CHARACTERIZATION OF MATERIALS BY PARTIALLY REPLACING CEMENT BY COPPER ORE TAILING AND SAND BY IRON ORE TAILING

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Abstract

The construction industry has been improvising through the advances in innovation and procedure. Concrete, which is the essential part in development industry, is being utilized more than manmade materials and it expands more crude materials. Cement, fine aggregate and coarse aggregate are vital ingredients of concrete .An earnest attempt is made through this project to fulfill all the pre and post factor of M20 concrete by partial replacement of cement by copper ore tailing of 5%, 10%, 15%, 20%, 25% and sand by iron ore tailing of 10%, 20%, 30%, 40%, 50%. The effect of copper ore tailing and iron ore tailing for the partial replacement of cement and sand on strength and durability characteristics were analyzed and compared with normal concrete. The test results shows that 15% copper ore tailing and 30% iron ore tailing shows the good and optimized results. Its use will lead to a reduction in cement and sand quantity required for construction purposes and hence sustainability in the construction industry.

Keywords: *Copper ore tailing, Iron ore tailing.*

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1. INTRODUCTION

Concrete is a standout amongst the most critical things among the building materials in a wide range of structural designing works. Since the adaptation of concrete as a building material with lot of researches and studies having been made to improve the quality strength and durability. Plain concrete is great in pressure however week in tension with extremely restricted flexibility & little immunity to splitting. Concrete leading to brittle fracture because of propagation of micro cracks and its poor elasticity. To meet the requests of the advanced world concrete technology is to be built with quality, strength and durability. The most important problem facing mankind today is how best to preserve natural resources to meet human needs and nurture economic growth without exhausting the resources and endangering the environmental integral on which life economic prosperity and our security depend.

Copper Ore Tailing (COT) and Iron Ore Tailing (IOT) are known to improve both mechanical characteristics and durability characteristics of concrete since both the chemical and physical impacts of these are critical. Physical impact of COT in concrete go about as filler material, as a result of its fineness can fit into spaces between sand grains in the same way IOT fills the spaces between particles of coarse aggregate. Due to the presence of high content of silica chemical reaction is carried out and it is highly active pozzolans compared to the cement.

2. MATERIAL

2.1 Copper Ore Tailing

Copper Ore Tailing (COT), the glassy material, produced during Crushing, Separation, Milling, Floatation having the specific gravity 3.15 and it is considered as waste and disposed as landfill. However, it causes severe environmental pollution due to the generated waste materials. Copper ore tailings of about 2.2-3 tons are generated for every ton of copper production in copper mines. It shows in its chemical composition containing high contents of aluminum, silica and iron oxide similar to that of cement.

2.2 Iron Ore Tailing

Iron Ore Tailing is a waste generated from the Iron Ore industry having specific gravity 3.01. It is a very fine aggregate residue resulting from the extraction of Iron from Iron Ore. Problems involved in the disposal of iron ore tailing are lack of space, technical problems, cost and environmental hazards. Tests on Iron Ore Tailings procured from Tumkur site were conducted.

2.3 Cement

Ordinary Portland cement of grade 43 is used in the present experimental study having specific gravity 3.08.

2.4 Coarse Aggregate

The aggregates were obtained from the local quarry free from lumps of clay, organic and vegetable matters, fine dust are used in the study having specific gravity 2.56.

2.5 Fine Aggregate

Natural river sand which is locally available has been selected for the dissertation work having specific gravity 2.4.

3. EXPERIMENTAL INVESTIGATION AND RESULTS

3.1 Compressive Strength

Compressive strength of concrete mixes prepared with conventional concrete and replacement of IOT and COT were experimentally determined at 7, 14 and 28days and results are tabulated in table in 1.1.

Table 1.1 Compressive Strength in N/mm^2 for 7.14.28 days

Sl. no	% Variation of COT and IOT	7days	14days	28 days
1	CC	18.16	23.83	26.73
2	5%COT & 10%IOT	20.34	24.99	27.89
3	10%COT & 20%IOT	21.51	26.00	28.33
4	15%COT & 30%IOT	23.83	28.33	29.93
5	20%COT & 40%IOT	22.39	24.55	27.89
6	25%COT &50%IOT	19.32	22.08	26.00

It can be seen from the tables that all specimens have attained compressive strengths higher than the target strength of 26.65 N/mm^2 for M20 mix at the end of 28 days. Maximum compressive strength is 29.93 N/mm^2 for the mix 15%COT and 30%IOT which is the optimum mix. Pozzolanic nature of copper ore contributes to the strength development and finer particles in IOT made more bonding effect to the concrete mix. The slight decrease in the strength a higher replacement levels may be due to the slow pozzolanic action.

3.2 Split Tensile Strength

Cylinder Specimen was prepared using design M20 grade of concrete mix with the use of different replacement material IOT for sand10% ,20%, 30%, 40% 50% and cement by COT in 5%, 10%, 15%, 20%, 25% and results are tabulated in table in 1.2.

Table 1.2 Split Tensile Strength in N/mm^2 for 7.14.28 days

Sl. no	% Variation of COT and IOT	7days	14 days	28 days
1	CC	1.618	2.217	2.544
2	5%COT & 10%IOT	1.757	2.226	2.681
3	10%COT & 20%IOT	1.896	2.405	2.771
4	15%COT & 30%IOT	2.034	2.544	2.866
5	20%COT & 40%IOT	1.757	2.173	2.544
6	25%COT &50%IOT	1.478	2.034	2.451

Maximum split tensile strength is 2.866 N/mm^2 with respect to conventional concrete, for the mix 15%COT and 30%IOT which is the optimum mix. Pozzolanic nature of copper ore contributes to the strength development and finer particles in IOT made finer and bond effect to increases in strength for the replacement levels. The slow pozzolanic action might have affected the strength gain so that the decrease in the split tensile strength for higher replacement of COT & IOT.

3.3 Flexural Strength

Prism Specimen were prepared using M20 grade of concrete mix with the use of different replacement levels of IOT and COT. Prism specimens of size 150x150x700mm were made with partial replacement IOT for sand10%, 20%, 30%, 40%, 50% and cement by COT in 5%, 10%, 15%, 20%, 25% for 28 and 56 days and results are tabulated in table in 1.3.

Table 1.3 Flexural Strength in N/mm^2 for.28 and 56 days

Sl. no	% Variation of COT and IOT	28days	56 days
1	CC	3.11	3.63
2	5%COT & 10%IOT	3.29	3.68
3	10%COT & 20%IOT	3.32	3.79
4	15%COT & 30%IOT	3.46	3.92
5	20%COT & 40%IOT	3.28	3.76
6	25%COT &50%IOT	3.19	3.68

Maximum flexural strength obtained for the mix 15% COT and 30% IOT at 28 days is 3.46 N/mm^2 which is And there after the strength goes reducing but almost the same as that of conventional concrete. Pozzolanic nature of copper ore contributes to the strength development and finer particles in IOT made bonding effect to increase in strength for the replacement levels.

3.4 Water Absorption

Cube specimens were prepared using M20 grade of concrete mix and by the use of replacement materials IOT and COT. Specimens of size 150x150x150mm were casted with partial replacement IOT for sand 10%, 20%, 30%, 40%, 50% and cement by COT in 5%, 10%, 15%, 20%, and 25% and results are tabulated in table in 1.4.

Table 1.4 Water absorption after.28 days

Sl. no	% Variation of COT and IOT	% of water absorption $(W_2-W_1)/W_1X100$
1	CC	2.98
2	5%COT & 10%IOT	2.82
3	10%COT & 20%IOT	2.70
4	15%COT & 30%IOT	2.43
5	20%COT & 40%IOT	2.35
6	25%COT &50%IOT	2.24

The water absorption decreases for partial replacement compared to the normal concrete. Decrease in water absorption shows that better durability of concrete as the replacement levels increases. Pozzolanic action of COT might have made concrete more uniform and denser IOT particles prevented much absorption.

3.5 Sorptivity

Cube specimens were prepared using M20 grade of concrete mix and by the use of replacement materials IOT and COT. Specimens of size 150x150x150mm were casted with partial replacement IOT for sand 10%, 20%, 30%, 40%, 50% and cement by COT in 5%, 10%, 15%, 20%, 25%.Test results are tabulated in table 1.5.

Table 1.5 Sorptivity after 28 days

Sl. no	% Variation of COT and IOT	Sorptivity $S=(Q/A)/t^{\{1/2\}}$ in $(mm/min^{\{1/2\}})$
1	CC	2.98
2	5%COT & 10%IOT	2.82
3	10%COT & 20%IOT	2.70
4	15%COT & 30%IOT	2.43
5	20%COT & 40%IOT	2.35
6	25%COT &50%IOT	2.24

The Sorptivity decreases for partial replacement compared to the normal concrete. Decrease in sorptivity shows that better durability of concrete as the replacement levels increases. Pozzolanic action of COT might have made concrete more uniform and denser IOT particles prevented much absorption.

3.6 Acid Resistance

Acid resistance test results are shown in Table 1.6 and cubes were tested and immersed in Hydro choric acid for 28 days of curing and results are tabulated in table in 1.6.

Table 1.6 Weight Loss Test

Sl. no	% Variation of COT and IOT	% of Weight Loss $(W_1-W_2)/W_1X100$
1	CC	2.262
2	5%COT & 10%IOT	2.720
3	10%COT & 20%IOT	3.291
4	15%COT & 30%IOT	4.625
5	20%COT & 40%IOT	5.108
6	25%COT &50%IOT	6.711

The weight loss increases for partial replacement compared to the normal concrete. Weight loss got increased for maximum replacement of copper ore tailing and iron ore tailing when compared with conventional concrete. Decrease in weight loss because of the reaction between acid and oxides present in iron ore tailing and copper ore tailing shows less durability of concrete as the replacement levels increases.

4. CONCLUSION

[1]. It is feasible to produce cost effective concrete, possessing acceptable 7, 14 days and 28 days strength by partial replacement of COT and IOT.
[2]. Workability of concrete decreases with raise in percentage of substitute COT and IOT as compared to control mix.
[3]. Compressive strength of concrete for 28 days of curing with various % replacements of COT and IOT has been increased and has achieved target strength.
[4]. The compressive strength increased 11.97% for the optimum mix 15%COT and 30%IOT beyond that strength decreased, but all replacements achieved target strength.
[5]. The split tensile strength of concrete at 7, 14 and 28days gradually increases with raise in percentage replacements of COT and IOT compared to conventional concrete.
[6]. The split tensile strength increased 12% for the optimum mix 15%COT and 30%IOT beyond that strength decreased, but all replacements achieved strength comparable to conventional concrete.
[7]. The Flexural strength of concrete maintains good result up to 15% COT and 30% IOT which is 11% more than conventional concrete. Beyond that strength decreased, but all replacements achieved strength almost the same as conventional concrete.
[8]. Water absorption rate is decreases with increases in percentage as compared to control mix, hence it is durable.
[9]. Sorptivity test of concrete mix is made with partially replacement of COT and IOT was after determined after 28 days .Sorptivity decreases with increasing replacement of COT and IOT compare to normal concrete mix.
[10]. While testing acid resistance, weight loss was absorbed to be increased proving this concrete is vulnerable to acid.

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