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Survey on Partial Replacement of Fine Aggregates Using Gold Mine Waste

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Abstract: *Concrete is a mixture of cement, sand, coarse aggregate and water. Its success lies in its versatility as can be designed to withstand harshest environments while taking on the most inspirational forms. Engineers and scientists are further trying to increase its limits with the help of innovative chemical admixtures and various waste materials.In a fast-developing country where almost each and every day construction activities takes place in a modern sense to improve the structural strength with economic value, uses of prior modern materials are required. Concrete can bear up the severest environmental conditions; however, in several conditions it may show very low characteristics.*

Keywords: *Gold Mine Tailings, Coarse Aggregates, Compressive Strength, Flexural Strength.*

1. Introduction

When it comes to the amount of raw materials and other natural resources it uses, the building industry in India ranks among the largest. By the end of 2020, it is predicted that cement usage would have climbed by 166%. According to usage around the world, concrete is ranked second only to water. The foundational elements of concrete are fine aggregates. Natural river sand is the fine material that is most frequently used. Due to the widespread usage of concrete, there is a relatively high global use of natural sand.

The usage of concrete is widespread throughout the world. It is ranked second after water in terms of global usage. The crucial element in concrete is fine aggregates. Natural sand, often known as pit sand, is the most widely utilised fine aggregate. Due to the widespread usage of concrete, natural sand is consumed quite widely worldwide. One of the main byproducts of mining operations is gold ore tailings. They are made up of tiny fragments of the parent rock, which is where the ore is found. The parent rock's composition affects the properties of the tailings. For the mining sector, disposing of this stuff is a significant environmental issue. When not used, tailings can be harmful. Because the tailings grain is so small, when it is dry, it can fly everywhere. Both agricultural and human health may be harmed. Following a chemical process to eliminate free cyanide and other heavy metals, gold ore tailings are released into the tailings pond. When mud, a material that is commonly used throughout the world, is used for tailings disposal. It is ranked second after water in terms of global usage. The crucial element in concrete is fine aggregates. Natural sand, often known as pit sand, is the most widely utilised fine aggregate. Due to the widespread usage of concrete, there is a very high demand for natural sand globally.

One of the main byproducts of mining operations is gold ore tailings. They are made up of tiny fragments of the parent rock, which is where the ore is found. The parent rock's composition affects the properties of the tailings. The mining industry has a serious environmental issue with the disposal of this material. When not used, tailings can be harmful. Because the tailings grain is so small, when it is dry, it can fly everywhere. Both agricultural and human health may be harmed. Following a chemical process to eliminate free cyanide and other heavy metals, gold ore tailings are released into the tailings pond. The expenses of treating tailings when they are dumped as mud into a reservoir are very high. After the mine is closed, we must construct a dam to handle the slurry from the tailings, environmental damage from seepage, and dam maintenance. Because it is difficult to manage, the disposal of tailings in the deep sea can contaminate the environment. One of the biggest issues in the mining

sector is how to dispose of gold ore. In KGF, gold ore tailings are a typical sort of solid waste that have major issues when dumped. The Kolar Gold Field, Kolar district of Karnataka, India's gold mining industry has generated a large amount of tailings that have been sitting idle for a while. Because there is no vegetation on dumps, wind erosion causes the release of fine particles into the atmosphere. This pollutes the air in the region. The geography and landscape of the region have also been impacted by the tailings. Finding a purpose for the gold ore tailings is so crucial. The purpose of this study is to determine whether gold ore tailings may partially replace fine aggregate in concrete. Evaluation criteria included workability, compressive strength, flexural strength, and gradation outcomes.

Fig.1 Deposition of Gold Ore Tailings

2. Literature Survey

B M Ramalinga Reddy[1] Natural sand is a diminishing resource, hence current construction material research is mostly focused on finding substitutes for it. In this study, an effort is made to partially replace natural sand with gold mine tailings. According to IS 10262-2009, concrete of grade M25 is produced and the natural fine aggregates are replaced by 10%, 20%, and 30% gold mine tailings. The resulting fine aggregates are cast into structural components including beams, slabs, and columns. Studying the behaviour of beams and slabs under axial compression, flexure, and column. due to partial replacement. The resulting sand's fineness modulus decreases. For a 10% replacement, the ultimate loads for beams, slabs, and columns are a little bit higher than the control elements. The final loads for 20% and 30% replacements are comparable. Study is also done on the fracture pattern and deflection. Results indicate that gold mine tailings could serve as a partial replacement for natural sand.

Daud and David[2] When managing mine tailings during mining operations and during mine rehabilitation after decommissioning, rigors and full characterization is essential. Applications requiring knowledge of tailings parameters might be either geotechnical or environmental. Effect of partially substituting natural sand for gold mine tailing on the workability of concrete.

Preethi A[4] V Meeting the need for fine aggregates in the building sector is getting harder as river sand becomes more and more scarce. In this study, an effort is made to partially replace river sand in the production of concrete with gold mining tailings. The fine aggregates produced while replacing river sand with 5%, 10%, 15%, 20%, and 25% gold mine tailings in the concrete mix are compared to ordinary concrete. Five mixtures were given the appropriate mix proportions for M20 concrete according to the guidelines in IS: 10262-2009. There are reports on workability, compressive strength, and flexural strength. The strengths were measured at 3, 7, and 28 days of age. From 5% to 15% replacement, compressive and flexural strength rose a little. The comparable compressive and flexural strengths after 20% replacement also slightly decline. Compressive strength and flexural strength showed good connection. It was found that the mechanical characteristics of concrete were improved when gold ore tailings were used to replace the fine material in a certain proportion. This study establishes that gold mining tailings can partially replace river sand for making concrete.

Sudhakar Rao[5]At the Kolar Gold Field (KGF) mines, the gold mining operation produced around 32 million tonnes of tailings. The cyanidation method, which entailed dissolving the gold in the ore using water soluble alkali metal cyanides, was used to extract gold from the mined ores (example, sodium cyanide or potassium cyanide). Prior to the KGF mines' closing in 2000, only the Kennedy's Line dump remained operational out of the various dumps that handled mining tailings. Sulphide-bearing tailings in slurry form, consisting of used ore and processing water containing soluble alkali metal cyanide, were delivered to the Kennedy's Line dump. Depending on the pH of the tailing slurry, the free cyanides may exist as soluble cyanide (CN) ions that can be reached by infiltrating water to the subsurface environment or as aqueous hydrogen cyanide that can escape to the atmosphere as hydrogen cyanide gas. Additionally, the Kennedy's Line dump is vulnerable to acid discharge because it contains pyrite minerals. The purpose of this study is to determine whether the gold tailings at the Kennedy's Line dump have the potential to release cyanide ions (CN) and acid drainage into the subsurface environment. To do this, physico-chemical and leaching tests were conducted using tailing samples taken from different depths in the dump, subsurface soil samples taken

beneath the dump, and groundwater samples taken from the area around the dump. The laboratory results are also used to infer the chemical processes in charge of the ambient cyanide and pH levels of the tailing dump, sub-surface soil samples, and groundwater.

3. Materials

The chemical composition and particle size distribution of gold mine tailings were assessed in accordance with IS: 20001985 (11) and IS: 2386 (part-II)-1963 (12), respectively. A hydrometer examination was performed on the portion of the sample that passed through a sieve with a 75 micron mesh size. Natural sand and gold mine tailings have specific gravities of 2.66 and 2.82, respectively. Figure 1 displays the particle size distribution curves for natural sand (NS) and gold mine tailings (GMT).

Tailing Dumps

Throughout the experiment, different ratios of tailing dump were used in relation to fine aggregates. Various tests are used to determine the physical characteristics of tailing dumps.

Cement

Throughout the investigation, regular Portland cement that complied with IS: 1489-1991 was used. Testing for setting time, uniformity standards, compressive strength, fineness, specific gravity, and soundness.

Fig.2 Cement Mixed with Gold Mine Tailing

River Sand

Fine aggregate is defined as material that has passed through IS Sieve No. 480 (4.75mm). Its purpose is to make concrete dense by filling up spaces left by coarse aggregates, reducing cement shrinkage, and producing a mix that is affordable. Concrete can employ natural sand or crushed stone dust as fine aggregates.

Coarse Aggregates

When cement paste bonds these chemically inert components into concrete, the term "aggregates" is used. Since aggregates make up the majority of the overall volume of concrete, they have a significant impact on the material's strength. Concrete's characteristics are directly tied to those of its constituent parts, therefore the aggregate used in a concrete mix should be tough, strong, dense, and long-lasting, devoid of chunks of clay, loam, vegetables, and other foreign materials. All of these compounds inhibit cement from adhering to aggregate surfaces and decrease the strength of concrete.

Fig.3 Coarse Aggregates

4. Conclusion

One of the biggest issues facing the mining sector is the disposal of mine tailing dumps. The use of tailings for productive uses is being investigated all around the world. The goal of this research is to examine how mining waste can be used to make concrete. The idea of employing mine waste as the primary ingredient in concrete to be used in construction has undergone extensive research and testing. Mining waste (tailing), which harms the environment unnecessarily, is transformed into an inert component, whose performance is frequently on par with that of common building materials. One of the main byproducts of mining operations, tailing dumps from gold mines are being evaluated for applicability in this study. The primary issue for the mining sector is the disposal of waste, which is taken from the mining industry as tailing dumps.

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