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Strength and Acid Effect Characteristics of Concrete Made with Sand Stone and Silica Fume

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ABSTRACT

Sand stone obtained from natural resources it the part of natural aggregate to replace part or whole of natural aggregate. The goal of this research is to determine the qualities of Sand stone and compare them to those of concrete made from natural aggregates. The mechanical and durability features of Sand stone concrete were investigated in this thesis. The study looked into concrete mixes with a water cementitious material ratio of 0.4. In this study, ordinary Portland Cement of Grade 43 was employed.The percentages of Sand stone aggregates that partially replaced natural aggregates by weight were 0%, 10%, 20%, 30%, 40%, and 50%. In laboratories, concrete cubes and cylinders were cast and tested. Mechanical characteristics tests such as the Compressive strength test and the Split tensile strength test were used to determine the optimal proportion of replacement.

Keywords: - sand stone, silica fume, design mix, compressive strength, split tensile strength, alkalinity test.

1. INTRODUCTION

Aggregates are the most important components of concrete, accounting for 60 percent to 80 percent of the total volume. The quality of aggregate has a significant impact on the properties of both fresh and hardened concrete, including long-term durability and crack resistance. Concrete's inhomogeneous structure is well understood to be a three-phase system made up of hardened cement paste, aggregate, and the contact between aggregate particles and cement paste. Stress concentrations arise around aggregate particles in the interfacial zone because to the comparatively substantial stiffness variations between aggregate and cured cement paste. As a result, the bond strength that keeps the stresses distributed at the interfacial zone has a big impact on the concrete composite's compressive strength. From an engineering standpoint, the most essential attribute of structural concrete is its strength.

2. LITERATURE REVIEWS

Kwan et al. (2012) carried out study on the durability properties of RCA by replacing natural aggregates (0% 15% 30% 60% 80%) with recycled ones. Lower the w/c ratio enables the RCA to achieve higher strength. Strain gauge was used to determine shrinkage and expansion with a precision of 0.001mm. The results indicate a decreasing trend in compressive strength with increase in RCA, but up to 30% replacement would be optimum level. It was found to be the 24hr's curing after casting, could prevent the shrinkage to a minimum level. The highest intrinsic permeability was observed to be at 80% RCA specimens at 7 days. The RCA is good in terms of UPV value and it generally achieves more than 4.0km/s at 56 days. It was observed to be that about 10% extra water is added to the mix to achieve the same slump. **Chandar et al. (2016)** study focuses on utilizing sandstone which is overburden waste rock in coal mines to use in concrete as a replacement of fine aggregate. Physical properties of sandstone like water absorption, moisture content, fineness modulus etc., were found to be similar to conventional fine aggregate. Scanning Electron Microscope (SEM) analysis was carried out for analysing elemental composition of sandstone. There was no sulphur content in sandstone which is a good sign to carry the replacement. Fine aggregate was replaced with sandstone at 25%, 50%, 75% and 100% by volume and moulds of concrete cubes and cylinders were prepared. Compressive strength of concrete cubes was tested after 3, 7 and 28 days and split tensile & flexural strength was determined after 28 days. The strength was found to be increasing marginally with increase in sandstone content. Fine aggregate that was replaced by 100% sandstone gave highest strength among all the replacements for the compressive, split tensile and flexural strengths. Though increase in strength was marginal, still sandstone can be an effective replacement for sand in order to save the natural resource and utilize the waste sandstone.

3. MATERIALS AND METHODOLOGY

3.1 Cement

Although all materials that go into concrete mix are essential, cement is very often the most important because it is usually the delicate link in the chain. The function of cement is first of all to bind the sand and stone together and second to fill up the voids in between sand and stone particles to form a compact mass. Although it constitutes only about 20 per cent of the volume of concrete mix, it is the active portion of binding medium and is

the only scientifically controlled ingredient of concrete. Any variation in its quantity affects the compressive strength of the concrete mix. In the present investigation, Ordinary Portland Cement (OPC) of 43 Grade was used for all concrete mixes.

3.2 Fine aggregate

IS: 383-1963 defines the fine aggregate as the aggregate most of which will pass 4.75mmIS sieve. The fine aggregate is usually termed as Sand. The sand is generally considered to have a lower size limit of 0.007 mm. usually natural sand is used as a fine aggregate. The sand used for the experimental work is locally available and conformed to grading zone III..

3.3 Course Aggregate

The aggregate is the matrix or principal structure consisting of relatively inert and coarse particles. The coarse aggregate is used primarily for the purpose of providing bulk to the concrete. The most important function of fine aggregates is to assist in producing a workable and a uniform concrete mix. The fine aggregate also assists the cement paste to hold the coarse aggregate particles in suspension. This action promotes plasticity in the concrete mix and prevents segregation of the paste and coarse aggregates during its transportation. The aggregates provide about 75 per cent of the body of concrete and hence their influence is extremely important. The properties of these particles greatly affect the performance of concrete.

3.4 Sand stone

Concrete wastes of material testing laboratory was used as a coarse aggregates. Both natural and sand stone aggregates followed the same grading and the same is shown in Table 3.1

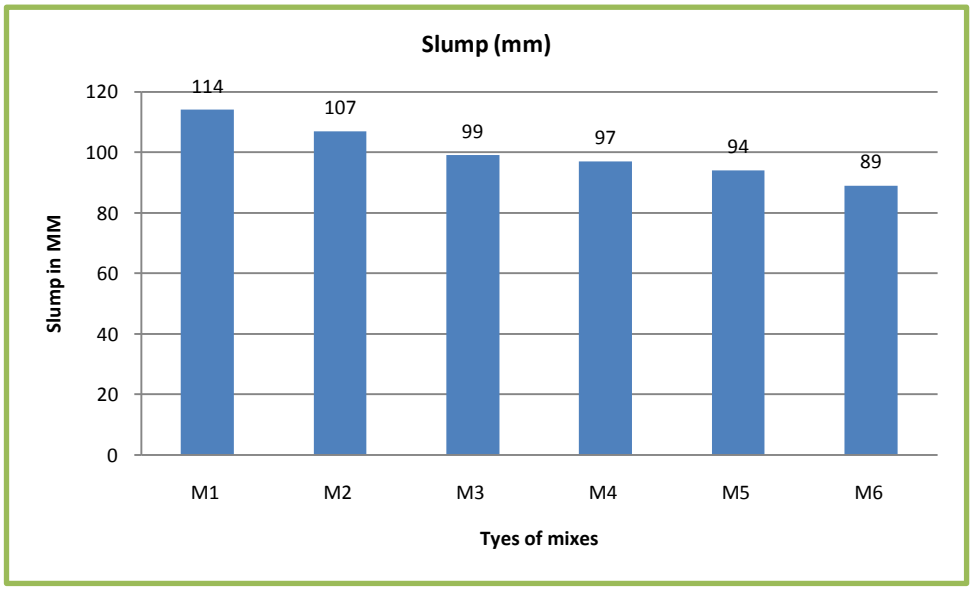
3.5 Silica fume

The terms of micro silica, condensed silica fume, and silica fume are often used to describe by-products extracted from the exhaust gases of ferrosilicon, silicon. And other metal alloy smelting furnaces. However, the terms of silica fume and micro silica are used for those condensed silica fumes that are of high quality for using in the cement and concrete industry. In the European standard, the term of silica fume has been used

4. RESULT AND DISCUSSIONS

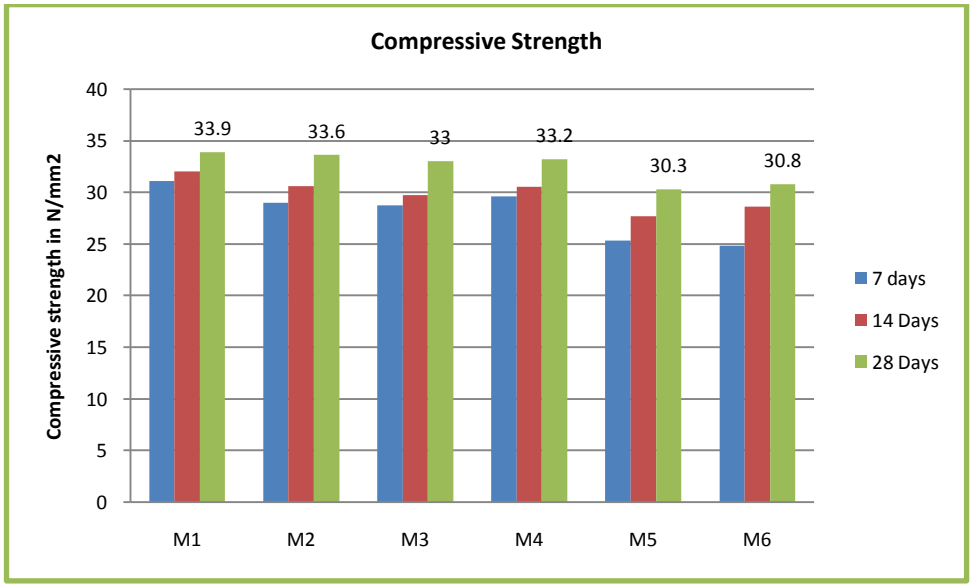
4.1 Slump test

Slump test is the most commonly used method of measuring consistency of concrete Slump test was carried out on all the concrete mixes in the concrete laboratory. This test was very useful in detecting variation in the uniformity of a mix of given proportions. It also gives an idea of Water cement ratio to be used for different mixes. Fresh unsupported concrete flows to and sinking in the height takes place. This vertical settlement is known as Slump. Concrete is said to be workable if it can be easily mixed, compacted and easily finished. The results of all slump values of all mixes are shown below.



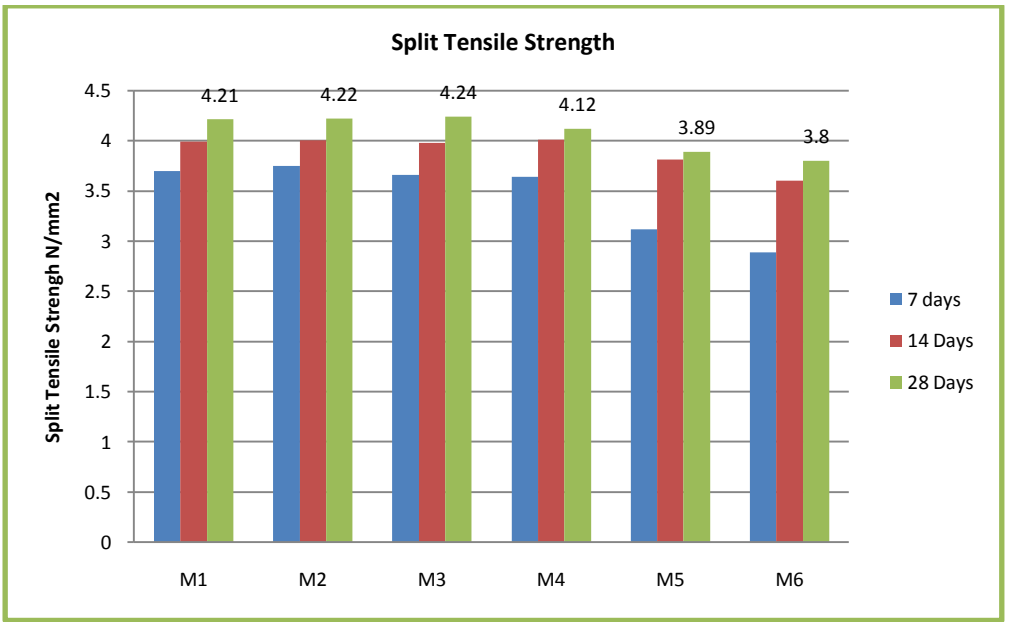
4.2 Compressive strength

Cubes of sizes 150 x 150 x 150 mm were cast for strength testing. These cubes were cured for 28 days and tested in Compression testing machine having a capacity of 200 T. The specimens were allowed to dry in sunlight for 1 day and are placed centrally in testing machine and load was applied continuously, uniformly and without any shock.



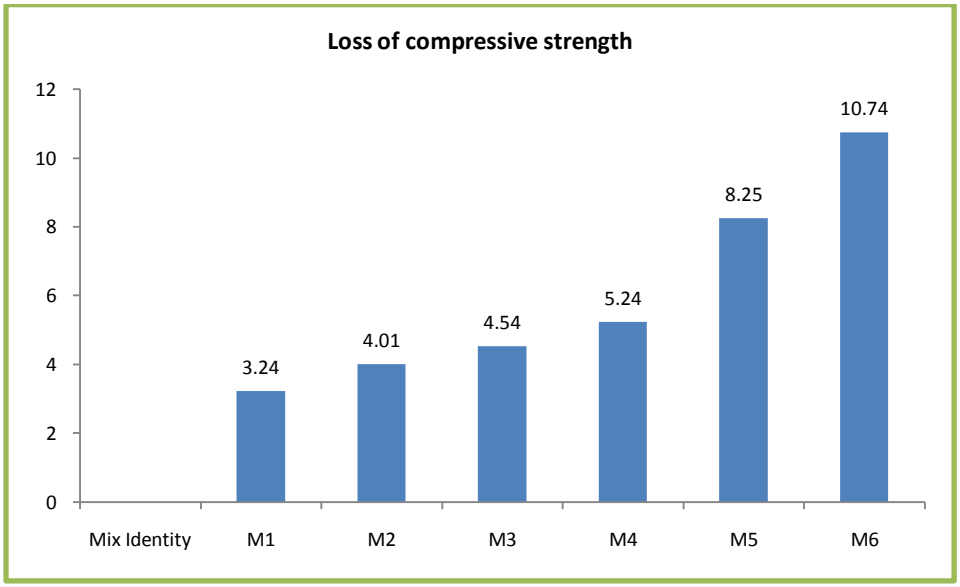
4.3 Tensile Strength

Cylinder of size 300×100mm were cast and cured for 28 days. After curing age the cubes were allowed to dry in the sunlight for 1 day and were tested under strength testing machine by placing the cubes diagonally in the centre. The load was increased until the specimen fails.



4.4 Alkalinity test Resistance

For alkalinity test 5% sodium hydroxide (NaOH) by volume of the water with pH value of 12 was maintained. Cubes were immersed in the above solution for a period of 28 days. It was observed that the weight of specimens increased when kept in solution after 28 days curing.



5. CONCLUSIONS

1 It is possible to gain the same compression and split tensile strength as conventional concrete up to 30% replacement of natural aggregate with sand stone ones. But from the overall study, both the compression and split tensile strength values are decreasing with the increase in replacement levels of sand stone aggregates

2 The increase of sand stone aggregates content beyond 30% has negative effect on compressive strength of sand stone aggregates concrete. The reduction in compressive strength after 28 days is about 10% when 50% sand stone aggregates are used.

3 Split Tensile results also show down trend like compressive strength beyond 30% replacement of sand stone aggregates.

4 The pores filling capacity of silica fume enhances the both mechanical and durability properties of sand stone aggregates concrete. The use of silica fumes as a partial replacement of cement decrease the water absorption of sand stone aggregate concrete.

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