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TERNARY EFFECTS OF CHEBULA POWDER, ALCCOFINE 1203, AND QUARTZ POWDER ON CONCRETE PROPERTIES

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Abstract:

Cement, fine and coarse aggregates, and water are the ingredients of concrete. The ideal amounts of chebula powder—0.25%, 0.5%, 0.75, and 1%—are used to improve the concrete's workability and strength. Concrete mixes can be made more workable by adding chebula powder. The percentage of cement that can be replaced with alccofine 1203 ranges from 5% to 15%. A supplementary cementitious material (SCM) called Alccofine 1203 increases the compressive strength and durability of concrete. Cement replaces 10%, 20%, and 30% of the quartz powder. In some areas or uses, Chebbula powder may be more cost-effective than sand, therefore using it in part to replace sand can save money when making concrete. Chebbula powder serves to save natural resources and lessen the environmental effect of sand mining by lowering the amount of sand in concrete mixes. By filling the pores and capillary voids, Alccofine 1203 can increase the workability of concrete and decrease its permeability. When used as a partial substitute for cement, Alccofine 1203 can help increase the concrete's early-age and ultimate compressive strength. By influencing the thermal characteristics of concrete, quartz powder can lessen temperature variations and lower the possibility of thermal cracking during the curing process.to assess split tensile strength and compressive strength over 28, 56, and 90 days.

Key words: Chebula powder, Alccofine 1203, Quartz powder, Workability, Compressive strength and Split tensile strength.

1. INTRODUCTION

One of the most important building materials that has shaped sophisticated infrastructure and development techniques is concrete. Concrete, which is made up of a mixture of cement, aggregates, water, and admixtures, provides a remarkable blend of strength, flexibility, and durability. By strengthening its resistance to elements like chemical attack, abrasion, or corrosion of reinforcing materials, chemula powder can be added to concrete to increase its durability. This improvement may be facilitated by the existence of certain composites in Chebula, which are comparable to tannins and polyphenols. Chebula powder could aid in decreasing concrete's permeability, increasing its resistance to water intrusion and possibly strengthening its defenses against chemical access and freeze-thaw cycles. Alccofine-1203, sometimes referred to as polycofine, is a cementitious ingredient. It is extensively utilized in the building sector. Rice husks are burned to create the highly reactive, finely granulated powder known as Alcofine-1203. ALCCOFINE-1203 is a pozzolanic. Stated differently, it is a substance that forms a cementitious compound when it combines with calcium hydride in water.

2. OBJECTIVES

1. To examine how adding Chebula powder, Alccofine 1203, and Quartz powder as supplemental cementitious materials affects concrete's mechanical qualities, including its tensile and compressive stren1.gths, in comparison to regular concrete.

2. To assess the environmental sustainability and durability properties (such as permeability, water absorption, and resistance to chemical attack) of concrete modified with quartz powder, Chebula powder, and Alccofine 1203, with the goal of improving concrete performance while lowering the carbon footprint of cementitious materials.

3. MATERIALS

3.1 Cement: As an essential component of mortar and concrete that secures and binds building components, cement plays a critical function in urban infrastructure. Whereas mortar is composed of cement, water, and lime aggregate, concrete is created by combining cement, water, sand, and gravel in precise amounts. Both are used to fill in spaces, seal joints, bind materials like bricks and stones, and make ornamental designs. Cement works well for waterproofing purposes because it combines with silicates and aluminates to create a hardened, water-repellent material when combined with water.

3.2 Fine aggregate: The majority of the natural sand particles that make up fine aggregates pass through a

3/8-inch filter and are sourced from crushed stone or mining. Zone II-compliant fine aggregate is utilized in this experimental investigation.

3.3 Coarse aggregate: Coarse aggregate is made up of big, sturdy particles that usually range in size from 4.75 mm to 40 mm, like slag, crushed stone, or gravel. It is the main load-bearing element in concrete, giving it volume, stability, and structural strength. The formation of a robust, dense concrete matrix, increased durability, decreased shrinkage, and improved mechanical qualities of the concrete are all made possible by coarse particles.

3.4 Water: Concrete requires water because it starts the hydration process, which allows cement to solidify and bind aggregate particles together. The amount and quality of water in the mixture have a big impact on the concrete's strength, durability, workability, and setting time. To balance workability and strength, the water-to-cement ratio must be carefully regulated. Too much water weakens the concrete and increases porosity, while too little water makes it difficult to handle and compact.

3.5 Chebula powder: The dried fruits of Terminalia chebula, also referred to as haritaki, are the source of this natural, finely powdered powder. It is used extensively in traditional medicine and as an environmentally friendly ingredient since it is high in tannins, antioxidants, and bioactive chemicals. Chebula powder is being investigated for its potential as an additional material in construction to improve the durability and strength of concrete.

3.6 Alccofine 1203 : Alccofine 1203, a micro-fine mineral addition that is mostly made of calcium silicate-based minerals, is frequently used to enhance the performance of concrete. By decreasing permeability and improving hydration efficiency, it improves workability, strength, and durability. Alccofine 1203, which has an ultra-fine particle size, works especially well in self-compacting and high-performance concrete applications.

3.7 Quartz powder : Natural quartz is a hard, crystalline mineral formed of silica (SiO_2) that is pulverized into a fine powder. It serves as a filler and additive to enhance the mechanical qualities, strength, and durability of concrete, and is widely utilized in a variety of industries, including construction. For high-performance concrete applications, its tiny particle size and chemical stability make it the perfect material.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

The compressive strength test measures the ability of a material, such as concrete, to withstand axial loads without failing or deforming. It is performed by applying a compressive force to a specimen, such as a cube until it fractures.

Table 1: The compressive strength results of concrete with partial replacement of Fine aggregate by Chebula powder.

Sl.no	% of ChebulaPowder	Compressive Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	32.13	34.96	37.54
2	0.25%	40.53	44.19	47.48
3	0.5%	41.56	45.28	48.62
4	0.75%	42.48	46.31	49.79
5	1.0%	40.04	43.67	46.81

Table 2: The compressive strength results of concrete with partial replacement of cement by Alccofine 1203.

Sl.no	% of Alccofine 1203	Compressive Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	32.13	34.96	37.54
2	5%	35.07	38.29	41.06
3	10%	36.94	40.26	43.38
4	15%	34.51	37.64	40.57

Table 3: The compressive strength results of concrete with partial replacement of cement by Quartz powder.

Sl.no	% of Quartz powder	Compressive Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	32.13	34.96	37.54
2	10%	36.44	39.63	42.38
3	20%	38.27	41.72	44.81
4	30%	37.03	40.36	43.57

Table 4: The combined replacement of 0.75% Chebula powder as a substitute for fine aggregate, 10% Alccofine 1203, and 20% Quartz powder as a replacement for cement.

Sl.no	0.75% of CP+10% AF+20% QP	Compressive Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	32.13	34.96	37.54
2	0.75% of CP+10% AF+20% QP	47.63	51.78	55.69

4.2 Split tensile strength

The split tensile strength of a concrete cylinder is a measure of its resistance to tensile stress, determined by loading the cylinder horizontally along its diameter.

Table 5: The Split tensile strength results of concrete with partial replacement of Fine aggregate by Chebula powder.

Sl.no	% of ChebulaPowder	Split tensile Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	3.21	3.49	3.75
2	0.25%	3.96	4.31	4.63
3	0.5%	4.10	4.45	4.79
4	0.75%	4.29	4.67	5.03
5	1.0%	3.92	4.24	4.58

Table 6: The Split tensile strength results of concrete with partial replacement of cement by Alccofine 1203.

Sl.no	% of Alccofine 1203	Split tensile Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	3.21	3.49	3.75
2	5%	3.46	3.81	4.03
3	10%	3.67	3.98	4.31
4	15%	3.38	3.64	3.97

Table 7: The Split tensile strength results of concrete with partial replacement of cement by Quartz powder.

Sl.no	% of Quartz powder	Split tensile Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	3.21	3.49	3.75
2	10%	3.64	3.93	4.27
3	20%	3.82	4.16	4.48
4	30%	3.68	4.03	4.32

Table 8: The combined replacement of 0.75% Chebula powder as a substitute for fine aggregate, 10% Alccofine 1203, and 20% Quartz powder as a replacement for cement.

Sl.no	0.75% of CP+10% AF+20% QP	Split tensile Strength Results, N/mm²		
		28 days	56 days	90 days
1	0%	3.21	3.49	3.75
2	0.75% of CP+10% AF+20% QP	4.28	4.64	5.02

5. CONCLUSION:

1. The normal concrete compressive strength result for 28, 56 and 90 days is given as 32.13, 34.96 and 37.54 N/mm².
2. At optimum of 0.75% chebula powder as partial replacement with fine aggregate compressive strength test result for 28, 56 and 90 days are 42.48, 46.31 and 49.79 N/mm².
3. At optimum of 10% alccofine 1203 as partial replacement with cement compressive strength test result for 28, 56 and 90 days are 36.94, 40.26 and 43.38 N/mm².
4. At optimum of 20% quartz powder as partial replacement with cement compressive strength test result for 28, 56 and 90 days are 38.27, 41.72 and 44.81 N/mm².
5. By combination of 0.75% of CP+ 10% of AF + 20% of QP the compressive strength result for 28, 56 and 90 days is given as 47.63, 51.78 and 55.69 N/mm².

6. The normal concrete split tensile strength test result values for 28, 56 and 90 days is given as 3.21, 3.49 and 3.75 N/mm^2.

7. At optimum of 0.75% chebula powder as partial replacement with fine aggregate split tensile strength test result for 28, 56 and 90 days are 4.29, 4.67 and 5.03 N/mm^2.

8. At optimum of 10% alccofine 1203 as partial replacement with cement split tensile strength test result for 28, 56 and 90 days are 3.67, 3.98 and 4.31 N/mm^2.

9. At optimum of 20% quartz powder as partial replacement with cement split tensile strength test result for 28, 56 and 90 days are 3.82, 4.16 and 4.48 N/mm^2.

10. By combination of 0.75% of CP+ 10% of AF + 20% of QP the split tensile strength test result for 28, 56 and 90 days is given as 4.28, 4.64 and 5.02 N/mm^2.

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