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An Experimental Investigation Using Glass Powder and Steel Slag Instead of Cement

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ABSTRACT: Pollution from cement is absolutely unbelievable. According to research for this article, the manufacturing of cement accounts for 5% of all man-made emissions worldwide. Cement is what holds concrete together, despite the fact that the terms are frequently used interchangeably. We manufacture over 4 billion tons of cement globally, and between the chemical processes and the fuel required to power them, they release an astounding 900 kg of CO₂ for every ton of cement produced. There might be an effect if there was a cement substitute that was as effective at reducing these emissions. An effective substitute for cement would be a mixture of glass powder and steel slag to create concrete. The truth is that Portland cement is not nearly as strong as steel slag and glass powder. It is able to withstand minor shocks.

I. INTRODUCTION

one of the most widely used building materials in the world. In recent years, it has become more and more common to employ residual materials and residues in concrete. Using these materials has various beneficial ecological consequences, including minimizing landfill fees, conserving energy, and protecting the environment from potential pollution, in addition to lowering the cost of cement and concrete manufacturing. They can also improve the mechanical properties, microstructure, and durability of the mortar; furthermore, the concrete is stronger than standard M25 concrete.

II. MATERIAL USED

A) PROPERTIES CEMENT:

In this experiment, cement slag and glass powder concrete are replaced with ordinary Portland cement grade 43.

Table 1: Cement characteristics

S.NO	COVERAGE	RESULT
1	Grade applied	43
2	Particular gravity	3.14
3	Taste typical	6.0%
4	Grade appliconstancy	33.0
5	first-time setting	30.0 min
6	Last-minute setup time	10.0hrs

B) FINE AGGREGATE:

M-sand that is readily available locally is employed in this experiment..



Table 2: Characteristics of fine aggregate

S.NO	COVERAGE	RESULT
1	Specific gravity	2.71kg/m ³
2	Water absorption	3.0%
3	Fineness modulus	3.31

C) COARSE AGGREGATE:

In this experiment, 20mm aggregate that is readily available locally is employed. In this experiment, 20mm aggregate that is readily available locally is employed

Table 3: Characteristics of coarse aggregate

S.NO	COVERAGE	RESULT
1	Specific gravity	2.80kg/m ³
2	Fineness modulus of Coarse aggregate	4.42%

D) WATER:

Water is the main part of the concrete. In this experimentation our campus usage water is used.

Table 3: Characteristics of water

S.NO	COVERAGE	RESULT
1	Appearance	Clear
2	pH value	7.3
3	Turbidity	Low

III. RESULT AND DISCUSSION

TEST RESULTS ON COMPRESSIVE STRENGTH

In order to determine the tensile strength of concrete, three samples are tested for each mix, and the average results are used. Table 5 presents the compressive strength values for both the conventional and other variation mixes, with a graph to clearly distinguish between them.

Conventional concrete = 100% fine aggregate & 100% coarse aggregate

Mix 1 = 70% Steel slag & 30% Glass powder

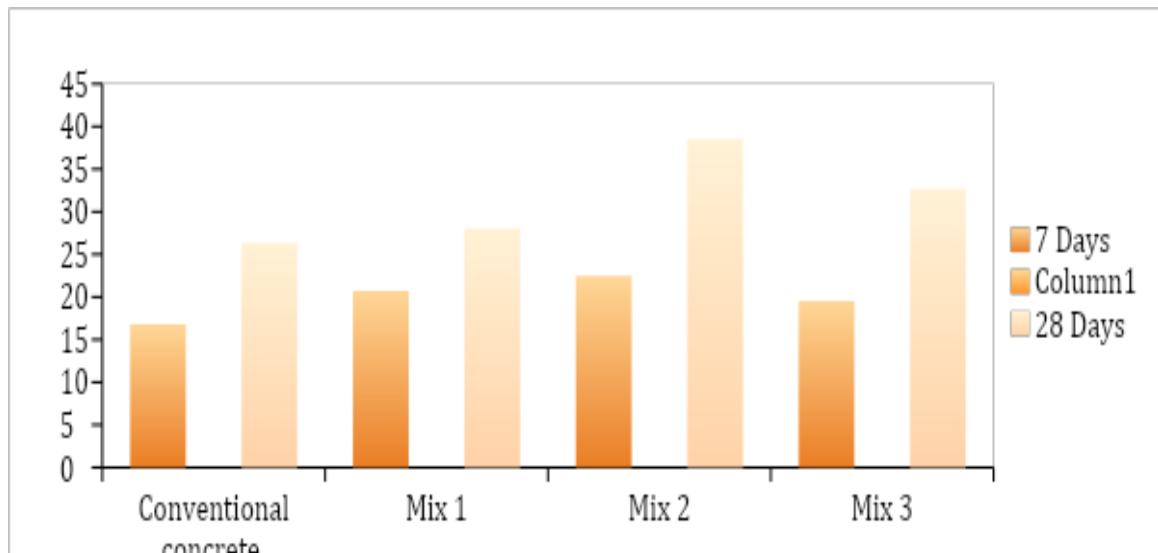


Mix 2 = 80% Steel slag & 20% Glass powder
 Mix 3 = 90% Steel slag & 10% Glass powder

Table 4: Result on compressive Strength at 7 and 28 Days

S.NO	Type of concrete	Compressive strength (N/mm ²)	
		7 Days	28 Days
1	Conventional concrete	16.79	26.36
2	Mix 1	20.76	28.03
3	Mix 2	22.43	38.5
4	Mix 3	19.54	32.66

Chart 1: compressive strength at 7 and 28 days



% of steel slag and Glass powder

TEST RESULTS ON SPLIT TENSILE STRENGTH

The tensile strength of concrete is determined by testing three samples for each mix and averaging the values. In Table 5, the split tensile strength values for the conventional and alternative variation mixes are displayed and graphically distinguished.

Conventional concrete = 100% fine aggregate & 100% coarse aggregate
 Mix 1 = 70% Steel slag & 30% Glass powder
 Mix 2 = 80% Steel slag & 20% Glass powder

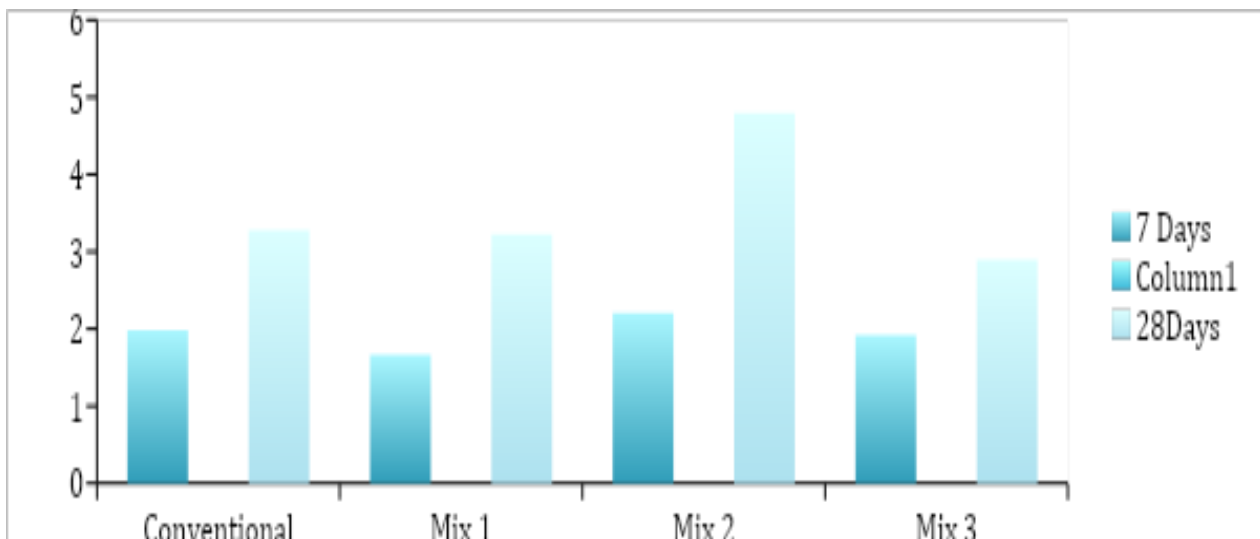


Mix 3 = 90% Steel slag & 10% Glass powder

Table 5: Result on Split Tensile Strength at 7 & 28 Days

S.NO	Type of concrete	Split Tensile strength (N/mm ²)	
		7 Days	28Days
1	Conventional concrete	1.98	3.28
2	Mix 1	1.66	3.22
3	Mix 2	2.21	4.8
4	Mix 3	1.92	2.9

Chart 2 : Split Tensile Strength at 7 & 25 Days



% of steel slag and Glass powder

TEST RESULTS ON FLEXURAL STRENGTH

The tensile strength of concrete is determined by testing three samples for each mix and averaging the values. In Table 5, the split tensile strength values for the conventional and alternative variation mixes are displayed and graphically distinguished.

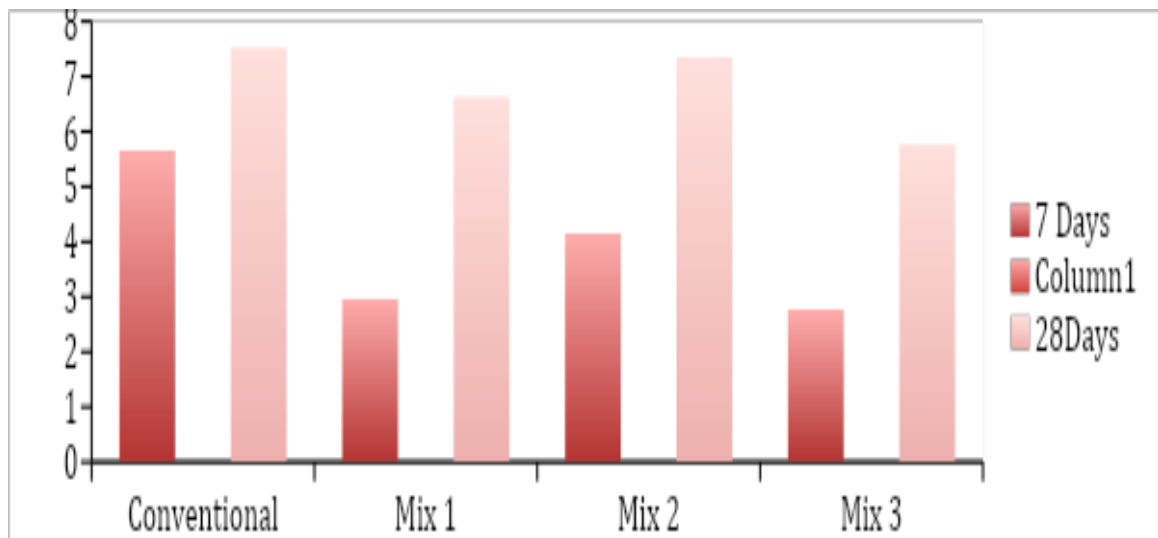
- Conventional concrete = 100% fine aggregate & 100% coarse aggregate
- Mix 1 = 70% Steel slag & 30% Glass powder
- Mix 2 = 80% Steel slag & 20% Glass powder
- Mix 3 = 90% Steel slag & 10% Glass powder



Table 6: Result on Flexural Strength at 7 and 28 Days

S.NO	Type of concrete	Split Tensile strength (N/mm ²)	
		7 Days	28 Days
1	Conventional concrete	5.65	7.52
2	Mix 1	2.96	6.62
3	Mix 2	4.15	7.34
4	Mix 3	2.76	5.76

Chart 3: Flexural Strength at 7 & 28 Days



% of steel slag and Glass powder

IV. CONCLUSION

An effective substitute for cement would be a mixture of glass powder and steel slag to create concrete. In actuality, Portland cement is not nearly as strong as steel wire and glass powder. It has the potential to withstand the force of minor earthquakes and industrial operations. Glass powder and steel slag become harder as they dry and collect CO₂ from the atmosphere. Increase the strength characteristic of M25 grade concrete by 30%, 20%, and 10% when glass powder and 70%, 80%, and 20% of steel slag are substituted.

The primary characteristics of these investigations below:

- Up to 80%-20% of Steel sing slag Glass powder there is optimum percentage increase of all mechanical properties.
- Compressive strength of material increases with increasing Steel slag added.
- Strengthening of the splitting tensile strength is attributed to the 30% increase in glass powder and steel slag replacement of cement.
- When compared to traditional concrete, the replacement of steel slag and glass powder increases the compressive strength and split tensile strength.



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