

APPLICATION OF CAST IRON WASTE (CIW) IN CONCRETE ENHANCING THE THERMAL INSULATING (TI) PROPERTY

Abstract

Concrete is a mixture material of cement, sand and aggregate (fine aggregate and coarse aggregate) with water content in a definite proportion. There are some admixture material who are enhance the property of concrete, such types of concrete is name as modified concrete. Cupola blast furnace slag is used in this experiment in the percentage of 1%, 3% and 5% with partially replacement of cement (OPC). For making M20 concrete used the ratio 1:1.5:3 mix proportion. After the adding CIW in cupola cement concrete the slump value is gradually reduced 2.64%, 9.22% and 16.79% resp. after adding the 1% to 5% of CIW the water holding capacity is also reduced by 12.65%, 16.66% and 27.02%. and the compressive strength is reduced after 1% adding of Cupola slag is 3.40% and increased 10.68% and 11.61% after adding the 3% and 5% of CIW resp. thermal conductivity is gradually reduced by 12.89%, 13.12% and 19.12% after adding the 1%, 3% and 5% of cupola slag. The thermal performance may be more good after adding the more percentage of CIW.

Keywords: Cast iron Waste, Normal cement concrete, cupola cement concrete, thermal conductivity, Ordinary Portland cement.

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I. INTRODUCTION

Slag can be used in various building construction material for changing their physical and chemical properties for the easy comfort of living. There are many waste are use in building construction material (BCM) like fly ash , slag, agricultural waste, industrial waste, domestic waste etc. these all waste contains different types of properties and basis of their property we can use these waste in building.

Slag can be produced from many metallurgical waste like –iron, steel, nickel, managnese, copper etc.[1] In construction industry many types of waste or slag can be used but mostly blast furnace slag are used due to its friendly property with cement but now a day a new material is introduced from industry waste “Cupola slag” it is byproduct of metals .from one tonns of metal 50-60 kg of CS is generated.

The chemical properties of CS is similar to the blast furnace slag ,which is depend on SiO_2 , Al_2O_3 , CaO , MgO , FeO , and other oxides and sulphides[2].The physical property of CS is huge similar to natural fine aggregate and coarse aggregate used in concrete. Cupola slag can be used in concrete for gaining satisfactory strength. Economic analysis shows a saving of 19% of cement replacement and 1,7 and 0.53 % for FA and CA resp.

II. LITERETURE REVIEW

The presence of alkalis in cement, particularly portland cement, such as potassium oxide (K_2O) and sodium oxide (Na_2O), may be of concern, according to Willie et al. For instance, if the cementitious materials are mixed with aggregates that include Silicon Oxide (SiO), the expanding alkali Silica gel that results from the reaction between the cementitious materials' alkalis and the SiO_2 may cause the concrete structure to fracture and crumble.

The use of cementitious materials with low alkali concentration is often preferred since it is challenging to identify reactive SiO_2 in aggregates. As a result, the ASTM C150 specification includes an optional restriction of a maximum equivalent NaO of about 0.6 percent. With SiO_2 reactive aggregates, it is feasible to utilize cement that contains more than 0.60 percent equivalent Na_2O while preventing excessive expansion and lowering the total energy required to make the cement. Cement, ideally portlandcement, and latently hydraulic materials like granulated blast furnace slag are one example.

However, because portland cement reacts more quickly, the latently hydraulic elements actually add to the strength of the later-developed cement rather of the earlier. Lower temperatures of hydration due to the early activity decline result in the creation of thermal cracks. Blast furnace slag is added; yet thermal fracture development still persists. Granulated slag (GS) has been successfully used in concrete in previous research as a cement substitute. The recycling of slag will undoubtedly become an important measure for the preservation of the environment and, as a result, will be of great relevance, according to Sun and Zhu's 2007 research. According to Dubey et al. (2012), GS concrete requires a longer curing time than normal concrete. Khan and Usman (2004) came to the conclusion that because GS concrete is more workable, the water-to-cement ratio may be decreased, increasing compressive strength. According to Shariq and Ahuja (2008), using GS in place of Ordinary Portland Cement (OPC) in concrete results in the strongest concrete at 40% after 56

days of curing. Geopolymer concrete with GS was the subject of a study by Naidu et al. (2012), who discovered that the concrete's strength had increased. The early strength development of composites including GS is significantly reliant on temperature under conventional curing conditions, and the GS mortar build strength more slowly than mortars with Ordinary Portland Cement, according to studies by Barnett et al.

III. MATERIAL AND METHODOLOGY

For the designing of concrete cement (OPC), aggregate (fine aggregate and coarse aggregate) and sand is required in a sufficient percentage of water As per IS code. In this experiment we have to use Cupola blast furnace slag (CBFS) to increase the property of concrete (M20). The ration of M20 concrete is 1:2:4 As per IS code.

- 1. Ingredient of Concrete:** Cement, sand and aggregate is mixed in a definite proportion for the designing concrete. Aggregate is a material which is responsible for the strength of the concrete, and the cement is responsible for the binding and the sand is work in concrete is to increased the crushing strength and prevent the shrinkage and cracking of the concrete. Figure 1 shows the material used in the experimental work. Figure 2 shows the admixture material which is used in the replacement material with cement. i.e.Cupola Blast furnace slag is used with the replacement of Cement in the concrete.



Figure 1: Cement (OPC), Sand, Aggregate



Figure 2: Cast Iron Waste (CIW)

- 2. Experimental Procedure:** To analyze the thermal property of concrete, in this experiment we were used the CBFS in the percentage of 1%, 3% and 5% respectively with the cement. Collect the raw material from the source and garding these material as per IS 456:2000. In this analysis experimental work composite material is prepared which is shown in table 3.1. to know the correct proportion of material in percentage.

Table 1: Percentage of material used in experiment

Name/Material	Cement (OPC) in %	Sand in %	Aggregate in %	Cupola Blast Furnace Slag in %
Normal Cement concrete (C0)	100	100	100	0
Cupola cement Concrete (C1)	99	100	100	1
Cupola cement Concrete (C2)	97	100	100	3
Cupola cement Concrete (C3)	95	100	100	5

3. Test on Concrete: Mainly Four test were conducted in this research work i.e. workability test, water absorption test, Compressive strength test and thermal conductivity test respectively. These test are conducted 7 days and after 28 days. For the workability test slump cone test is used in the different proportion of water content but here we take 50% of water content. For the water absorption test cube (150 mm*150mm*150mm) is casted and test done after the 7 and 28 days. After that compressive strength test were conducted with the compressive testing machine after 7days and 28 days. The main test were performed the Thermal conductivity test (TC) with the help of KD2 pro analyzer after 28 days.

The test results were discussed further point. The thermal conductivity test are performed of concrete bricks which have dimension 150mm*75mm*75mm. the needle of Analyzer is insert in the bricks in a fixed time interval of 10 min.

IV. RESULT AND DISCUSSION

The test conducted in previous poits are discussed here to analyze the result of concrete:

1. Workability of Concrete: The workability on Normal cement concrete of M25 is recorded 76 mm. and the after adding the CBFS in the percentage of 1%, 3% and 5% the slump value is gradually decreased with increasing CBFS. The figure 1 shows the workability property of NCC and CCC.

Table 1: workability of Concrete and CCC

Name/Material	Concrete code	OPC in %	Replacement with CBFS	Water content	Slump value in MM
Normal cement Concrete	C0	100	0	0.50	76
Cupola cement Concrete	C1	99	1	0.50	74
	C2	97	3	0.50	69
	C3	95	5	0.50	64

- 2. Water Absorption of Concrete:** The water absorption capacity is recorded of Normal cement concrete and cupola cement concrete after the 7 days and 28 days. It is observed that when we add the CBFS in the increasing order the water holding capacity is reduced gradually. The figure 2 shows the performance of CBFS for the water holding capacity.

Table 2: Water absorption of Concrete

Name/Material	Concrete code	OPC in %	Replacement with CBFS	Water absorption in %	
				7 Days	28 Days
Normal cement Concrete	C0	100	0	29.5	17.4
Cupola cement Concrete	C1	99	1	26.0	15.2
	C2	97	3	23.7	14.5
	C3	95	5	22.8	12.7

- 3. Compressive Strength of Concrete:** After the adding cupola blast furnace slag in the percentage of 1%, 3% and 5% the compressive strength is decreased in early stage and after adding 3% and 5% it is recorded the CS is increased in 7 days and 28 days.

Table 3: Analysis of Compressive strength of concrete and modified concrete

Name/Material	Concrete code	Compressive strength in N/mm ²	
		7 days	28 days
Normal cement concrete	C0	11.2	33.4
Cupola cement concrete	C1	10.1	32.6
	C2	12.7	35.7
	C3	14.9	38.8

- 4. Thermal Conductivity of Concrete:** The thermal conductivity of concrete and modified concrete is recorded with partial replacement of cement 1%, 3% and 5% respectively. It is observed that after adding CBFS the thermal conductivity was decreased gradually. Figure 4 shows the performance of CBFS in concrete.

Table 4: Thermal performance of Concrete and Modified concrete

Name/ Material	Concrete code	Thermal conductivity in W/mK
Normal cement concrete	C0	2.25
Cupola cement concrete	C1	1.96
	C2	1.91
	C3	1.82

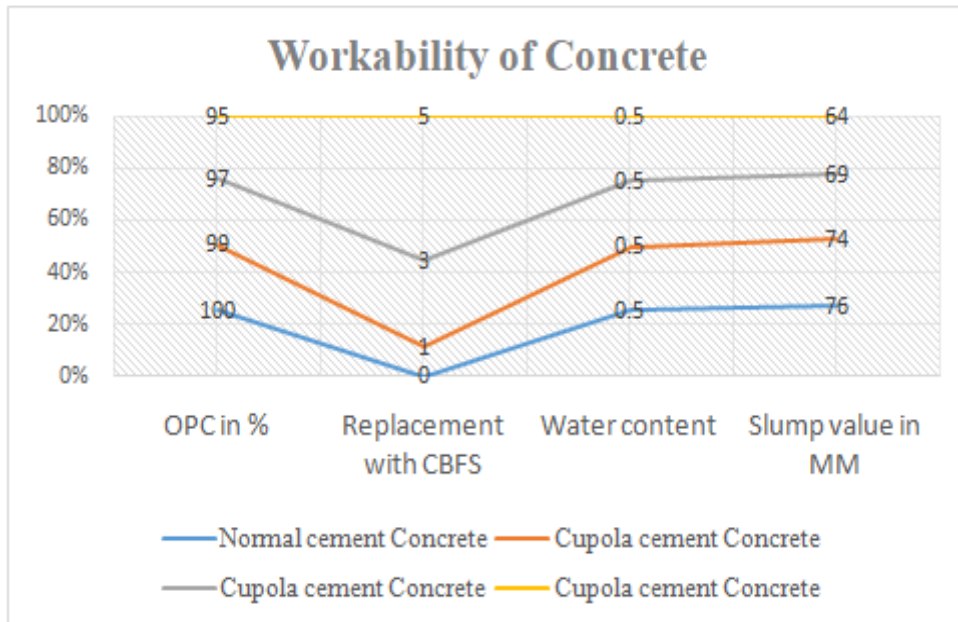


Figure 1: Workability of concrete

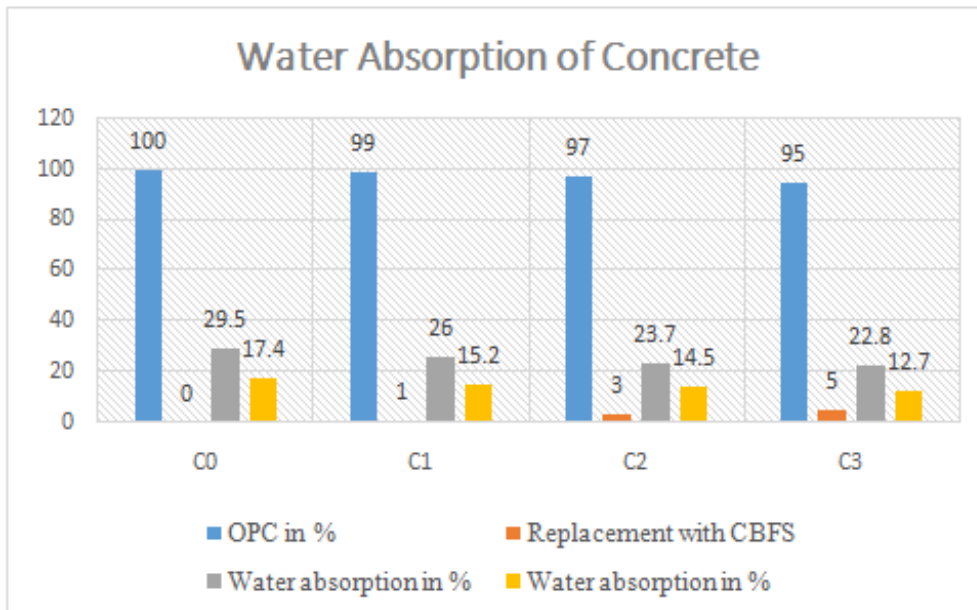


Figure 2: water absorption of concrete and modified concrete

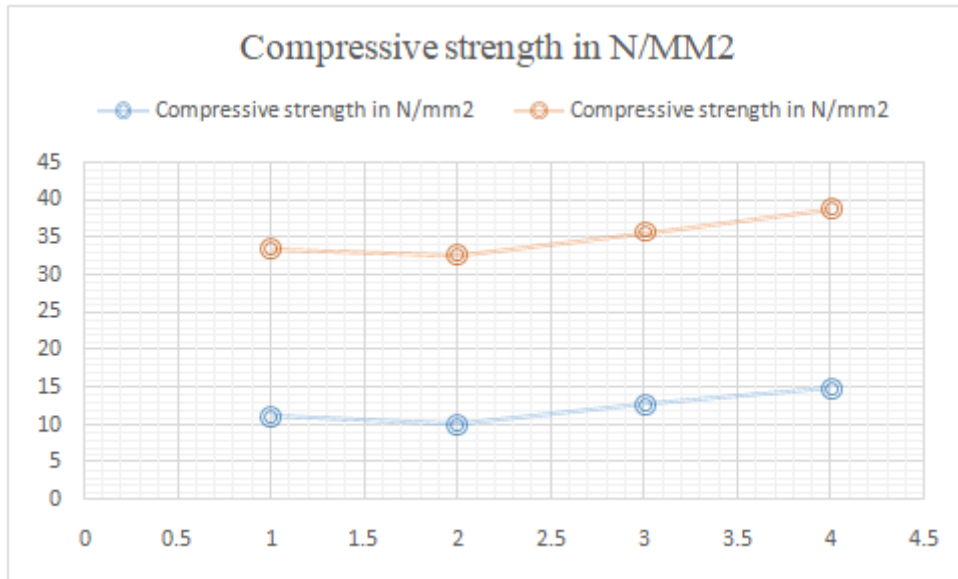


Figure 3: Compressive strength of NCC and CCC

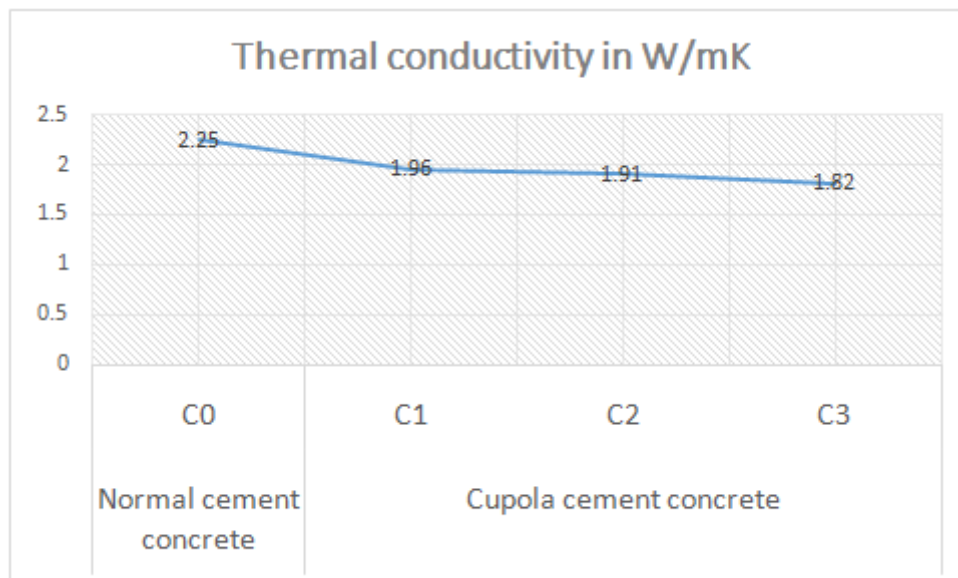


Figure 4: Thermal conductivity of concrete

V. CONCLUSION

Concrete is a most importance building construction material used in all types of construction. It is have some main property like strength, durability, safety etc. But there is one more property to feel comfort to the people that is thermal conductivity. The tc of concrete is 2.25 to 2.30 w/mk as per experiment. After the adding 1% of cupola blast furnace slag the slump value is reduced by 2.64%, water absorption capacity is reduced by 12.65% and compressive strength and thermal conductivity is reduced 3.40% and 12.89% respectively. After adding the 3% and 5% of cbfs the slump value, water absorption,

compressive strength and thermal conductivity is 9.22%, 16.79% (reduced), 16.66%, 27.02% (reduced), 10.68%, 11.61% (increased), 13.12%, 19.12% (reduced) respectively. The percentage of cupola blast furnace slag is increased more the performance of concrete is enhance more. After the adding cbfs the thermal performance of concrete is reduced.

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