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UTILIZATION OF SILICA FUME AND WATSTE RUBBER TYRE AS COARSE AGGREGATES IN M30 GRADE CONCRETE

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Abstract: A very large amount of waste rubber tire are being generated each year all around the world. Being non biodegradable in nature their recycling is not easy. On burning they produce very toxic and harmful smoke. So the only option is to dump them to landfills. It is also not a proper solution as it takes a lot of space and stockpiles of waste rubber leads to soil pollution and contaminate water bodies along with ground water. Statistics show that every year more than 500 million tires are discarded to landfills, and the estimation is about 5000 million tires would be discarded by 2030. Many research studies has shown that the waste rubber tires could be used in concrete. Concrete with rubber tire has shown reduction in compressive and flexural tensile strength but they do possess some positive aspects as they have better toughness, impact resistance, thermal and sound properties.

The main objectives of this study is to investigate the strength properties of M30 grade concrete by replacing cement with silica fume and rubber tyre aggregates (RTA). The percentage of silica fume and rubber tyre used as 0%SF+0%RT, 5%SF+10%RTA, 10%SF+20%RTA, 15%SF+30%RTA, 20%SF+40%RTA.

Key Index: Bayer process, red mud, hydrated lime, strength, pozzolanic.

1. INTRODUCTION

The recent growth of automobile industry and use of vehicles has increased the production of tires all through the world. This has lead to large accumulation of used tires. The major problem of these tires is their disposal. Million of tires are discarded each year causing environmental risk to pollution. It is estimated that each year about 1000 million tires end their service life and more than 500 million among them are discarded to landfills. A future estimation is that the number of waste tire discarded yearly would reach 1200 million. And there could be as many as 5000 million of stockpiled discarded tire throughout the world. In 2008, the global production of waste tire was about one billion and production of new tires was about 1.5 billion. Rubber Manufacturer's Association in one of their statement say that every year about 75 million of waste tires are stockpiled in US itself and more than 230 million are produced. In India also there would be about 112 million of discarded tire per year after retreading twice. These waste tires are non-biodegradable in nature and on burning produces very harmful and toxic gases dangerous to health. So, a maximum amount of these waste tires are thrown to landfills causing very adverse effect on environment.

A very small amount of rubber from the tire gets abraded after its whole service life, this means that a whole of rubber is discarded. Their disposal in landfill also has some adverse effect on nature. Along with occupying a very large space in a landfill their decomposition also creates a variety of issues making it unfeasible to decompose. Waste tire rubber own shape allows it to store water for a long period causing a breeding place for mosquitoes and other insects. It also causes contamination of underground water and above ground water and also spoils the fertility of soil by destroying many beneficial bacteria present in soil. [Wikipedia] Research in the past has shown that these waste tire rubbers could be used in concrete. In literatures, the term "Rubberized Concrete" or "Rubber Modified Concrete" is used for concrete made with mixing waste tire rubber particles into plain concrete.

For the current study the the workability, strength of M30 grade concrete containing silica fume and rubber tyre aggregates. To compare the test results with conventional mix concrete. To determine the concrete strength values for different percentages of silica fume and rubber tyre aggregates. Determine compressive strength, split tensile strength and flexural strength of concrete

2. LITERATURE STUDIES

Karthikeya Rao.U1 and G.Senthil Kumar The broad aim of this work was to investigate the effects of partially replaced Ordinary Portland Cement (OPC) by ground granulated blast furnace slag (GGBS) and Nano Alumina (Al_2O_3) on the concrete. The optimum percentage of GGBS replacement was found to be 50%. Nano Alumina particles of average diameter 15nm were used in different percentages such as 0.5%, 1.0%, 1.5%, 2.0% by volume of cement. Strength parameters have been studied through compressive strength, split tensile strength and flexural strength on concrete specimens

Ehsan Mohseni and Konstantinos Daniel Tsavdaridis In this study the effect of pore structure on the mechanical properties and durability characteristics of Self-Compacting Mortars (SCM) containing nano-Al_2O_3 (NA) and class F fly ash are investigated. Al_2O_3 nanoparticles with the maximum size of 15 nm in three different proportions of 1, 3 and 5% of the binder content were utilized to partially replace the cement. The 25% of the cement weight was also replaced by class F fly ash. The pore structure of cement mortars was determined through the Mercury Intrusion Porosimetry (MIP) and Gas Adsorption (BET) methods.

Jitendra Patil, Dr. Umesh Pendharkar In this paper, the significance of nonmaterial for construction industry is emphasized and reviews of recent developments and present state of the application of nano alumina, nano titanium dioxide, nano zinc oxide and nano-silica for sustainable development of concrete industry. From this study it was concluded that Compressive strength of Nanoconcrete by using nano Alumina as cement replacement 10 % is reduced by 52.52 % for 7 days samples as compare to normal concrete.

3. METHODOLOGY

The fresh properties of concrete like slump cone test and compaction factor test was studied. Hardened properties of concrete like compressive, split tractable, flexural quality was determined. The rate substitution of silica fume and rubber aggregates as 0%+0%, 5%+10%, 10%+20%, 15%+30%, 20%+40%, 40% the comparison of results for concrete using silica fume and rubber tyre aggregates.

A. Physical properties of research materials

For this study the physical properties of research materials like cement, fine aggregates, coarse aggregates and red mud material were conducted in order to get IS a code specification.

B. Mix design

For this study a mix design was prepared based on the physical properties of research materials for M30 grade concrete.

Final trial mix for M30 grade concrete is 1:1.62:2.7186 at w/c of 0.50

C. Batching of materials

Batching is the process of measuring the quantity of materials for this study weight batching is made for all materials for mixing of concrete.

D. Mixing of concrete

With the help of measured quantities of materials we need to mix concrete trials for checking the workability, for casting the specimens.

E. Casting of specimens

For this research specimen of cubes, cylinders, prisms were casted to study the strength properties. Generally cube specimen of 150mmX150mmX150mm, cylinder specimen of 150mm dia and 300mm length and prism specimen of 150mmX150mmX70mm was taken. The specimens were casted with compaction method for the cube, cylinder and prism specimens we need to compact concrete by 3 layers each layer was compacted with 25 number of blows after compaction process id done we need to finish the concrete specimens with cement mortar.

F. Curing of specimens

After casting of cubes we need to demould the specimens and immerse those specimens in curing tank. The curing process is carried out for 7 days and 28 days for with and without hydrated lime case.

G. Strength of concrete

After curing of concrete specimens we need to check the strength of concrete like compressive, split tensile and flexural strength for M30 grade concrete.

4.RESULTS AND ANALYSIS

Slump cone test

The slump cone test is the one of the most important property of concrete it is generally measured in mm. It is the concrete drop from initial position to final position.

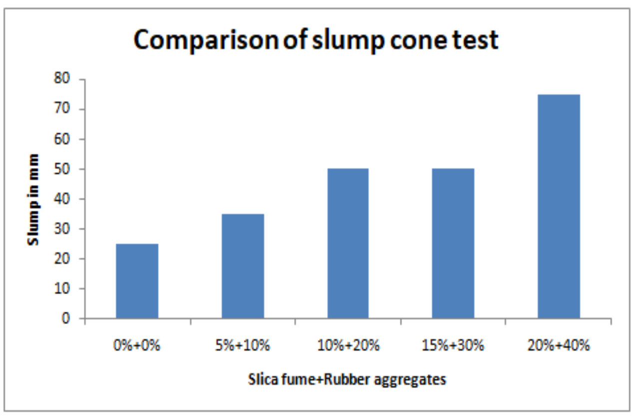

Fig 1 Comparison of slump cone test

Compaction factor test

The value of compaction factor is the ration of partial compaction concrete weight to the ration of full compaction concrete weight.

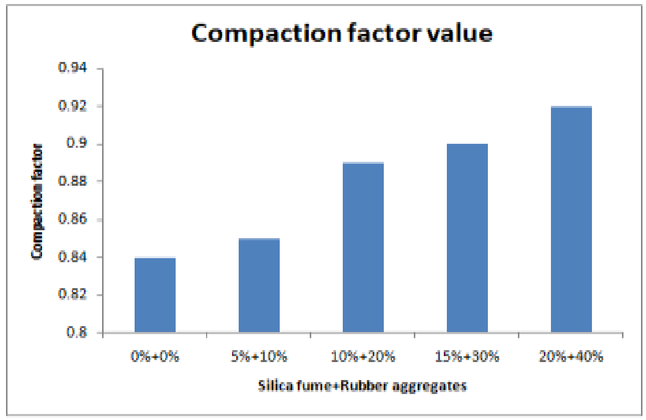

Fig 2 Comparison of compaction factor test

Compressive strength of concrete

In this test the blocks were casted of measurements 150mm× 150mm × 150mm and checked for compressive strength at curing of 7 and 28 days. 3D squares were casted with expanding level of silica fume and rubber aggregates

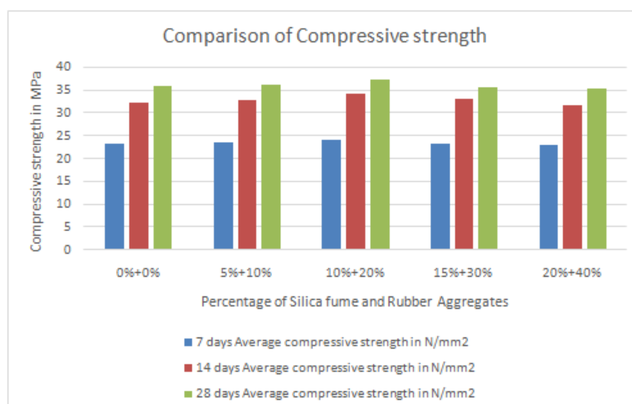

Fig 3 Comparison of compressive strength without hydrated lime

Split tensile strength

The concretes compatibility to face up to the pulling force (Tensile Stress) without breaking is referred to as the Tensile Strength of concrete. Its unit is

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(N/Sqmm or Mpa). The tensile strength = ($2P/\pi dl$) N/mm2. The split check became carried out on cylinders with dimensions 300mm peak and 150mm diameter.

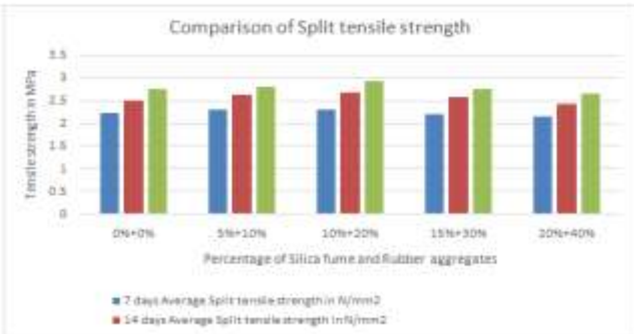

Fig 4: Split tensile strength without hydrated lime

Flexural strength of concrete

The Flexural strength is an important property of concrete it is also called as modulus of rupture. It is the maximum amount of stress just before the rupture of concrete. For this test square prisms of 100mm×100mm×700mm were used to test on universal testing machine.

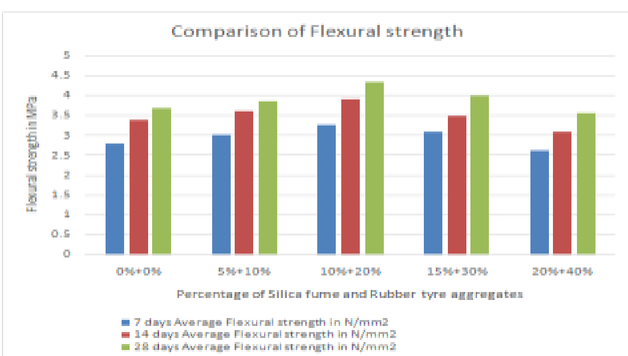

Fig 5: Flexural strength

5. CONCLUSION

Eco friendly, Green Concrete has been promoted worldwide to encourage Sustainable Development in the field of Construction where huge amount of concreting works are carried out. Utilizing silica fume and rubber waste as a partial replacement for Cement and coarse aggregates provides a significant role in its disposal due to its adversarial effects. When investigated for partial replacement the following highlights were noted:

1. From the observations, it is noted that unit weight of beam and cylindrical specimen's has been reduced upto increasing the percentage of chipped rubber into concrete. From this test it has to be concluded that rubberized concrete is used in the light weight structures and restricted to the structural application.
2. Silica fume and rubber aggregates concrete has been highly effective in increasing the workability of the fresh concrete easing the placement of concrete.
3. A gradual increase in the workability was promisingly observed in Slump Cone and Compaction Factor Test.
4. For Compressive strength the optimum replacement of cement were observed for 10%silica fume+20% rubber aggregates. Further increase in Silica fume and rubber aggregates reduced the Compressive Strength.
5. For Split Tensile strength and Flexural Strength the optimum replacement of cement were observed for 5%silica fume+20% rubber aggregates mix. Further increase in Silica fume and rubber aggregates showed a gradual drop.

Upon careful examination, a suitable proportion where optimum results in strength characteristics were obtained at 5%silica fume+20% rubber aggregates mix. Further investigation over Silica fume and rubber aggregates with extensive chemical characteristics could be tested for replacement in cement with higher proportion.

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