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Effect of Waste Steel over the Performance of Low & Medium Grade Concrete

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ABSTRACT: In this research Cement blended with glass powder and partial replacement of Sand by torn steel waste has been considered. Experimental study had been conducted to evaluate the workability of fresh concrete and strength characteristics of hardened concrete. Properties of low strength and medium grade of concrete have been assessed by blending cement with glass powder and partial replacement of sand with torn steel waste. The cement blended with 20% glass powder by weight of cement has been used to prepare M-15, and M-25concrete mix. The sand has been replaced by torn steel waste accordingly in the range of 0%, 10%, 15%, 20%, and 25% by weight of sand. Concrete mixtures have been produced, tested and compared in terms of compressive, strength with the conventional concrete after 7,14, 28 days. The replacement of natural resources or basic ingredients in the manufacturing of cement concrete is a significant topic in the present construction scenario. Glass powder and torn steel waste are industrial by-product materials produced from the process of manufacturing of glasses and iron. Use of Glass powder and torn steel waste does not only reduce the cost of construction but also helps to reduce the impact on environment by consuming the material generally considered as waste product. Hence, in the current study an attempt has been made to minimize the cost of preparing concrete of grades M-15 and M-25 by partially replacing cement and sand with glass dust and torn steel waste in concrete. It has been observed that replacing a fixed percentage of cement and sand not only maintains the economy of project but also manages the industrial waste.

Keywords: Glass powder; torn steel; conventional concrete; eco-friendly

INTRODUCTION

The most effective way to manage these materials is to partially substitute the cement or sand with this materials in different grades of concrete such as M30 and M15 grades of concrete to facilitate the waste management. The hardening is caused by chemical reaction between water and cement and it continues for a long time, and consequently the concrete grows stronger with age. The hardened concrete may also be considered as an artificial stone in which the voids of larger particles (coarse aggregate) are filled by the smaller particles (fine aggregate) and the voids of fine aggregate are filled with cement. Properties of concrete with glass powder and torn steel waste as partial percentile replacement have been studied in this research. Water - binder ratio of 0.45 has been considered for all mixes and properties like workability, density, water absorption, and compressive strength at 7, 14, and 28 days have been analysed.

The influence of binary and ternary blend of mineral admixtures on the short and long term performances of concrete and brought to closed many improved concrete properties in fresh and hardened states had been studied by Meena and Singh [1].

Rudy [2] performed experimental study on Effect of mixture composition and Initial curing conditions over resistance of ternary concrete, revealed that the effect of dissimilar proportions of ingredients of ternary blend concrete mix on resistance of concrete at lower temperatures.

By the addition of hydrated lime and silica fume the properties of fly ash concrete investigated by Barbhuiya et al. [3], and observed that accumulation of lime and silica fume increases the early compressive strength and long term strength development and resilience of concrete.

An experimental research on comparison of properties of steel slag and crushed limestone aggregate concrete performed Abdullah et al. [4], which concludes that resilience characteristics of steel slag cement concrete is better than crushed limestones aggregate concrete.

Patel et al. [5] performed an experimental work on broader use of steel slag aggregate in concrete and revealed that durability of steel slag aggregates concrete under freeze-thaw environment was the main goal in this research, as there was a belief that the steel slag aggregates have expansive characteristics and would cause cracking in concrete.

Qasrawi et al. [6] performed Research work on utilization of low CaO untreated steel slag in concrete as fine aggregate. Finally concluded that compressive and tensile strengths of concrete steel slag are more beneficial for concretes of lower strength.

Boukendakdji et al. [7] studied the Effect of slag on the theology of fresh self- compacted concrete observed by performing experiments and concluded that slag can produce good self-compacting concrete.

MATERIALS AND METHODS

Torn Steel Waste- Torn Steel waste, which is produced locally in great amounts from steel workshops and factories, has a negative impact on the environment when disposed. Partial substitution of sand in concrete minimizes the energy consumption and thus, reduces the content of cement or sand in the concrete mix. Torn steel waste is added to cement concrete to improve its properties, in particular its compressive strength. Torn steel waste is consists of fine particles of size very small to the average size. Because of its extreme fineness, torn steel waste is a very effective alternative material.

Glass Powder- As the glass is primarily a silica-based substance in amorphous form can be utilized in cement-based applications. The chief concerns for the use of crushed glasses as aggregates for ordinary cement concrete are the expansion and cracking caused by the glass aggregates due to alkali silica reaction. The consumption of recycled waste glass in Portland occupied significant amount of interest because of higher dumping costs and environmental hazards.

Methodology adopted in present research-For completing the present research following steps are followed.

Collection of waste materials- Materials such as glass powder and Torn steel powder had been collected from different industries, these materials are stored at testing laboratory. Replacement of cement and sand with these materials in different proportions.

RESULTS AND DISCUSSION

This chapter summarizes the results and discussion over it. Following are the details of prepared specimens and conducted tests -

Preparation of specimens- Five specimens are prepared for each Concrete Mixes of concrete.

Fig. 1- Torn steel waste

Fig.2 - Glass powder

Table 1: Concrete mixes prepared for M-25 (1:1:2) grade of concrete

Mix Designation	Sample no.	Ingredients (Kg)					
		Cement	Glass Powder	Sand	Coarse Aggregate	torn Steel Waste	% torn Steel Waste
TM1 (Plain Cement concrete)	TM100	2	0	2	4	0	0
	TM110	2	0	1.8	4	0.2	10
	TM115	2	0	1.7	4	0.3	15
	TM120	2	0	1.6	4	0.4	20
	TM125	2	0	1.5	4	0.5	25
TM 2 (Blended ce-	TM200	1	1	2	4	0	0
	TM210	1	1	1.8	4	0.2	10

ment concrete)	TM215	1	1	1.7	4	0.3	15
	TM220	1	1	1.6	4	0.4	20
	TM225	1	1	1.5	4	0.5	25

Table 2: Concrete mixes prepared for M-15 (1:2:4) grade of concrete

Mix Designation	Sample no.	Ingredients (Kg)					
		Cement	Marble Powder	Sand	Coarse Aggregate	Torn Steel Waste	% Torn Steel Waste
TM3 (Plain cement concrete)	TM 300	2	0	4	8	0	0
	TM 310	2	0	3.6	8	0.4	10
	TM 315	2	0	3.4	8	0.6	15
	TM 320	2	0	3.2	8	0.8	20
	TM 325	2	0	3	8	1	25
TM4 (Blended cement concrete)	TM 400	1	1	4	8	0	0
	TM 410	1	1	3.6	8	0.4	10
	TM 415	1	1	3.4	8	0.6	15
	TM 420	1	1	3.2	8	0.8	20
	TM 425	1	1	3	8	1	25

Table 3: Slump value (mm) for M25 and M15 grade of Concrete

Sr. No.	Sample no. TM1	Slump Value (mm)	Sample no. TM2	Slump Value (mm)	Sample no TM3	Slump Value (mm)	Sample no TM4	Slump Value (mm)
1	TM100	109	TM200	104	TM300	94	TM400	98
2	TM110	94	TM210	99	TM310	79	TM410	89
3	TM115	89	TM215	93	TM315	74	TM415	81
4	TM120	86	TM220	87	TM320	70	TM420	77
5	TM125	81	TM225	84	TM325	65	TM425	74

Table 4: Compressive strength of M15 & M25 grade of Concrete

Sr. No.	Sample no. TM1	Compressive Strength N/mm^2 at 28 days	Sample no. TM2	Compressive Strength N/mm^2 at 28 days	Sample no TM3	Compressive Strength N/mm^2 at 28 days	Sample no TM4	Compressive Strength N/mm^2 at 28 days
1	TM100	23.26	TM200	22.9	TM300	16.9	TM400	12.83
2	TM110	26.57	TM210	24.54	TM310	18.79	TM410	13.64
3	TM115	28.66	TM215	24.9	TM315	20.49	TM415	13.94

4	TM120	30.10	TM220	26.10	TM320	22.04	TM420	14.9
5	TM125	32.54	TM225	27.86	TM325	22.84	TM425	16.65

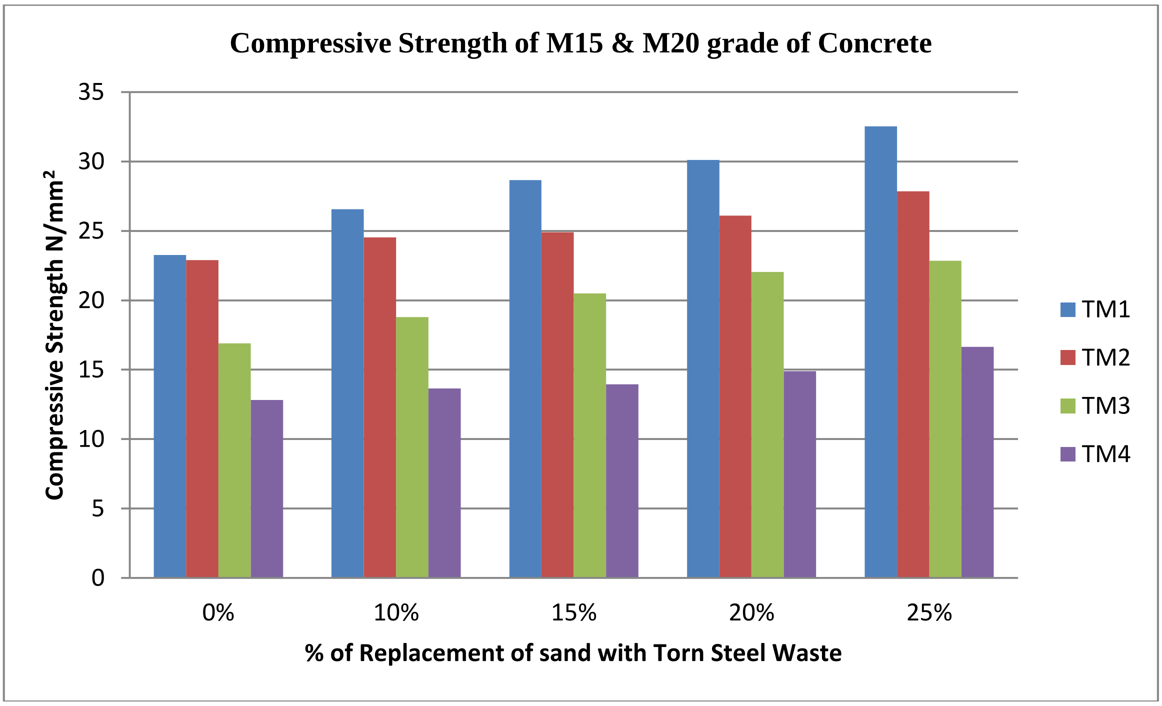

Figure 3: Compressive strength of M15 & M25 grade of Concrete

CONCLUSIONS

Following are the Conclusions of present work

1. When increasing the percentage of torn steel waste in M25 grade of concrete the compressive strength is increased and we achieved higher values of compressive strength.
2. When increasing the percentage replacement of sand using torn steel waste in M15 grade of concrete the compressive strength also increased and we achieved nearest values of compressive strength.
3. When blended cement and the replacement of sand using sharded steel waste in M25 grade of concrete the compressive strength is also increased and we achieved higher values of compressive strength.
4. When blended cement and the replacement of sand using sharded steel waste in M15 grade of concrete the compressive strength is also increased and we achieved higher values of compressive strength. No effect on concrete as a replacement of cement by marble powder.
5. The workability of both concrete is decreased using replacement of torn steel waste and the concrete is less workable when increasing the % of sharded steel waste.
6. The cost of overall construction is also reduced using blended cement and torn steel waste.

The overall conclusion are increased the compressive strength using torn steel waste, workability is reduced and cost is also reduced. The setting of cement is same when marble powder mix with torn steel waste.

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