An Experimental Study On Ultra High Performance Concrete Using Micro Fine And GGBS

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Abstract- *The researchers and scientists have been constantly working on the development of the concrete. As per today's requirement of industry, it is essential to have good performance and durability of concrete for RCC structures. Two decades ago, the scientist has developed the ultra-high-performance concrete. The research and development have been into the progress on how to improve the durability, performance of concrete and make it more environment friendly. In the present study, the aim is to develop concrete mix incorporating ground granulated blast furnace slag and microfine. Ultra high-performance concrete usually provides the compressive strength more than 60 Mpa with good performance during service life of concrete. We have incorporated waste material like GGBS and microfine in the concrete so that impact of waste material on the environment can be reduced.*

Keywords- Compressive Strength, Durability, GGBS, Microfine, Performance etc.

I. INTRODUCTION

Concrete is the essential material in Construction industry. Concrete is the highest consumed material in the world after water. The use of concreting per day is on very high. As the population of the world is increasing, the smart material is required to fulfil the requirement of infrastructure with great durability. The rapid development on Ultra High-performance concrete has been going from last 20 years rigorously. The frequent use of UHPC (ultra high-performance concrete) is limited because it has very high cost and skilled labor is required for using it. One more material which has been used in this process is microfine. These are the material which is found as a byproduct of steel and iron manufacturing industry. These materials having cementitious property that is why these materials are used as a replacement of cement.

As per the past studies done on this topic, these materials are capable to provide bonding and strength in between all the ingredients of the concrete. Still there are many pros and cons in using it.

While we adding these materials, the good performance can be seen in the dance concrete. Construction industry requires both the thing Higher strength and good performance as well.

Ultra high-performance concrete having high modulus of Elasticity and reduces deflection in the concrete. There are many disadvantages of Ultra High performance Concrete. Due to inadequate research in this field, it is very difficult to identify proportion of material in the mix design as per UHPC requirement. Material selection is the also having the main factor on which performance of concrete depends.

Along with the GGBS and microfine, the scientists have used various admixtures different type of fibres various industrial waste to improve the mechanical and chemical properties of concrete material.

While designing the ultra-performance concrete we must keep into our mind the impact of sulphate and chloride attack on the concrete.

II. EXPERIMENTAL STUDY

The waste material used in this study isGround Granulated Blast Furnace Slag (GGBS) and Microfine. These are the waste materials by product of steel industry. Both material having some cementitious property that attracts researchers to incorporate these materials into the concrete mix. Effective outcome could be achieved by proper selection of materials, inspection, quality control and required proportion of all ingredient of concrete. The Ordinary Portland Cement is used having 53 Grade to meet the optimum requirement. The Typical Chemical Composition of GGBS is mentioned below:

Compound	Quantity Present (%)
Calcium Oxide	40-45 %
Silica	35-40 %
Magnesia	8-10 %
Alumina	10-15 %

The Typical Physical composition of GGBS are mentioned below:
Color: Off White
Specific Gravity: 2.85
Bulk Density: 1060-1160 kg/m3 (Loose)
1275-1375 kg/m3 (vibrated)
Fineness: >360 m2/kg

Typical Physical Composition of Microfine:
Fineness: >560 m2/kg
Compressive Strength: >18 (in N/mm2 at 28 Days)
Initial Setting: 140 minutes
Final Setting: 190 minutes Grain Density: 2.75 kg/m3

Table 5.1 Experimental Result Obtained for OPC 53 Grade

Property of Cement	Result Obtained	Value Specified by IS 12269:2013
Fineness	1.60 %	< 10 %
Standard Consistency	35 %	Range 25-35 %
Initial Setting Time	31 minutes	30 min
Final Setting Time	580 minutes	600 min

Table2 Experimental Result Obtained of Fine and Coarse Aggregate (20mm & 10mm)

Sr. No.	Characteristic Properties	Artificial Sand	CA (10mm)	CA (20 mm)
1	Fineness modulus	3.17	3.5	2.65
2	Silt Content	15.25%	NA	NA
3	Surface absorption	4.2%	2.23%	1.50%
4	Specific gravity	2.55	2.78	2.85

III. RESULTS AND DISCUSSION

Table3Slump Values on different trials

No. of Trial	Mix Design	Slump Value (mm)	Average Slump Value (mm)	Workability
1	M 50 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	107	113	Good
2		118		
3		112		
4	M 40 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	105	112	Good
5		119		
6		114		

Table4 Split Tensile Strength Results on different trials

Mix Design	Split Tensile Strength (N/mm2)		
	7 Days	14 Days	28 Days
M 50 (W/C = 0.35) + GGBS (30%)& Microfine (10%)	5.6	7.2	7.9
M 40 (W/C = 0.35) + GGBS (30%) & Microfine (10%)	4.5	5.8	6.8

Table 4 Flexural Strength Test Results on different trials

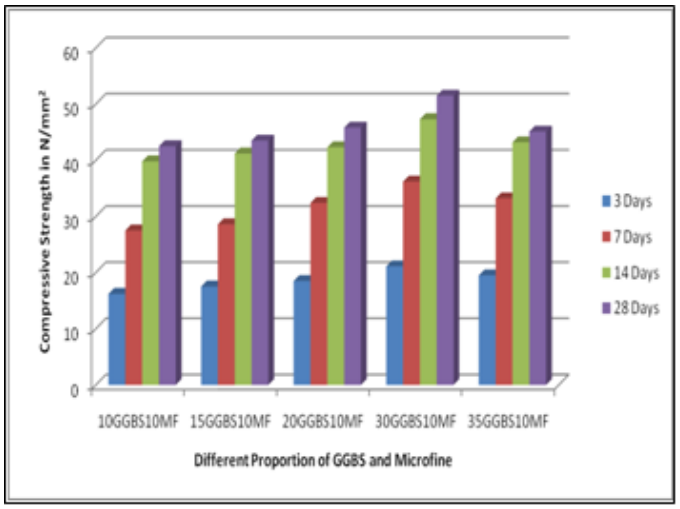
Mix Details	Flexural Tensile Strength (N/mm2)		
	7 Days	14 Days	28 Days
M50 (W/C=0.35) + GGBS(30%)andMicrofine(10%)	5.7	7.5	9.6
M40 (W/C=0.35) + GGBS(30%)andMicrofine(10%)	4.5	6.6	6.8

Table6Pulse Velocity Test Observations

Spot No.	Pulse Velocity (Km/Sec)		Concrete Quality (Grading)
	Direct Method	Semi Direct Method	
1	4.05	4.00	Good
2	4.25	3.95	
3	3.80	3.91	
4	4.17	4.20	
5	4.3	3.99	

Table7Compressive Strength Observations for M40 and M50 Grade of concrete

Mix	W/C	GGBS (%)	MF (%)	Compressive Strength in (N/mm2)			
				3 days	7 days	14 days	28 days
M50	0.35	10	10	15.2	26.5	40.8	41.5
		15	10	18.5	29.6	40.2	42.5
		20	10	19.5	33.4	43.3	46.8
		30	10	20.1	35.2	48.3	**52.5**
		40	10	20.5	31.2	44.2	46.1
M40	0.35	10	10	11.2	22.2	32.4	32.5
		15	10	12.5	22.4	31.6	36.1
		20	10	13.2	24.4	33.5	39.0
		30	10	17.1	26.4	38.5	**43.2**
		40	10	13.1	23.2	34.2	38.5



Graph 1 Compressive Strength results comparison for M40 Grade of Concrete

IV. CONCLUSIONS

The Following conclusion can be given as an outcome of this study:

1. GGBS and Microfine both are very good cementitious material and have ability to improve compressive strength and durability of concrete.
2. The Best outcome found when we add 30% GGBS and 10% Microfine as a replacement of Cement. Further, the results go down if we increase the amount of waste material.
3. The Split and Flexural Strength result found maximum at replacement of cement by 30% GGBS and 10% Microfine.
4. NDT Test (Rebound Hammer and Ultrasonic Pulse Velocity Test) results show that dispersion of ingredient of concrete and mixing bond with GGBS and microfine was very good.
5. This study shows that if we continue doing research on this material, would have great results in future. This would have direct benefit not only in construction industry but also for environmental protection also.

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