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EVALUATION OF STRENGTH OF CONCRETE BY PARTIAL REPLACEMENT OF C.A. BY STEEL SLAG AND CEMENT BY BENTONITE POWDER

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Abstract - *In this study, we study the strength of concrete by replacing cement partially by bentonite powder and C.A. by steel slag. We are going to try replacement of bentonite powder is 0%, 10%, 20%, and 30% and steel slag is 60%. Various tests such as compressive strength, split tensile strength and Flexural strength are investigated and these values are greater as compared to the conventional concrete. Several researches have been made on Bentonite powder and Steel slag and found that there is greater future scope for further research on Bentonite powder and Steel slag. For our experiment, we have to study the strength of concrete by replacing cement partially by bentonite powder and C.A. by steel slag. We are going to try replacement of bentonite powder is 0%, 10%, 20%, and 30% and steel slag is 60%. Various tests such as compressive strength, split tensile strength and Flexural strength are investigated and these values are greater as compared to the conventional concrete.*

Key Words: Induction furnace slag; Super plasticizer; Compressive Strength; Split Tensile Strength; Flexural Strength; Slump Test.

1. INTRODUCTION

Concrete is one of the most widely used construction material in the world. It can be cast in diverse shapes. Concrete is a composite material formed by the combination of cement, sand, coarse aggregate and water in a particular proportion in such a way that the concrete produced meets the needs as regards its workability, strength, durability and economy. It is found to be versatile and hence gained importance in building materials. The concrete has high compressive strength, stiffness low thermal conductivity and low combustibility, but it has very low resistance tensile strength, limited ductility and little resistance to cracking. In the context of increased awareness regarding the ill effects of global warming, eco-friendly technologies are to be developed for the effective management of resources.

The cost effectiveness in construction will be achieved only if we thinking from every corner of construction material and also there is a demand for natural aggregates. Hence alternative materials must replace the construction material in concrete to meet the future problems. In this project, an attempt has made to overcome this problem by the limited use of Bentonite powder in place of Cement and steel slag as a partial replacement of coarse aggregate.

1.1 OBJECTIVES

Consequently, the main objectives of this investigations are to,

- Determining the degree of strength improvement in concrete obtained after addition of Steel slag and Bentonite powder.
- Compare the properties of conventional concrete mix M30 with the properties of concrete with steel slag and Bentonite partially replacing Coarse aggregate and Cement respectively.
- Find the optimum percentage of bentonite powder that can be replaced for cement.

1.2 PROBLEM STATEMENT

In that present work, an attempt has been made to use bentonite powder as a supplementary binding material for cement. The main aim of this work is to study fresh and hardened properties of M-30 grade concrete and concrete made with bentonite powder as a partial replacement of cement and steel slag partial replacement of coarse aggregate.

2. RESEARCH METHODOLOGY

Figure 2.1 Split tensile testing machine

2.1 MATERIAL REQUIRED PER CUBE OF CONCRETE

The quantities of material used per cube, cylinder, and beam specimen are expressed in the Table 3.7, Table 3.8, and Table 3.9 below.

Table 2.7 Material required for per cube

Volume of Cube: 0.15x0.15x0.15 = 0.003375 m3

00	Water (Lit.)	Replacement %	ement (kg)	tonite (kg)	Fine Aggregate (kg)	cement (%)	Coarse Aggregate (kg)	el slag (kg)
1	0.675	00%	1.687	00	2.173	00%	3.321	00
2	0.675	10%	1.518	0.169	2.173	60%	1.325	1.993
3	0.675	20%	1.350	0.337	2.173	60%	1.325	1.993
4	0.675	30%	1.181	0.506	2.173	60%	1.325	1.993

Table 2.8 Material required for per cylinder

Volume of cylinder: π/4 x d2 x l = π/4 x 0.152 x 0.3 = 5.301 x10-3 m3

Sr. No.	Water (Lit.)	Replacement %	ment (kg)	tonite (kg)	Fine Aggregate (kg)	cement (%)	Coarse Aggregate (kg)	el slag (kg)
1	1.06	00%	2.651	00	3.414	00%	5.216	00
2	1.06	10%	2.386	0.265	3.414	60%	2.086	3.130
3	1.06	20%	2.121	0.530	3.414	60%	2.086	3.130
4	1.06	30%	1.867	0.785	3.414	60%	2.086	3.130

Table 2.9 Material required for per Beam:

Volume of beam: 0.15x0.15x0.7 = 0.01575 m3

Sr. No.	Water (Lit.)	Replacement %	ement (kg)	tonite (kg)	Fine Aggregate (kg)	cement (%)	Coarse Aggregate (kg)	el slag (kg)
1	3.15	00%	7.875	00	10.143	00%	15.498	00
2	3.15	10%	7.088	0.787	10.143	60%	6.20	9.298
3	3.15	20%	6.3	1.575	10.143	60%	6.20	9.298
4	3.15	30%	5.513	2.362	10.143	60%	6.20	9.298

3. RESULTS AND DISCUSSIONS

3.1 EFFECT OF BENTONITE POWDER AND STEEL SLAG ON WORKABILITY OF CONCRETE

The workability of concrete of M30 grade is measured by using widely used empirical test i.e. Slump cone test with same W/C Ratio 0.40 for addition of different percentage of Bentonite powder ant Steel slag. Values obtained for different percentage mix as shown in Table 4.1.

Table 3.1 Slump cone test on fresh concrete

Percentage of Replacement	W/C Ratio	Slump Value	Nature of Collapse
Conventional concrete	0.40	70	True
10% Bentonite 60%Steel Slag	0.40	68	True
10% Bentonite 60%Steel Slag	0.40	72	True
10% Bentonite 60%Steel Slag	0.40	65	True

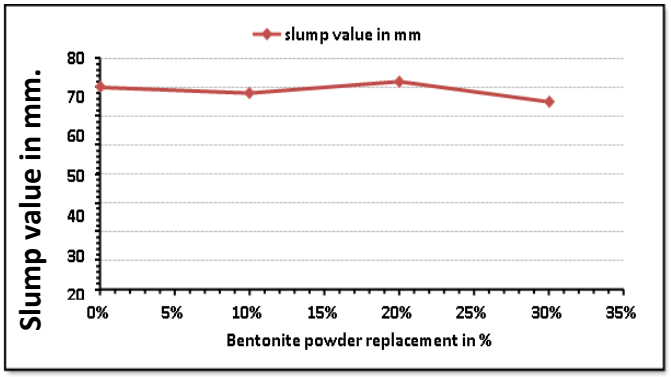

Figure 3.1 Slump of concrete in mm.

3.3 COMPRESSIVE STRENGTH

Table 3.2 Compressive strength of concrete for Different percentage of Bentonite powder and 60% of Steel slag constant for 7 curing days.

Sr. No.	Percentage of replacement	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
1	Conventional Concrete	23.98	26.11
		28.92	
		25.44	
		31.31	

2	10% Bentonite 60%Steel slag	29.26 27.74	29.44
3	20% Bentonite 60%Steel slag	27.29 34.01 30.14	30.48
4	30% Bentonite 60%Steel slag	23.95 24.94 21.53	23.47

Table 3.3 Compressive strength of concrete for Different percentage of Bentonite powder and 60% of Steel slag constant for 28 days curing.

Sr. no.	Percentage of replacement	Compressive strength in N/mm^2	Average compressive strength in N/mm^2
1	Conventional Concrete	38.46 36.03 33.12	35.88
2	10% Bentonite 60%Steel slag	38.97 38.05 36.56	37.86
3	20% Bentonite 60%Steel slag	38.75 42.92 40.83	40.83
4	30% Bentonite 60%Steel slag	34.46 29.48 30.38	31.44

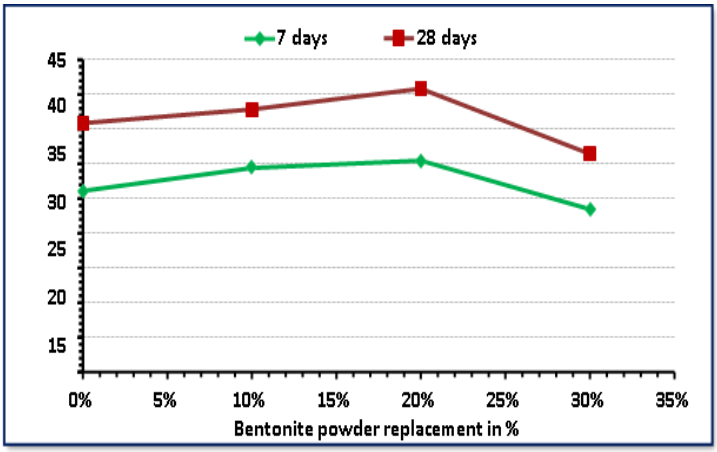

Figure 3.2 Average Compressive strength in MPa

3.4 SPLIT TENSILE STRENGTH

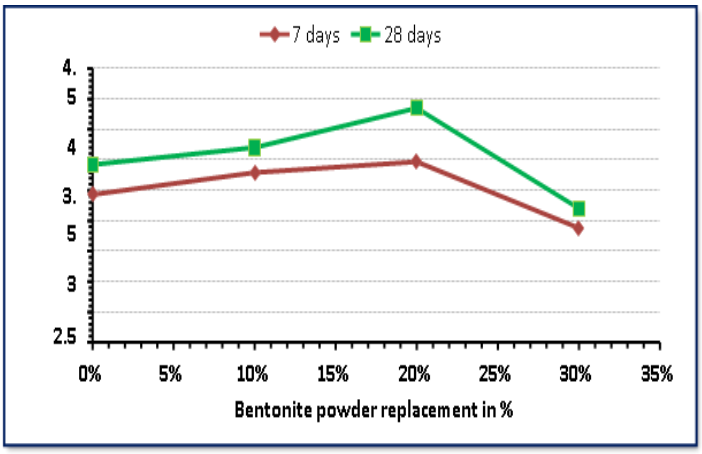

Figure 3.3 Average Split tensile strength in MPa.

Table 3.4 Split tensile strength of concrete for Different percentage of Bentonite powder and 60% of Steel slag constant for 7 days curing.

Sr. no.	Percentage of replacement	Tensile strength in N/mm^2	Average Tensile strength in N/mm^2
1	Conventional Concrete	2.52 2.06 2.70	2.43
2	10% Bentonite 60%Steel slag	2.80 2.62 2.95	2.79
		3.20	

3	20% Bentonite 60%Steel slag	3.55	2.97
		2.16	
4	30% Bentonite 60%Steel slag	1.92	1.88
		2.12	
		1.61	

Table 3.5 Split tensile strength of concrete for Different percentage of Bentonite powder and 60% Steel slag of constant for 28 days curing.

Sr. No.	Percentage of replacement	Tensile strength in N/mm^2	Average Tensile strength in N/mm^2
1	Conventional Concrete	2.82	2.92
		2.91	
		3.05	
2	10% Bentonite 60%Steel slag	3.20	3.20
		3.57	
		2.83	
3	20% Bentonite 60%Steel slag	3.71	3.85
		3.54	
		4.31	
4	30% Bentonite 60%Steel slag	2.22	2.20
		2.56	
		1.82	

3.5 FLEXURAL STRENGT

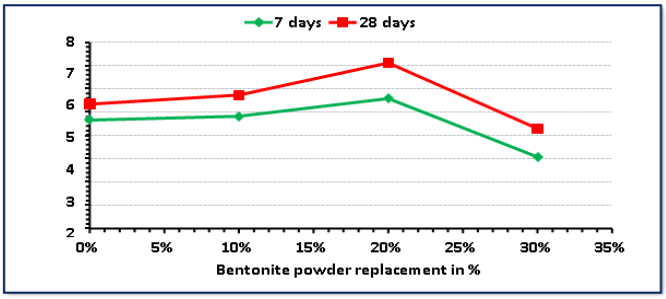

Figure 4.4 Average Flexural strength in MPa.

Table 4.6 Flexural strength of concrete for Different percentage of Bentonite powder and 60% of Steel slag constant for 7 days curing.

Sr. no.	Percentage of replacement	xural strength In N/mm2	Average Flexural strength in N/mm2
1	Conventional Concrete	4.52	4.65
		5.03	
		4.43	
2	10% Bentonite 60%Steel slag	4.73	4.82
		5.29	
		4.45	
3	20% Bentonite 60%Steel slag	5.73	5.58
		4.74	
		6.28	
4	30% Bentonite 60%Steel slag	3.87	3.07
		3.09	
		2.28	

Table 4.7 Flexural Strength of concrete for Different percentage of Bentonite powder and 60% of Steel slag constant for 28 days curing.

Sr. no.	Percentage of replacement	xural strength In N/mm2	Average Flexural strength in N/mm2
1	Conventional Concrete	5.77	5.34
		5.44	
		4.83	
2	10% Bentonite 60%Steel slag	5.55	5.73
		6.01	
		5.64	
3	20% Bentonite 60%Steel slag	6.79	7.11
		8.10	
		6.49	
4	30%	4.65	4.29
		4.14	

	Bentonite 60%Steel slag	4.08	

4. CONCLUSIONS

Based on the results and observation made in this experimental research study. The following conclusions are drawn.

1. The experimental study has proved to be better method in providing strong and durable concrete it also gives solution to disposal problem of steel slag.
2. After conducting all the tests on the specimen, it has been observed that up to 20% replacement of cement with bentonite provide to be good in compression, as well as Split tensile, whereas the concrete properties with equal proportion of bentonite and conventional cement and confirmed to be inefficient.
3. From this we conclude that cement can replace by bentonite partially without affecting strength characteristics.
4. The compressive strength, split tensile strength and flexural strength of the cubes, cylinders and beams increases when the 10% and 20% of cement is replaced by Bentonite and 60% of Coarse aggregate is replaced by steel slag. When the 30% cement replaced by Bentonite with 60% of Steel slag, reduction in compressive strength, split tensile strength and flexural strength is observed.
5. 14.23&13.85% increment in the compressive strength is found at 20% replacement of cement by Bentonite and 60% of coarse aggregate by steel slag at7 and 28 days respectively when compared to normal concrete. And the strength decreases by 10.11% &12.37% when the cement is replaced by 30% of Bentonite and coarse aggregate is replaced by 60% of steel slag, by using Aggregate cement ratio (A/C) is 3.25 and Water cement ratio (W/C) is 0.40.
6. 15.63%&10.52% and 13.33&12.86% increment in the split tensile strength and flexural strength is found at 20% replacement of cement by Bentonite and 60% of coarse aggregate by steel slag at 7 & 28 days respectively when compared to normal concrete. And the strength decreases by 10.68%&8.26% and 19.32%&9.84% when the cement is replaced by 30% of Bentonite and coarse aggregate is replaced by 60% of steel slag, by using Aggregate cement ratio (A/C) is 3.25 and Water cement ratio (W/C) is 0.40.

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