Geo Technical Investigation on Gold Mine Residual Soil

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- ***Abstract*—The report talks about geotechnical investigations on gold mine residual soil, centering on the physical and chemical properties of the soil, mix design for concrete, compression tests, and the impact of replacing fine aggregates with gold mine tailings.The report incorporates details on the physical properties of the mine soil, such as moisture content, specific gravity, and fineness modulus.It traces the mix design for M20 grade concrete, indicating the water-cement proportion, type of cement, and maximum aggregate size.Compression tests were conducted on concrete specimens with changing levels of sand replacement, appearing that 10% replacement with gold mine tailings brought about in high compressive strength.**

Keywords—compressive strength, gold ore tailing, Sieve Analysis

I. INTRODUCTION

Investigating gold mine residual soil involves examining the leftover materials after gold extraction to understand their composition, stability, and environmental impact. Residual soil from gold mining is often enriched with heavy metals and other contaminants, posing significant environmental and health risks. The study typically includes geotechnical, mineralogical, and chemical analyses to assess soil properties such as texture, mineral content, pH levels, and the presence of toxic elements like arsenic and mercury.

Geotechnical analysis evaluates the physical characteristics of the soil, including its bearing capacity, permeability, and stability, which are critical for ensuring safe construction practices in mining areas. Mineralogical analysis identifies the mineral composition, which helps in understanding the distribution of gold and other valuable elements. Chemical analysis, on the other hand, focuses on detecting contaminants and assessing the potential for acid mine drainage, which can severely impact surrounding ecosystems.

The findings from these investigations are crucial for developing remediation strategies, managing mine tailings, and mitigating environmental damage. By understanding the properties and risks associated with gold mine residual soil, stakeholders can implementmore effective soil management and rehabilitation practices, ultimately contributing to more sustainable mining operations and reduced environmental footprint.

The Kolar Gold Fields (KGF) in India have a wealthy history of gold mining, and geotechnical examinations play a crucial part in understanding the subsurface conditions for secure and effective mining operations. This examination includes comprehensive soil examining, research facility testing, and examination to assess variables such as geographical structure, metal characteristics, and ground solidness. By analyzing the geotechnical perspectives of the Kolar Gold Fields, engineers can make educated choices almost uncovering strategies, bolster frameworks, and natural affect relief. This guarantees the maintainable and dependable extraction of gold from the Kolar district, considering both the financial benefits and natural contemplations.

I. SCOPE OF STUDY

In this study, concrete of M20 grade was obtained and the mixtures were modified by partially replacing river sand with gold ore tailings. The properties of concrete in the fresh and hardened state examined are workability and strength respectively. The workability of concrete mixtures was evaluated in terms of slump and compaction factor tests. The strength of concrete was evaluated in terms of compressive strength.

II. COLLECTION OF SAMPLES

The gold ore tailings were collected from the dumps of Kolar Gold ores, Karnataka, after removing the grass and other weeds from the top surface.

III. MATERIAL PROPERTIES

4.1 Gold Ore Tailing

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.

The chemical compositions of gold ore tailings were evaluated and are shown in Table 1.

Particulars	Mine soil value	Natural sand value
pH	7.8	6 - 7.5
Electrical conductivity	208 µs/cm	1100 - 5700 µs/cm
Total Nitrogen	2.45%	0.02 – 2.5%
Phosphorous	1.80%	1.1 – 2.2%
Potassium	2.89%	0.32 – 2.5%
Organic Carbon	3.08%	0.7 – 4%
Iron	1.84%	2 – 4%
Copper	24.0 ppm	1 – 140 ppm
Manganese	7.8 ppm	200 – 10000 ppm

4.2 physical properties of gold mine soil

The various physical tests conducted on gold mine soil and results obtained are tabulated as shown in table 2.

Particulars	Mine soil value	Natural sand value
Moisture content	8.07%	3%-10%
Specific gravity	2.083	<2.00
Fineness modulus	2.57 (zone II)	<3.2
Optimum moisture Content (OMC)	10%	6-10%
Dry density	0.38 g/cc	<1.6 g/cc

IV. METHODOLOGY

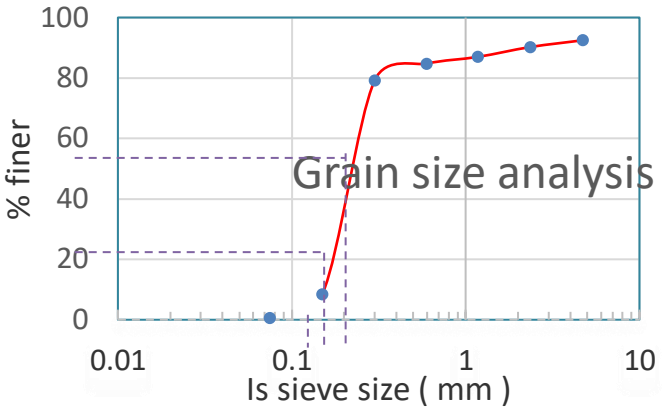
The test work is classified into three stages, namely

a) Sieve analysis
b) Moisture content
c) Specific gravity

a) Sieve Analysis

The fundamental objective of the examination is to somewhat supplant natural sand with quarry clean and think about the behavior of concrete in the new and solidified state. The materials utilized for the examination is to begin with sieved and reviewing of totals is carried out at that point the zone esteem is gotten. Characteristic sand replaced with gold mineral tailings at an interim up to 20%.

IS Sieve size (mm)	Wt. of soil retained(g)	% wt. Retained	Cumulative % retained	% Finer
4.75	150	7.5	7.5	92.5
2.36	45	2.25	9.75	90.25
1.18	65	3.25	13	87
0.6	45	2.25	15.25	84.75
0.3	110	5.5	20.75	79.25
0.15	1415	70.75	91.5	8.5
0.075	160	8	99.5	0.5
0	10	0.5	100	0



b) Moisture content

Moisture content theory involves understanding and quantifying the amount of water within a material, expressed as a percentage of the material's total weight. It is crucial because water influences the physical, chemical, and biological properties of materials. Moisture content is classified into free and bound water: free water is easily removed, while bound water is chemically or physically attached to the material. Measurement techniques include the gravimetric method (weighing before and after drying), capacitive and resistive sensors (electrical properties), infrared spectroscopy (light absorption), Karl Fischer titration (chemical analysis), and microwave meters (dielectric properties). Accurate moisture content determination is essential for quality control, processing efficiency, storage, and preservation across various industries like agriculture, food, pharmaceuticals, construction, and textiles, as it affects product stability, performance, and economic value.The Mine soil test conducted and result are obtained 8.07%.

c) Specific gravity

Specific gravity, also known as relative density, is the ratio of the density of a substance to the density of a reference substance, typically water at 4°C (where water's density is 1 g/cm³). It is a dimensionless quantity, as it represents a ratio of two densities. Specific gravity indicates how heavy or light a substance is compared to water. For example, if a substance has a specific gravity of 2, it is twice as dense as water. This concept is crucial in various industries, including geology, material science, and engineering, for identifying materials and determining their properties. Specific gravity can be measured using devices like hydrometers or pycnometers. Unlike density, specific gravity remains constant regardless of the measurement system used (e.g., metric or imperial), making it a convenient comparative tool.The Mine soil test Conducted and result are obtained is 2.083 g/mm^3

VI. 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:

- Gold mine tailings are the finer materials which can reduce the voids in concrete.
- Up to 20% replacement of fine aggregates by gold mine tailings, the results obtained are satisfactory.
- Compare to the standard concrete block the strength increased by 14.2% with 10% of replacement and 0.27% for 20% of replacement.
- From the above results 10% replacement of fine aggregates by gold mine tailings gives high compressive strength.
- By using this waste, it will preserve the natural precious resources and also solve the problems of disposal of waste, which become a problem.
- Construction of buildings from mine waste is eco- friendly as it utilizes waste and reduces air, land and water pollution.
- It is energy efficient and also cost effective.
- There is large scope of utilizing mine wastes for the manufacture of building materials and products.
- This mine wastes are used as fine aggregates in concrete can meet the demand for next few decades.

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