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A Review on Use of Gold Mine Waste in Preparation of Concrete

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Abstract: ***The Rapid increase in urbanisation and industrialisation lead to the construction of huge buildings and factories. So, the usage of concrete is also increased. The partial replacement of cement and fine and coarse aggregate that will fulfil the strength of the concrete without the native materials. Even the fine and coarse aggregates are becoming scarce due to this excessive usage. The usage of cement also affects the environment by the emission of carbon and heat this is due to the hydration process of cement. Crushed black stones are a primary waste product from Gold mines which also affects the environment. This waste is a combination of dust and stone chips from parent rock of the ore and the properties of the waste directly depends upon the composition of the parent rock. The waste that is generated from the goldmines does not withstand the vegetation and it will release the fine particles into the atmosphere causing air pollution. Hence, it is essential to find some innovative way to use this Gold Mine waste. This gold mine waste can be used in the construction industry as a substitute for the coarse aggregate in making concrete.***

Keywords: Goldmines waste (GMW) coarse aggregates, compressive strength, flexural strength and durability.

I. INTRODUCTION

Gold mines Crushed Black stones are one of the primary waste products of mining operations of Hutti 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 million tons of solid waste generated annually in India, nearly 290 million tons are inorganic wastes of industrial and mining sectors. The gold mining industry at Hutti 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 Hutti goldmines limited is generating nearly 50 million tons of waste 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. This causes air pollution in the area. 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 use the Gold mine wastes. actory on the basis of compressive strength and durability. This study is initiated to assess the suitability of Gold mines Crushed Blackstone as substitute for coarse aggregate in concrete. The evaluation was based on parameters such as physical properties of materials, workability, compressive strength, flexural strength and durability. A Hutti goldmine is in the nearby locality of Kalaburagi, black stone is available in large quantity. therefore to utilize this waste following objectives have been framed.

II. LITERATURE SURVEY

1) Shitole et. al. in 2014 They examine In present era vast development occurred in the field of concrete technology. Many research scientists and research fallows have been developed numerous techniques to improve the strength & durability parameters of the concrete. This present research work is mainly focused on one of such method in which silica fume is used to improve the compressive and flexural strength of concrete. It gives the brief information regarding how exactly silica fume affects strength and durability parameters like compressive strength, flexural strength of concrete. Various samples of M20 grade concrete were taken with water cement ratio as 0.5 to show the effect of silica-fume additions as 0%, 7.5% and 10% of binder replacement. The results show significant increase in compressive and flexural strength of concrete up to certain percentage of silica fume addition.
2) S Laxshmanan et. al. in 2014 They studied Concrete is the most widely used construction material in civil engineering industry because of its high structural strength and stability. The concrete industry is constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem. Ground granulated blast furnace slag (GGBS) and Quarry sand (QS) are among the solid wastes generated by industry. The global consumption of natural sand is too high due to

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its extensive use in concrete. The demand for natural sand is quite high in developing countries owing to rapid infrastructural growth which results supply scarcity. This paper describes the feasibility of using waste in concrete production as a partial replacement of cement and sand. The cement has been replaced by GGBS in the range of 30%, 40% and 50% by weight of cement, quarry sand in the range of 40%, 50% and 60% by weight of cement for M40 grade mix. Slump test was carried on fresh concrete while compressive strength, split tensile strength and flexural strength were carried on hardened concrete. The cube, beams and cylinders are tested for compressive, Flexural and tensile strengths. It is found that by the partial replacement of cement with GGBS and sand with Quarry sand helped in improving the strength of the concrete substantially compared to normal mix concrete. These tests are carried out to determine the mechanical properties of concrete up to 7, 28, 56, 90 days for compressive strength, 28 days for split.

3) K. Kunt et. al. in 2015 They examine Bergama is the first gold mine in the history of Turkish Republic and currently one of the operating gold mine in Turkey. About 3 tons of gold and equal amounts of silver are mined each year. The estimated ore reserves at the Bergama gold mine are 2.4 million tons with about 10 g Au per tonne of ore. About 277.882 tons of the tailings slurry of gold mine treatment is produced every year during the recovery of gold. Increasing amounts of tailings slurry cause a problem in large disposal areas. Therefore, the recycling of this kind of slurries into useful materials is quite important in terms of economic and environmental aspects. The aim of this study was the investigation of utilization of the gold tailings as an additive material in Portland cement production. For this purpose, the effects of the gold tailings on the compressive strength properties of Portland cement were investigated. Cement mortars were prepared with Portland cement (CEM I 42,5 N) and dried gold tailings. Gold tailings with different ratios (5, 10, 15, 20, 25%) were added as cement additive in the mortar. The fresh properties of mortar such as consistency and setting time were investigated by using Flow table and Standard Vicat apparatus. The mortars were tested for compressive and flexural strength values after 3, 7 and 28 days. Mineralogical composition and microstructure of the 28-day mortars were determined by X-ray diffraction (XRD) and scanning electron microscope (SEM). According to results, it can be concluded that the tailings are eligible for mortar aggregate and the optimum ratio of gold tailings is 5%.

4) M.M. Khan, S. Patil in 2017 In the present work, experimental investigations were performed such as compressive strength test and flexural strength test on the concrete containing (0% and 100% replacement of goldmines waste in place of coarse aggregate. The tests were conducted for the above replacements of goldmines waste for M20 and M40 Grade concrete at different curing periods of (7, 14 and 28 days). The results of compressive strength of M20 and M40 grade concrete were in the range of 31.218N/mm 2 to 34.008N/mm 2 and 51.293N/mm 2 to 52.174N/mm 2 respectively. The Flexural Strength results of M20 and M40 grade concrete were in the range of 6.28 N/mm 2 to 6.90N/mm 2 and 8.306N/mm 2 to 9.060N/mm 2 respectively.

5) John Paul J. Aseniero et. al. in 2018 In this study, chemical and mineralogical characterizations of gold-mine tailings in key mining areas in Mindanao, Philippines were investigated for possible utilization as geopolymeric source material. Results of X-ray fluorescence (XRF) and energy dispersive X-ray spectroscopy (EDS) showed that the mine tailings samples have significant amounts of silicon, aluminum and calcium, which are crucial elements needed for geopolymerization. This was confirmed by the IR spectroscopic and mineralogical characteristics of the tailings where vibration bonds and minerals associated with Al and Si such as kaolinite and zeolite are detected. These minerals are already established as indicators for a material to be a good feedstock for geopolymerization. Furthermore, one of the tailings samples had an Si/Al ratio of 4.81, which was close to the recommended value of 3.0 for geopolymerization. The compressive strength of the synthesized geopolymer bricks gained an average of 5.48 MPa. The results suggested that gold mine tailings from key mining areas in Mindanao, Philippines could be used as geopolymer source material.

6) T Falayi in 2019 They examine Fly ash (FA) and Basic oxygen furnace (BOF) slag were used to as additives in the geopolymerisation of gold mine tailings (GMT).The aim of the research was to determine the effects of the two additives on the strength formation and mechanism of metal immobilisation by modified GMT geopolymers. GMT, FA and BOF were mixed, respectively, and made into a paste with the addition of potassium hydroxide (KOH) before curing at various conditions. 50% replacement of GMT in the starting materials gave the highest unconfined compressive strength (UCS). The UCS for BOF-based geopolymer was 21.44 Mega Pascals (MPa), whilst the one for FA-based geopolymer was 12.98 MPa. The BOF-based geopolymer cured at lower temperature (70 °C) as compared to the FA-based geopolymer (90 °C). The optimum KOH concentration was 10 and 15 M for BOF- and FA-based geopolymers, respectively. BOF-based geopolymers resulted in the formation of calcium silicate hydrate (CSH) phases which contributed to higher strength; whereas in FA-based geopolymers, no new structures were formed. BOF-based geopolymers resulted in over 94% iron (Fe) immobilisation, whereas FA-based

geopolymers had 76% Fe immobilisation. Fe immobilisation was via incorporation into the CSH or geopolymer structure, whilst other metal immobilisations were thought to be via encapsulation. 12-month static leaching tests showed that the synthesised geopolymers posed insignificant environmental pollution threat for long-term use.

7) A Longos et. al. in 2020 They performed studies on Geopolymer cement has been popularly studied nowadays compared to ordinary Portland cement because it demonstrated superior environmental advantages due to its lower carbon emissions and waste material utilization. This paper focuses on the formulation of geopolymer cement from nickel–laterite mine waste (NMW) and coal fly ash (CFA) as geopolymer precursors, and sodium hydroxide (SH), and sodium silicate (SS) as alkali activators. Different mix formulations of raw materials are prepared to produce a geopolymer based on an I-optimal design and obtained different compressive strengths. A mixed formulation of 50% NMW and 50% CFA, SH-to-SS ratio of 0.5, and an activator-to-precursor ratio of 0.429 yielded the highest 28 d unconfined compressive strength (UCS) of 22.10 ± 5.40 MPa. Furthermore, using an optimized formulation of 50.12% NMW, SH-to-SS ratio of 0.516, and an activator-to-precursor ratio of 0.428, a UCS value of 36.30 ± 3.60 MPa was obtained. The result implies that the synthesized geopolymer material can be potentially used for concrete structures and pavers, pedestrian pavers, light traffic pavers, and plain concrete.

8) D. Vijayan et. al. in 2021 They performed studies on an ecofriendly fiber reinforced polymer (FRP) had been used in the last decade to enhance the short concrete column's strength and deformation capacity. This study involves the wrapping of FRP sheets with a thickness of 3 mm and 5 mm on a short column, and then the compressive strength is determined. The rectangular columns of size 150 mm × 300 mm are used for this study, and cast under the grades of M20 and M40 are wrapped with GFRP sheets at the thickness of 3 mm and 5 mm. These results are clarified at a specific thickness of the FRP-wrapped columns. It provides a maximum axial compressive strength, and Young's modulus gets enhanced rigorously when it is to be compared to the normal concrete. This thesis deals with experimental studies of different parameters associated with wrapped glass fiber reinforced polymer (GFRP). In M20 grade, when the 3 mm wrapped specimen and the 5 mm wrapped specimen are compared, the specimen wrapped with 5 mm increases 5.182% more than the specimen wrapped with 3 mm. In M40 grade, when the 0 mm, 3 mm, and 5 mm wrapped specimens are compared, the specimen wrapped with 5 mm increases 2.47% more than the specimen wrapped with 0 mm. The 5 mm wrapping attains the maximum strength.

9) S. Praveena et. al. in 2022 They studied Natural fiber-reinforced polymer composite is a rapidly growing topic of research due to the simplicity of obtaining composites that is biodegradable and environmentally friendly. The resulting composites have mechanical properties comparable to synthetic fiber-reinforced composites. In this regard, the present work is formulated with the objectives related to the development, characterization, and optimization of the wt% of reinforcements and the process parameters. The novelty of this work is related to the identification and standardization of the appropriate wt% of reinforcements and parameters for the processing of the areca nut leaf sheath fiber-based polymer composites for enhanced performance attributes. With this basic purview and scope, the composites are synthesized using the hand layup process, and the composite samples of various fiber compositions (20%, 30%, 40%, and 50%) are fabricated. The mechanical characteristics of biodegradable polymer composites reinforced with areca nut leaf sheath fibers are investigated in the present work, with a focus on the effect of fiber composition (tensile properties, flexural strength, and impact strength).

III. CONCLUSION

1) The specific gravity for both locally available and GMW Coarse Aggregate are same but Variation in Fineness modulus and bulk density due to manual crushing of GMW coarse aggregate. The water absorption of GMW coarse aggregate is higher than local aggregate.

2) Coarse aggregate are stronger as compare to local coarse aggregate, this evident from the results of crushing value of both the aggregate.

3) The workability of local and GMW coarse aggregate is nearly same in terms of slump.

4) For M20 and M40 grade concrete, the compressive strength of both control and GMW concrete has exceeded the target mean strength. The compressive strength of GMW concrete is higher than the control concrete. The relation between 7 and 28 compressive strength is agreement with the various researchers.

5) For M20 and M40 grade concrete, the flexural strength of both control and GMW concrete has exceeded the theoretical value of flexural strength. The flexural strength of GMW concrete is higher than the control concrete. The relation between flexural and compressive strength at 28 days is agreement with the various researchers.

6) From permeability tests results for M20 and M40 grade concrete, the depth of penetration of GMW concrete is higher as compare to control concrete, this may be due to high water absorption of GMW coarse aggregate.

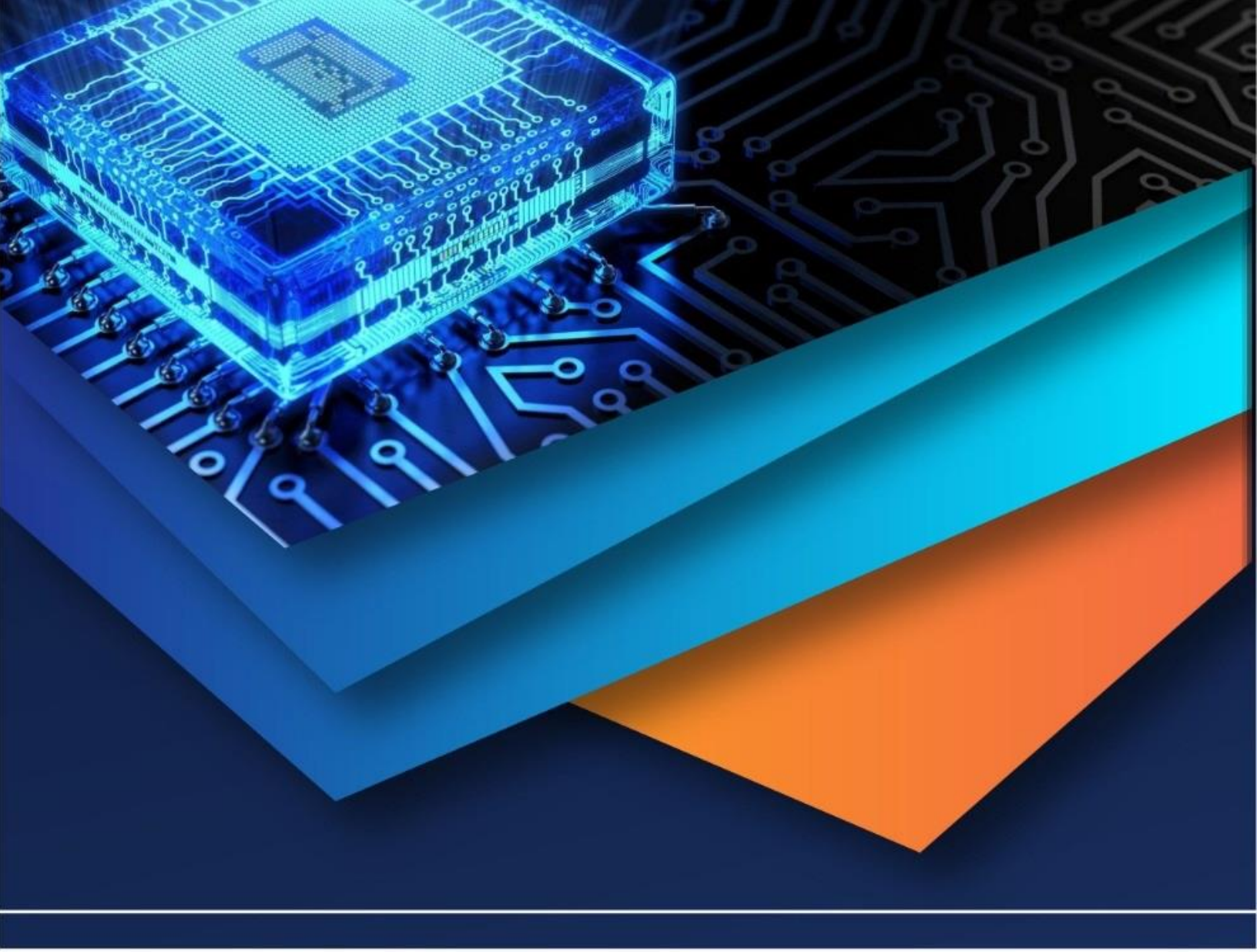
7) Concrete using Goldmines waste coarse aggregate is resistant to chloride attack after immersion for a period of 28 days.

IV. ACKNOWLEDGMENT

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