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Mechanical Properties of Pine Apple Leaf Fibre Concrete with Copper Slag as Partial Replacement of Fine Aggregate

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ABSTRACT

We are all too aware that building construction is essential to the world's rapid development. A thorough investigation shows that the natural resources are being depleted as the use of concrete rises. For the sake of preserving our natural resources, we thought about replacing some of the proportions. The study is primarily concerned with the compressive strength and split tensile strength testing of blended concrete that includes various percentages of copper slag as a partial replacement of fine aggregate and pine apple leaf fiber. Pine apple leaf fiber is added to concrete in levels of 0.1%, 0.2%, 0.3%, and 0.4%, and the weight of fine aggregate in concrete is substituted with percentages of 0%, 10%, 30%, 40%, and 50%. After 7 and 28 days, concrete cylinders and cubes are examined. The strength performance of traditional concrete is then compared to that of slag blended fiber reinforced concrete.

Keywords- ***Copper Slag, Pine Apple Leaf Fibre, Compressive strength, Split tensile strength.***

1. INTRODUCTION

Concrete is the most prevalent and incredibly strong building material. Concrete's basic elements are cement, coarse aggregates, fine aggregates, and water. Concrete is the material that holds the coarse and fine particles together. A glue-like gel comprised of concrete and water surrounds the sand and rock. As a high-quality material, whole coarse aggregates are used. Concrete operates well under pressure but fails when subjected to strain. To prevent these issues, we now use many sources of admixtures in the solid. The use of copper slag as a partial replacement for fine total concrete results in less concrete being required. Pineapple leaf fiber (PALF) is an unwanted byproduct of pineapple plants. PALF is inexpensive, easily accessible, has a high specific strength, and is plentiful and rigid for industrial use. PALF employs bio-composites to strengthen structures. This promotes long-

term development. A natural fiber known as pineapple leaf fiber (PALF) has the potential to replace synthetic fibers in concrete reinforcement. If PALF is utilized as a reinforcing fiber, freshly poured concrete will fibrillate, absorb water, and change mechanical properties.

2. OBJECTIVE

a) To use copper slag as efficiently as feasible in fine aggregate.
c) Using pineapple leaf fiber to absorb water and improve the mechanical properties of the concrete.
c) To assess the results of the split tensile and compressive strength tests.

3. MATERIALS

a. Cement: Ordinary Portland cement is the most commonly used type of cement in construction globally, as it is an essential component of concrete, mortar, plaster, and the bulk of nonspecialty grout. Cement is the principal component used in the production of concrete. Changing the cement content has a large impact on the characteristics of concrete. The cement used in this project is standard Portland cement of grade 53, according to IS 12269-2013.
b. Fine Aggregate: The most important component of concrete formed from natural sand or crushed stone is fine aggregate. The density and quality of the fine aggregate have a significant impact on the cured concrete's properties.
c. Coarse Aggregate: The coarse aggregate utilized had a maximum particle size of 20 mm and a minimum particle size of 12.5 mm. It was easily accessible on a local level. After being washed to remove dust and filth, the aggregates were dried until only the surface was damp. IS: 383-1970 compliance was discovered in the aggregates.
d. Water: One of the most important elements in construction, water is required for a number of jobs such as mortar production, cement concrete mixing, and curing operations. The quality of the water used in the construction project has a direct impact on the strength of the motor and cement concrete.
e. Copper slag: Copper slag can be used in place of some of the sand in concrete. Copper slag is formed into blocks and used as a construction material. Such use was common in areas where smelting occurred, such as Cornwall and St Helens in England. In Sweden (Skellefte region), fumed and settled granulated copper slag from the Boliden copper smelter is utilized as road construction material.
f. Pineapple Leaf Fiber Pineapple leaf fiber composite has made significant contributions to bio composites and material science. PALF has shown to be a good substitute for artificial filaments due to its reasonable and endless character. To make the fibers, the outermost layer of the leaves is separated from the leaf fibers, which are then dried.

4. RESULTS

a. Compressive Strength: The measurement of concrete's compressive strength is crucial since it serves as a benchmark for the material's quality. Compressive strength is the standard unit of measurement for other strength. In N/mm2, the strength is measured.Test conducted after 7 and 28 days.

Table 1: Compressive Strength Results on Concrete by Partial Replacement of Copper Slag in FineAggregate.

S.No	% Of Copper Slag	Compressive Strength Results, N/mm^2	
		7 days	28 days
1	0%	26.58	39.15
2	10%	28.01	41.06
3	20%	29.04	42.34
4	30%	30.33	43.84
5	40%	31.95	45.72
6	50%	28.63	41.51

Table 2: Compressive strength result by addition of Pine Apple Leaf Fibre in concrete

S.No	% Pine Apple Leaf Fibre	Compressive Strength Results, N/mm^2	
		7 days	28 days
1	0%	26.58	39.15
2	0.1%	28.55	41.45
3	0.2%	29.62	42.84
4	0.3 %	31.53	45.38
5	0.4%	29.01	41.51

Table3: Compressive Strength of concrete for combined partial replacement of Fine Aggregate by 40% Copper Slag+ 0.3% Pine Apple Leaf Fibre.

S.No	Combined replacements (%)	Compressive Strength Results, N/mm^2	
		7 days	28 days
1	0	26.58	39.15
2	40%CS+0.3%PALF	34.22	48.72

b. Split tensile Strength: At ages 7 and 28 days the cylindrical specimens (150 mm in diameter x 300 mm in height) were inspected to determine the split tensile strength. A load is applied to a cylindrical sample that is positioned horizontally between the loading surface of a compression testing equipment until the cylinder fails along its vertical diameter.

Table 4: Split tensile Strength Results on Concrete by Partial Replacement of Copper Slag in Fine Aggregate.

S.No	% Of Copper Slag	Split tensile Strength Results, N/mm^2	
		7 days	28 days
1	0%	2.63	3.84
2	10%	2.78	4.06
3	20%	2.82	4.18
4	30%	3.01	4.38
5	40%	3.21	4.66
6	50%	2.87	4.13

Table 5:Split tensile Result by addition of Pine Apple Leaf Fibre in concrete

S.No	% Pine Apple Leaf Fibre	Split tensile Strength Results, N/mm^2	
		7 days	28 days
1	0%	2.63	3.84
2	0.1%	2.79	4.08
3	0.2%	2.91	4.23
4	0.3 %	3.13	4.51
5	0.4%	2.85	4.12

Table6:Split tensile Strength of concrete for combined partial replacement of Fine Aggregate by 40% Copper Slag+ 0.3% Pine Apple Leaf Fibre.

S.No	Combined replacements (%)	Split tensile Strength Results, N/mm^2	
		7 days	28 days
1	0	2.63	3.84
2	40%CS+0.3%PALF	3.37	4.89

CONCLUSIONS

1. The Normal Concrete of Compressive Strength results for 7 and 28 days is 26.58 N/mm^2 and 39.15 N/mm^2.
2. The Normal Concrete of Split tensile Strength results is for 7 and 28 days is 2.63 N/mm^2 and 3.84 N/mm^2.
3. At 40% partial replacement of Copper Slag with Fine Aggregate the Compressive Strength results for 7 and 28 days is 31.95 N/mm^2 and 45.72 N/mm^2.
4. At 40% partial replacement of Copper Slag with Fine Aggregate the Split tensile Strength results for 7 and 28 days is 3.21 N/mm^2 and 4.66 N/mm^2.
5. By addition of 0.3% Pine Apple Leaf Fibre in concrete the Compressive Strength results for 7 and 28 days is 31.53 N/mm^2 and 45.38N/mm^2.
6. By addition of 0.3% Pine Apple Leaf Fibre in concrete the Split tensile Strength results for 7 and 28 days is 3.13 N/mm^2 and 4.51N/mm^2.
7. By the combination of 40% partial replacement of Copper Slag with Fine Aggregate +By adding 0.3% Pine Apple Leaf Fibre in Concrete the Compressive Strength results for 7 and 28 days is 34.22 N/mm^2 and 48.72N/mm^2.
8. By the combination of 40% partial replacement of Copper Slag with Fine Aggregate +By adding 0.3% Pine Apple Leaf Fibre in Concrete the Split tensile Strength results for 7 and 28 days is 3.37 N/mm^2 and 4.89N/mm^2.

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