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"PREPARATION OF CONCRETE BY PARTIAL REPLACEMENT OF COARSE AGGREGATE WITH GOLD MINE WASTE"

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ABSTRACT

Coarse aggregate is becoming scarce and meeting the demand of coarse aggregates in the construction industry is becoming a challenging task. In this investigation an attempt is made to utilize gold ore tailings as a partial substitute for Coarse aggregate in producing concrete. Coarse aggregate is replaced with 5%, 10%, 15%, 20% and 25% gold ore tailings and the resulting coarse aggregates were used in concrete mix and it is compared with conventional concrete. Mix proportions for M20 concrete were obtained for five mixes as per guidelines given in IS: 10262-2009. The parameters like Workability, compressive strength were recorded. The strengths were obtained at the ages of 3, 7 and 28 days. Compressive strength increased marginally for 5% to 15% replacement. There is a slight decrease in the corresponding compressive strength at 20% replacement. Good correlation was observed between compressive strength. It was observed that the addition of gold ore tailings that would replace the coarse material at particular proportion has displayed an enhancing effect on mechanical properties of concrete. This investigation proves that gold ore tailings can be used as a partial substitute for coarse aggregate in preparing concrete.

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KEY WORDS: Gold mine tailings, partial replacement, coarse aggregate, Gold mine waste.

INTRODUCTION

Large volumes of natural resources are consumed annually to meet the demand of construction industry. It is estimated that consumption of cement will increase by 166% at the end of 2020. This leads to large consumption of fine and coarse aggregates. Meeting the demand for fine aggregates in its natural form without exploiting the natural resources is a challenging task. Large quantity of industrial waste is generated annually. Concrete is widely used material in the world. Based on the global usage, it is placed at second position after water. Concrete's versatility, durability, sustainability, and economy have made it the world's most widely used construction material. About four tons of concrete are produced per person per year worldwide and about 500 Goldmine ion tons of Concrete is required for a year in India. The term concrete refers to a mixture of aggregates, usually sand, and either gravel or crushed stone, held together by a binder of cement paste. The paste is typically made up of Portland cement and water and may also contain supplementary cementing materials, such as fly ash or slag cement, and chemical admixtures. Fine aggregates are the essential component of concrete. Fine and coarse aggregates are becoming scarce and meeting the demand of aggregates in the construction industry is becoming a challenging task.

Gold mines Crushed Black stones are one of the primary waste products of mining operations of Hatti Goldmines Limited. They comprise of Stone chips and dust of the parent rock from which the ore is extracted. The characteristics of Gold mines Crushed Blackstone depend upon the composition of parent rock. The disposal of this material is a major environmental problem for the mining industry. Among the 960 Goldmine ion tons of solid waste generated annually in India, nearly 290 Goldmine ion tons are inorganic wastes of industrial and mining sectors. The gold mining industry at Hatti village in Raichur district of Karnataka is producing abundant quantity of tailings and Crushed Blackstone which is un-utilized for several years, for extraction of 1 gram of gold, 1 ton of waste material is generated; Annually Hatti goldmines limited is generating nearly 2000 tons of waste daily containing tailing and crushed Blackstone. There is no vegetation on dumps, which leads to release of fine particles into the atmosphere due to wind erosion. The tailings and Crushed Blackstone have affected the landscape and topography of the area as well. Hence, it is essential to find some way to

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use the Gold mine wastes.

In this investigation an attempt is made to utilize Gold mines Crushed Blackstone as a substitute for coarse aggregates in producing concrete. The acceptability of utilizing goldmine tailings as a substitute to sand in concrete production was found to be satisfactory on the basis of compressive strength and durability. The evaluation was based on parameters such as physical properties of materials, workability, compressive strength, flexural strength and durability. A Hatti goldmine is in the nearby locality of Raichur, black stone is available in large quantity. About 70% of gold mine tailings are coarser than 75 micron size and 63% of this material belongs to fine sand category. Chemical composition of gold mine tailings shows that the major constituent is silica. Due to presence of silica content, the goldmine waste in different industrial application ensures environmental sustainability and economic benefits. The presence of cyanide contain in goldmine waste is very less. Thus, goldmine tailing is safe as construction material. The workability of concrete in terms of both slump and compaction factor for concrete containing gold mine tailings alone is very low, which can be attributed by the presence very fine particles. Concrete containing goldmine waste was observed good workability. The acceptability of utilizing Goldmine tailings as a substitute to sand in concrete production was found to be satisfactory on the basis compressive strength and durability. The control mix can attain a compressive strength more than the target strength at 28 days and replacement of goldmine waste does not affect the rate of gaining strength. The flexural strength of concrete is increasing marginally with percentage of replacement of sand up to 20% however at 30% replacement, the flexural strength decreases marginally. Good correlation was observed between flexure strength and compressive strength.

Advantages of goldmine waste:

1) The presence of cyanide contain in goldmine waste is very less. Thus, goldmine tailing is safe as construction material.
2) The workability of concrete in terms of both slump and compaction factor for concrete containing gold mine tailings alone is very low, which can be attributed by the presence very fine particles.

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MATERIALS

The materials used in this study include ordinary Portland cement, fine aggregate, coarse aggregate, goldmine waste tailings as partial replacement material and water. The properties of the materials are described below.

Cement :

The cements used in this experimental works are ordinary Portland cement (53 grades). All properties of cement are tested by referring IS: 1489-1991 53 grade for Ordinary Portland cement. The specific gravity test was conducted and was found to be 3.97.

Fine aggregate:

It was river sand and the specific gravity test was conducted and was found to be 2.65.

Coarse aggregate:

Coarse aggregates are 20mm down size and the specific gravity test was conducted and was found to be 2.63.

Goldmines waste as coarse aggregate:

Crushed Blackstone taken from Hutti Goldmines Limited was manually crushed and used as 100% replacement to locally available coarse aggregates, because of difficulty in manual crushing only 20mm and down size has being used. The suitability of the material was determined by analyzing particle size distribution, specific gravity and chemical composition. The particle size distribution of gold ore tailings was evaluated as per IS: 383-1970 and conforms to Zone – II.

Water :

Potable water available in laboratory is used for mixing and curing of concrete. Good quality of water is used for mixing and curing so that the quality of concrete is well remains good and gives good strength and durability

METHODOLOGY

This experimental study deals with the study of the physical properties of goldmine waste as a coarse aggregate, fresh state properties of concrete and also strength properties of concrete using

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goldmine as coarse aggregates. Concrete specimens of 150mmX150mmX150mm size were casted by replacing coarse aggregate by goldmine waste at proportion of 0%, 5%, 10%, 15% 20% and 25% by weight. The characteristic strength such as compressive strength for 3 days, 7days and 28 days were determined. In this experimental work it was planned to prepare a mix of M20 with cement water ratio of 0.5%. To achieve better workability superplasticer conplast430 was used in this experimental work.

Cement concrete Grade M20 with a proportion of 1:1.72:3.19 respectively were prepared with a water cement ratio of 0.5.

TESTS ON SPECIMENS

Compressive strength of concrete. (IS: 516-1959)

Standard moulds of 150mmx150mmx150mm size are used for casting concrete cubes. The cubes were compacted in three layers. Nine concrete cubes were casted for each mix. A total of forty five concrete cubes were casted. Cubes were immersed in water for curing till the date of testing. The specimens were prepared as per IS: 516-1989 and tested for uniaxial compressive strength at 3, 7 and 28 days. The results obtained are the average of three specimens tested and the results are presented in Table

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Fig 1 : Compressive Strength Testing on cube

Slump cone test. (IS 1199-1959)

Mix the dry constituents thoroughly to get a uniform colour and then add water. The internal surface of the mould is to be thoroughly cleaned and placed on a smooth, horizontal and non-absorbent surface. Place the mixed concrete in the cleaned slump cone in 4 layers each approximately 1/4 in height of the mould. Tamp each layer 25 times with tamping rod. Using the tampering rod or a trowel strike off the excess concrete above the concrete cone. Measure the vertical height of cone (h1). Slowly and carefully remove in the vertical direction. As soon as the cone is removed the concrete settles in vertical direction. Place the steel scale above top of settled concrete in horizontal position and measure the height of cone(h2). Complete the experiment in two minutes after sampling. The difference of two heights (h1-h2) gives the value of slump.

RESULTS AND DISCUSSION

It is observed that the workability as measured from slump, go on decreasing as the gold mine ore tailings percentage increases in concrete. The slump value is maximum for GOT replacement of zero percentage

It is observed that the compressive strength goes on increasing for replacement of GOT by 15%, there afterwards there is decrease in compressive strength by increase of percentage of GOT.

Table 1 shows the variation of slump results for different percentage variation of 5%, 10%,15%,20% and 25% with replacement of coarse aggregate by Gold mine waste.

Table 1 shows the variation of compressive strength test results for different percentage variation of 5%, 10%, 15%, 20% and 25% with replacement of coarse aggregate by Gold mine waste.

% of replacement	Slump in mm	Average compressive strength N/mm2

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of Gold Ore Tailings		3 Days	7 Days	28 days
0	40	19.64	23.99	29.92
5	35	20.22	25.33	32.44
10	35	20.96	29.41	34.29
15	30	22.00	30.15	35.26
20	25	19.63	22.74	30.00
25	25	15.56	19.33	24.81

Table No 1: Compressive strength with age

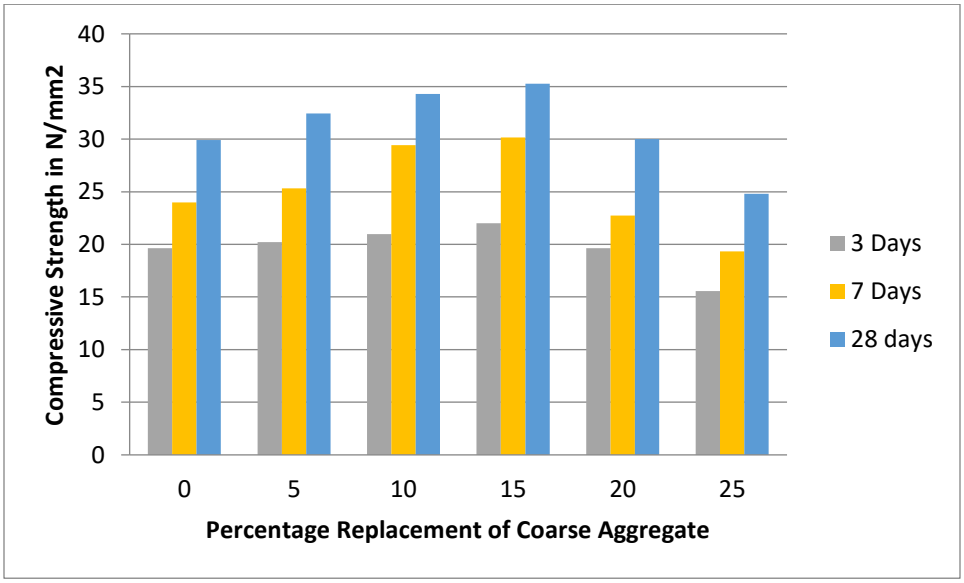

Fig 1: Graph of variation of compressive strength with age

Table No 2: Slump cone test

Sr. No.	Mix Designation	Cement (Kg)	CA (Kg)	FA (kg)	GMW to CA(%)	PA (Kg)	Water (Kg)	Slump (mm)

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1	B0	294	1078	841	0	0	148	40
2	B1	294	1078	798.95	5	42.05	148	35
3	B2	294	1078	756.90	10	84.10	148	35
4	B3	294	1078	714.85	15	126.15	148	30
5	B4	294	1078	672.80	20	168.20	148	25
6	B5	294	1078	630.75	25	210.25	148	25

CONCLUSION

In this experimental investigation, an attempt has been made use Gold Ore Tailings to replace the fine aggregates in concrete. Following are some of the conclusions drawn from the results of this investigation:

1. Gold ore tailings are the finer materials which can reduce the voids in concrete.

2. Up to 20% replacement of fine aggregates by gold ore tailings, the results obtained are satisfactory.

3. From the above results 15 % replacement of GOT gives high Compressive.

4. Hutti Gold Fields of Karnataka have 33 million tons of gold waste which can be utilized in construction resulting in conservation of around 19.8 million tons of sand and reduction in pollution.
5. By using these wastes instead of conventional materials, which would not only be preserving the natural precious resources, but also solving the problems of disposal of waste, which has become a problem.

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6. Construction of buildings from ore waste is eco-friendly as it utilizes waste and reduces air, land and water pollution. It is energy efficient and also cost effective.

7. There is large scope for utilizing ore wastes for the manufacture of building materials and products. This ore wastes are used as fine aggregates in concrete can meet the demand for next few decades.

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