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STRENGTHENING ON CONCRETE WITH CALCIUM CHLORIDE AND GLASS POWDER

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ABSTRACT

Concrete, a ubiquitous construction material, is a versatile, strong, and durable composite of cement, aggregates (fine and coarse), and water.This study aims to enhance its properties by incorporating industrial by-products and chemical admixtures. Specifically, we're investigating the partial replacement of *fine aggregate with glass powder**and**cement with calcium chloride*. ***Glass powder, an abundant waste material, exhibits pozzolanic properties that can improve concrete's strength and durability.Calcium chloride, a common accelerator, is known to speed up cement hydration and boost early strength. Our goal is to evaluate the combined effects of these replacements on both the fresh and hardened properties of concrete, ultimately determining the optimal replacement percentages for both glass powder and calcium chloride.Test for compressive strength and split tensile strength for 28,56 and 90 days.***

***KEYWORDS:* Calcium Chloride, Glass powder, Durability, Compressive strength and Split tensile strength**

1. INTRODUCTION

Concrete is a cornerstone of global construction, with only water being consumed more.This essential composite material consists primarily of cement, aggregates like sand and gravel, and water.Through a chemical reaction called hydration, the cement and water form a hardened paste that binds the aggregates into a durable, stone-like mass.Its remarkable versatility, strength, and durability have made concrete the backbone of modern infrastructure.It provides essential structural integrity and long-term performance for diverse applications, from towering skyscrapers and vast road networks to intricate bridges, dams, and residential buildings.Concrete's widespread adoption is largely due to its ability to be molded into virtually any shape when fresh, combined with its resistance to heavy loads, fire, and harsh environmental conditions.

This study investigates the utilization of glass powder as a partial replacement for fine aggregate in concrete, offering a two-fold solution to environmental challenges. Not only does it help conserve natural sand deposits, but it also provides a viable outlet for the enormous quantities of waste glass generated worldwide. When finely ground, glass exhibits pozzolanic activity, meaning it can chemically react with calcium hydroxide in the cement paste to form additional binding compounds, thereby improving concrete's long-term strength and microstructure.

Calcium chloride (CaCl2) is a familiar concrete admixture, primarily known for speeding up cement hydration.When incorporated, it drastically cuts down both initial and final setting times, leading to quicker strength gain. This acceleration proves especially useful in cold weather, allowing for faster form removal and earlier use of the structure. While usually an additive, investigating CaCl2 as a partial cement replacement in some applications is worth exploring. This strategy aims to capitalize on its accelerating properties while potentially optimizing cement content, thereby influencing concrete production's cost and environmental impact.

2. OBJECTIVES

1. To determine the fresh and hardened properties of concrete incorporating various percentages of glass powder as a partial replacement for fine aggregate.

2. To assesses the influence of partially replacing cement with calcium chloride on the setting time and early-age strength development of concrete.

3. MATERIALS

3.1 Cement: Cementis a finely ground powder, usually derived from limestone and clay, that acts as a vital binding agent. When mixed with water, it undergoes **hydration,** a chemical reaction that creates a solid paste crucial for bonding aggregates in concrete and mortar.

3.2 Fineaggregate:In civil engineering, **fine aggregate** refers to granular materials such as sand, crushed stone, or crushed slag. Its particles typically pass through a 4.75 mm sieve but are retained on a 0.075 mm sieve.

3.3 Coarse aggregate: Coarse **aggregate** consists of larger granular materials like gravel or crushed stone, with particles primarily retained on a 4.75 mm sieve.

3.4 Water: Water is a critical component that contributes to concrete's volume, strength, and structural integrity. It serves two main functions: it chemically reacts with cement through **hydration** to form a solid binding paste, and it acts as a lubricant, assisting with the proper placement and finishing of the mix.

3.5Glass Powder: It’s a synthetic, finely milled material made from recycled or waste glass.

3.6 Calcium Chloride: While **calcium chloride (CaCl2)** is primarily known as a concrete admixture to speed up setting and early strength gain, its application as a **partial cement replacement** involves directly substituting a small percentage of cement with CaCl2 in the mix..

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

The compressive strength test assesses the greatest load that a material, such as concrete, can endure under compression before it either fails or deforms. This is usually performed by incrementally applying force to a standard specimen cube within a testing apparatus for 28,56 and 90 days.

Table 1: Compressive strength results of concrete with Glass Powder used as a partial replacement of fine aggregate.

Sl.no	% of Glass powder	Compressive Strength Results, N/mm^2		
		28 days	**56 days**	**90 days**
1	0%	39.07	42.48	45.61
2	5%	48.54	52.83	56.67
3	10%	50.88	55.43	59.45
4	15%	53.54	58.86	62.52
5	20%	52.16	57.02	61.26

Table 2: Compressive strength results of concrete with Calcium Chloride used as a partial replacement of cement.

Sl.no	% of Calcium Chloride	Compressive Strength Results, N/mm^2		
		28 days	**56 days**	**90 days**
1	0%	39.07	42.48	45.61
2	1%	40.22	43.73	46.97
3	2%	42.03	45.75	49.12
4	3%	43.34	47.63	50.74

Table 3: Combined Compressive strength results of concrete with 3% CC+15% GP

Sl.no	7.5% of Glass powder	Compressive Strength Results, N/mm^2		
		28 days	**56 days**	**90 days**
1	0%	39.07	42.48	45.61
2	*3% CC+15% GP*	60.12	65.47	70.28

4.2 Split tensile strength

The split tensile strength test is an indirect method used to determine the tensile strength of brittle materials like concrete. It involves placing a cylindrical specimen horizontally and applying a compressive load diametrically along its length, causing the cylinder to split along the loaded diameter due to induced tensile stresses.To cracking in concrete constructions for 28,56 and 90 days.

Table 4: Split tensile strength results of concrete with Glass Powder used as a partial replacement of fine aggregate.

Sl.no	% of Glass powder	Split tensile Strength Results, N/mm^2		
		28 days	**56 days**	**90 days**
1	0%	3.47	3.78	4.04
2	5%	4.73	5.12	5.57
3	10%	5.01	5.44	5.89
4	15%	5.34	5.81	6.23
5	20%	5.16	5.64	6.03

Table 5: Split tensile strength results of concrete with Calcium Chloride used as a partial replacement of cement.

Sl.no	% of Calcium Chloride	Split tensile Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	3.47	3.78	4.04
2	1%	3.91	4.25	4.54
3	2%	4.13	4.48	4.82
4	3%	4.29	4.61	4.98

Table 6: Combined Split tensile strength results of concrete with 3% CC+15% GP

Sl.no	7.5% of Glass powder	Split tensile Strength Results, N/mm^2		
		28 days	56 days	90 days
1	0%	3.47	3.78	4.04
2	*3% CC+15% GP*	5.94	6.46	6.94

5. CONCLUSION

1. The normal concrete compressive strength results for 28, 56 and 90 days is 39.07, 42.48 and 45.61 N/mm^2.
2. At 15% partial replacement of fine aggregate with Glass powder which gives compressive strength result for 28, 56 and 90 days is 53.54 , 58.86 and 62.52 N/mm^2.
3. At 3% partial replacement of cement with Calcium Chloride which gives compressive strength result 28, 56 and 90 days is 43.34 , 47.63 and 50.74 N/mm^2.
4. Compressive strength result for combined replacement of 15% partial replacement of fine aggregate with Glass powder and 3% partial replacement of cement with Calcium Chloride which gives compressive strength result for 28, 56 and 90 days is 60.12 , 65.47 and 70.28 N/mm^2.
5. The normal concrete split tensile strength results for 28, 56 and 90 days is 3.47 , 3.78 and 4.04 N/mm^2..
6. At 15% partial replacement of fine aggregate with Glass powder which gives split tensile strength result for 28, 56 and 90 days is 5.34 , 5.81 and 6.23 N/mm^2.
7. At 3% partial replacement of cement with Calcium Chloride which gives split tensile strength result for 28, 56 and 90 days is 4.29 , 4.61 and 4.98 N/mm^2.
8. Split tensile strength result for combined replacement of 15% partial replacement of fine aggregate with Glass powder and 3% partial replacement of cement with Calcium Chloride which gives compressive strength result for 28, 56 and 90 days is 5.94, 6.46 and 6.94 N/mm^2.

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