORY TESTS ON M-SAND

M-Sand should adhere to the highest standards and must undergo the following quality tests

- 1) Sieve analysis
- 2) Cube test on compressive strength
- 3) Specific gravity & Water absorption
- 4) Bulk density (loose and compact)
- 5) Alkali aggregate reaction
- 6) Soundness
- 7) Deleterious materials & Organic Impurities
- 8) Micro fines content
- 9) Chloride and Sulphate Content
- 10) Petro graphical Analysis & Tests for Silt and clay

10.1 Particle Size Distribution by Sieve Analysis

Sieve Analysis can be carried out at site with the set of sieves as stipulated by BIS to find out the particle size distribution of M-Sand across various size fractions.

Particles less than 75 micron (Micro fines)

This test is done by “Wet Sieving” M-Sand sample through 75 micron sieve through which the presence of Micro fines can be measured. Though IS 383:2016 accepts 15% as upper limit for presence of Micro fines, according to Industry experts it is advisable to limit this upper value to 7%.



10.2 Cube test for compressive strength

After the use of M-Sand, to test the compressive strength of concrete, the specimen of required numbers of standard cube of (150 mm x 150 mm x 150 mm) have to be casted and cured in water and tested for 3, 7 and 28 days and test results should comply the stipulated requirements of Bureau Indian Standards.

XI. ADVANTAGES OF M-SAND OVER RIVER SAND

Any M-Sand manufactured with strict quality control process will have the following advantages

It is well graded in the required proportion.

It does not contain organic and soluble compound that affects the setting time and properties of cement, thus the required strength of concrete can be maintained.

It does not have the presence of impurities such as clay, dust and silt coatings, increase water requirement as in the case of river sand which impair bond between cement paste and aggregate. Thus, increased quality and durability of concrete.

XII. COMPARISION OF.RIVER SAND VS M-SAND

SIEVE ANALYSIS		River Sand Vs M-Sand	
IS SIEVE	RIVER SAND % Age Passing	M-SAND % Age Passing	% Age passing for single sized aggregates of Normal Sand (IS 383 - 1970) Zone II
4.75 mm	99.25	99.75	90 to 100
2.36 mm	93.50	78.25	75 to 100
1.18 mm	48.00	52.00	55 to 90
600 Microns	21.00	38.00	35 to 59
300 Microns	04.00	21.00	08 to 30
150 Microns	0.05	5.00	0 to 10

Comparison of Impurities - River Sand Vs M-Sand		
	RIVER SAND	M-SAND
Marine Products	2 - 4 %	Nil
Oversized Materials	6 - 10 %	Nil
Clay & Silt	5 - 20 %	Nil

Expectation of users

- 1) Adopting quality of M-Sand during manufacturing and Consistency in supply
- 2) Control over the supply rates

XIII. CONCLUSION

Considering, The Acute Shortage Of River Sand, Huge Short Coming On Quality Of River Sand, High Cost, And Environmental Effects, The Construction Industry Shall Start Using The Manufactured Sand To Full Extent As Alternative. Hence M-Sand is eco friendly.

M-Sand is more economical and cost effective in construction industry as it gives more workability, High strength and durability to the concrete with less pre and post concrete defects.

REFERENCES

- [1]. M.S. Shetty, Concrete Technology, (New Delhi, S. Chand & Company Ltd., 2012),
- [2]. IS: 383. Specification for Coarse and Fine aggregates from Natural Sources of Concrete. Bureau of Indian Standards. New Delhi, India; 1970.
- [3]. IS: 456. Code of practice for Plain and Reinforced Concrete (Fourth Revision). Bureau of Indian Standards. New Delhi, India; 2000.
- [4]. IS: 10262. Concrete Mix Proportioning – Guidelines. Bureau of Indian Standards. New Delhi, India; 2009.
- [5]. Public Works Department (PWD) and they issued a guidelines vide “Technical Circular No. AEE / T10 / 57017, dated 12.07.2017 by the ENGINEER-IN-CHIEF (BUILDINGS).
- [6]. Shanmugavadivu P.M., Malathy R. “A comparative study on Mechanical Properties of concrete with Manufactured Sand” International Journal of Technology World, Oct – Nov 200
- [7]. Vijayaraghavan Nimitha and Wayal A S 2014 Effects of manufactured sand on compressive strength and workability of concrete IJRET International Journal of Research in Engineering and Technology.
- [8]. Department of Mines And Geology, Govt. of Karnataka 2011 Effects of manufactured sand on compressive strength and workability of concrete CSIC Project:CP 6597/0505/11-330

R.Padmanaban, et. al. “Use of M-Sand in Concrete Manufacturing, Mix Design & Quality expectations from the User Industry.” *International Journal of Engineering Research And Development*, vol. 16(7), 2020, pp 18-23.