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Effects of Mechanical Properties of Concrete with TiO_2 and Ggbs

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ABSTRACT: Concrete is the abundant man made material in the world. The quantity of Co_2 emission through the industrialized of OPC is almost one ton. The Co_2 emission is approximately 7% of the worlds Co_2 emission. In order to decrease the Co_2 emission and create the sustainable environment we have to develop greener building material. In this the $TiO_2$and GGBS is use in cement on mixing of concrete. In this TiO_2 go about as a self cleaning material and the solid with expansion of TiO_2 is 1% by mass of the concrete dependent on the past tasks are finished by the scientists and GGBS with 5%, 10% and 15% by mass of cement was prepared. In this research hardened tests are Compressive, Flexural, Split Tensile strength tests of concrete observations mixed with TiO_2 and GGBS for optimum content was considered.

KEYWORDS: Titanium dioxide, GGBS, Compressive, Flexural, Split Tensile strength

I. INTRODUCTION

Concrete is the most usable abundant material on the earth for infrastructure development. It is used in construction industry for buildings, roadways, dams, bridges and for developing infrastructure of a country. Generally normal concrete or conventional concrete is made up of cement, water and aggregates. But a modern concrete consist of two more components in addition to the above four components [1]. Mineral admixtures are the kind of materials which goes into the concrete and sometimes even in cement manufacturing like fly ash, silica fume, rice husk ash and other pozzolans or other similar materials. In the present study the admixture which is used is GGBS and the chemical compound TiO_2. Now days the GGBS is mostly common used material in concrete [2].The utilization of photograph reactant building materials to decrease barometrical contaminations, which negatively affect health, especially among kids and the old, is getting progressively vital. Vehicular traffic outflows and contaminants brought about by lodging and industry are the primary wellsprings of barometrical contamination in thick urban zones[3].

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Photo catalytic substances incorporates nano titanium dioxide (TiO2), with the nearness of UV light (daylight), can quicken the photograph reactant process through the decay of natural and inorganic materials, for example, air contaminations including NOx, SOx, and volatile organic compounds (VOCs)[4].

II. LITERATURE REVIEW

Shihui Shen (2012)[1] their study has utilizing TiO2 to asphalts would perhaps upgrade the end of emanations at street level. Dislike customary non-pervious asphalts, the unnecessary porosity and surface harshness of pervious solid asphalt grant more TiO2 particles to have direct contact with UV lighting and subsequently improve disposal execution. When DPM coatings were looked at changed TiO2 on focuses (5%, 10%, 15%, and 18% TiO2), each of the four fixations had comparable outcomes for NO decrease, keeping up somewhere in the range of 94% and 98% static NO% decrease. This shows the DPM covering can even now function admirably with lower measures of TiO2. The effect of the TiO2 to the surface and contact properties of the asphalt should be contemplated.

Decheng Feng (2013)[2] has been explored by means of trial concentrates on the mechanical properties and microstructure of the concrete glues containing TiO2 nanoparticles. The research center testing demonstrated that the 28-day 3-point twist quality of the concrete glue with a water/concrete proportion of 0.4 improved regarding 0.1%, 0.5%, 1.0%, and 1.5% TiO2 nanoparticles by methods for mass of concrete had been incorporated. Such overhauls inside the mechanical properties can be credited to advancement of the glue microstructure by method of the expansion of a little amount (1.0%by methods for mass) of TiO2 nanoparticles and accomplishment of attractive scattering, nano change expanded the amount of cementitious portion inside the glue, diminished the small scale porosity and amount of interior miniaturized scale splits and imperfections, obtained a denser microstructure with decreased nano harshness, and prompted the development of needle-formed nano accelerates.

Jitendra Patil (2016)[3] have studied that the compressive strength of Nano particles such as Alumina, Silica and Titania are reduced when compared to the normal concrete. The compressive strength of Titania is reduced by 63.31% for 7 days and 42.85% for 14 days. As the compressive strength of concrete and cement by using Nano products is not achieved up to the desired degree although workability is achieved up to some extent also the Nano products are not easily available in market at present, So the other alternatives which are easily available are preferable as compare to Nano products, in case 10 % replacement of cement is adopted.

Nano Products used are costlier than other additives and admixtures, so use of Nano product increases the overall cost of the project.

B.Mangamma (2016)[4] has carried out experiments on GGBS. It gives good strength when compared to normal mix Partial replacement of GGBS decrease the environmental pollution such as ground pollution, water pollution etc. Partial replacements of GGBS increase the strengths at 10%, 20%, 30% as well as reduce the strength at 40%, 50%. It also reduces the cost of construction.

III. MATERIALS USED

1. Cement: Cement is used as a binding material in concrete. In this research we preferred Zuari Cement Company of 53 grade of cement is used.

2. Aggregates: Basically aggregates are very important to the concrete without aggregates concrete can't be formed. Aggregates are classified into two types

A) Fine Aggregates

B) Coarse Aggregates

a. Fine aggregates: Aggregates which are passing through the 4.75mm sieve is defined as fine aggregate. River sand is the most regularly used fine aggregate in the concrete. In addition, crushed rock fines can be used as fine aggregate. In this research we are preferred River sand for the good finishing and to fill the voids between the coarse aggregate.

b. Coarse Aggregates: Aggregates which are retained on 4.75 mm sieve is defined as coarse aggregate. Frequently, the size of coarse aggregate is from 5 to 150 mm. For normal concrete which is used for structural members including beams and columns, the maximum size of coarse aggregate is about 25 mm. In this research we preferred the 20mm size of coarse aggregate is used.

3. Titanium Dioxide: The principle reason TiO2 was stacked with cementitious materials on the grounds that solitary water, oxygen and sun based light required for photograph catalysis response. Also, TiO2 is a photograph impetus that can separate practically any natural compound with the nearness of daylight. On the off chance that any earth present on a superficial level, the water will infiltrates under the soil and expels it. The specific gravity of TiO2 is 3.7.

4. **GGBS:** GGBS is a mineral admixture which has the synthetic segments like that of Portland concrete. Because of hydraulicity, accordingly, it contributes improvement of solid execution, yet in addition in asset and vitality reserve funds. The specific gravity of GGBS is 2.9.

IV. IV.EXPERIMENTAL PROGRAM

a. Mix Proportions: In the present investigation **M30** concrete is prepared with the water cement ratio **0.5**. Concrete mixes are prepared by different proportions of cement replacing with TiO_2 (1%) and GGBS (0%, 5%, 10% and 15%). i.e. the percentages with different combinations of 1% TiO_2 with 0% GGBS, 1% TiO_2 with 5% GGBS, 1% TiO_2 with 10% GGBS and 1%TiO_2 with 15% GGBS along with normal concrete without TiO_2 and GGBS. The mix designations are follows:

1. CM refers to the Control Mix

2. G_0T_1 refers to 1% TiO_2 and 0% GGBS

3. G_5T_1 refers to 1% TiO_2 and 5% GGBS

4. $G_{10}T_1$ refers to 1% TiO_2 and 10% GGBS

5. $G_{15}T_1$ refers to 1% TiO_2 and 15% GGBS

b. Casting of Specimens: After mix proportions next we can do casting the concrete the cube dimensions is 150X150X150mm and height of the cylinder is 300mm and diameter of the cylinder is 150mm and for beam dimensions is 150X150X700mm for7,14,28 days casting of concrete specimens are required.

c. Mix Proportions:

Mix Proportions for M30 Control Mix concrete.

Table 1: Mix Proportions of Concrete

Material	Quantity
Cement	363.16 Kg/m^3
F.A	730.45 Kg/m^3
C.A	1104.05 Kg/m^3
Water	181.58it/m^3

V. EXPERIMENTAL RESULTS

A. Compressive strength: The compressive strength of concrete with different proportions are increased up to 1%TiO_2 and 10% GGBS concrete, then it is decreased for 1% TiO_2 and 15% GGBS.

The concrete with TiO_2 (G_0T_1) of compressive strength is decreased by 10.61%, 6.96% and 4.65% with respect to normal OPC Concrete (CM) in 7 days, 14 days and 28 days. When compared with normal OPC concrete, the compressive strength is decreased by 28.32%, 16.16% and 7.79% for 1% TiO_2 + 5% GGBS (G_5T_1) in 7, 14 and 28 days respectively. It is decreased by 28.1% in 7 days, 11.04% in 14 days and increased by 0.42% in 28 days for 1% TiO_2 + 10% GGBS ($G_{10}T_1$). It is decreased by 31.65% for 7 days, 8.28% for 14 days and 7.30% for 28 days for 1% TiO_2 + 15% GGBS ($G_{15}T_1$). When compared with normal concrete (CM) the compressive strength is decreased while adding with TiO_2 and GGBS in concrete with respect to these curing days. The test results of the concrete with different proportions are listed in above table. The comparison of conventional OPC concrete (CM) and concrete with TiO_2 and GGBS are represented in below chart.

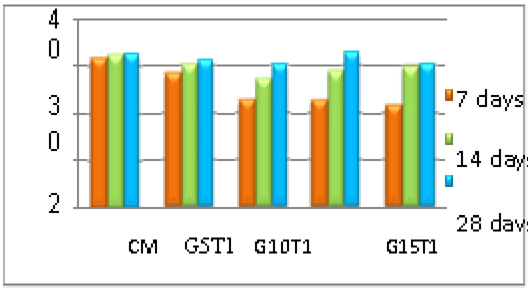

Fig.1: Compressive Strength test

B. Split Tensile Strength:

The Split tensile strength of the concrete is increases up to $G_{15}T_1$ from CM. The split tensile strength of OPC Concrete (CM) is more compared to the all mix combinations of the concrete G_0T_1, G_5T_1, $G_{10}T_1$ and $G_{15}T_1$.

The tensile strength decreases by 0.35% for 7 days, 13.37% for 14 days and 10.10% for 28 days for concrete with 1% TiO_2 (G_0T_1) when compared with conventional OPC concrete (CM).

When compared with Conventional OPC concrete, the tensile strength of concrete is decreased while adding GGBS to the concrete, by 6.32% in 7 days, 17.15% in 14 days, 3.88% in 28 days for 1% TiO_2 + 5% GGBS (G_5T_1), Decreased by 3.86% for 7 days, 14.82% for 14 days, 0.26% for 28 days for 1% TiO_2 + 10% GGBS ($G_{10}T_1$), Decreased by 14.03% in 7 days, 24.71% in 14 days and 18.65% in 28 days for 1% TiO_2 + 15% GGBS ($G_{15}T_1$), while adding GGBS to the concrete the tensile strength decreases in these curing days. The maximum strength is obtained at $G_{10}T_1$ among the concrete with GGBS. The graphical representation of the tensile strength of concrete is shown in below chart.

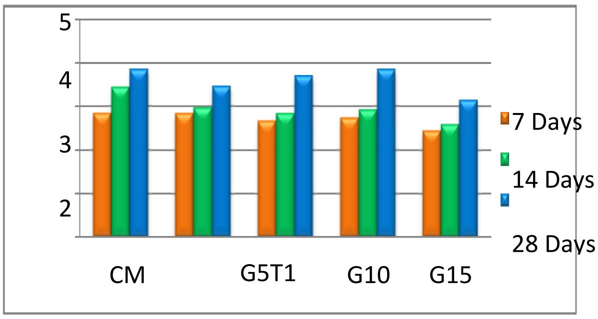

Fig.2: Split tensile Strength test

C. Flexural Strength: The Flexural strength of M_{30} grade concrete mixes replacing OPC by TiO_2 and GGBS at 0%, 5%, 10% and 15% is investigated. The tabular column represents the flexural strength at 28 days results CM, G_0T_1, G_5T_1, $G_{10}T_1$ and $G_{15}T_1$ concrete mixtures tested for 28 days.

The bending strength of concrete is more in 1% TiO_2 and 10 % GGBS concrete when compared with all mix proportions. The bending strength of concrete is more for 1% TiO_2 + 10% GGBS ($G_{10}T_1$) increases by 25.73% compared to normal concrete (CM). 10.49% increases for 1% TiO_2 + 0% GGBS (G_0T_1), 3.28% decreases for 1% TiO_2 + 5% GGBS (G_5T_1), 3.68% increases for 1% TiO_2 + 15 % GGBS ($G_{15}T_1$) concrete while compare with normal concrete. The strength of concrete is less in 1% TiO2 and 5% GGBS concrete while compared with normal conventional OPC concrete.

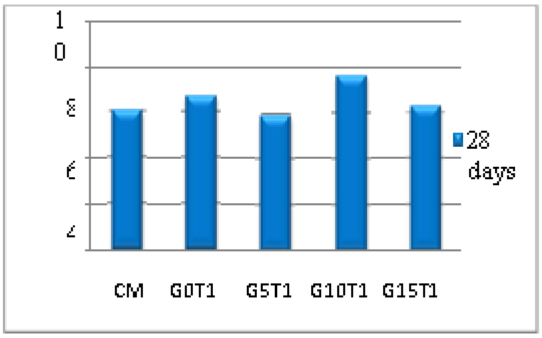

Fig.3: Flexural Strength test

VI. CONCLUSION

- The present research is concluded that photo catalytic component of TiO_2 and GGBS in the form of nano particles by replacing in the concrete as various propotions. An effect of Tio2 and GGBS of concrete defined as width decrease in workability and minor amount of strength decrease in compression Test.
- The compressive strength of concrete with Ti_{O2} is decreased while compared with the conventional OPC concrete. The compressive strength of concrete is decreased while adding GGBS up to 10% of concrete.
- The compressive strength of concrete with 10% GGBS and 1% TiO_2 is increased and is optimum when compared to all the mix proportions. The compressive strength of concrete with 15% GGBS and 1% TiO_2 is decreased.
- The Tensile strength of conventional OPC concrete is more compared with the all proportions. By adding TiO_2 to the conventional concrete the Spit tensile strength is reduced and then adding GGBS 5%, 10%, 15% the split tensile strength is decreased up to 10% of concrete.
- The Tensile strength of the concrete with 1% TiO_2+10% GGBS is more compared with all proportions of the concrete including conventional OPC concrete.
- The flexural strength is 1% TiO_2 is slightly increased by adding in conventional OPC concrete without GGBS. By adding 5%, 10%, 15% GGBS and TiO_2, the bending strength is increased up to 10% GGBS + 1% TiO_2, then it is decreased.

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