

Experimental Study on Durability Properties of High Performance Self Compacting Concrete

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ABSTRACT: Concrete is versatile material used in many different construction. There are different types of concrete which have more beneficial than conventional concrete. Self compacting concrete is one type of the special concrete having many advantages when compared with conventional concrete. After studying the various literature reviews, We have carried out investigation on durability study on high performance of self compacting concrete by using various different mineral admixtures such as fly-ash (F type), Ground granulated blast furnace slag (GGBS This admixture are replaced with cement material by various percentage.

Fly ash is replaced with 10% 20% 30% 40% 50%, GGBS is replaced with 10% 20% 30% 40% 50%, To carry out the durability studies concentrated for 10% sodium chloride (NaCl), magnesium sulphate (MgSO₄) as been used, the ph valve of NaCl 6.8 and MgSO₄ 6.5, By the design mix the cubes are cast, they are curried in water for 28 and 56days.. Durability study is carried out after curing in water for 28 days, the cubes are immersed in NaCl and MgSO₄ solution for 28 and 56 days. Residual Strength & weight loss are compared with water curing & chemical curing for 10% concentrate

KEYWORDS: Self-compacting concrete, Fly ash, and GGBS, sodium chloride and magnesium Sulphate , Mineral admixture..

I. INTRODUCTION

The Self-compacting concrete is a special concrete it was introduce by Japan in 1980's due to growing shortage of skilled labors , this concrete will flow by its self weight and it do not required any additional equipments for bounding. The usage of scc started growing rapidly,. According to IS 456 -2000 it has a very high degree of workability mineral admixture are use as partially replacement of cement, Durability refers to resistance of concrete to adverse conditions. Adverse conditions include the corrosive, erosive and abrasive factors which are expected to reduce the strength and hamper microstructure that may limit the possibility of usage in construction sector. It is well established that coastal construction sites are more exposed to air and water with higher salt concentration. The sites near industries are more susceptible to sulphate attack, since soil near these areas does have more sulphate contents

II. LITERATURE SURVEY

1. **GANESH BABU AND SREERAMAKUMAR (2000)**In this studied the chloride diffusivity of GGBS concretes and reported that chloride ion diffusion resistance of GGBS concretes were high compared to normal concretes. The resistance is increased with an increase in percentage replacement of cement by GGBS, up to 15 percent.
2. **DHIYANESHWARAN, ~S. RAMANATHAN, P. BASKAR, I. AND VENKATASUBRAMANI, R.(2013)**the investigation, carried out on SCC with mineral admixture like, fly ash with replacement levels (10%,20%,30%,40%and50%).

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The Glenium super plasticizer B233 was used & adopting a water-binder ratio of 0.45. The absorption are done at the age of 28 56&90days to know the durability of concrete on acid resistance and sulphate attack test.

3. **AIAD HASSAN,1HILMI BIN MAHMUD,1 MOHD. ZAMIN JUMAAT,1BELAL ALSUBARI,1 AND AZIZ ABDULLA2(2013):**, The durability of SCC gives a good advice about concrete suffering from weight loss. To over come such problem. this investigation is carried out, by using replacement of cement with different admixture such as FA, RHA, and GGBS with various percentage levels of 15%, 10%, and 5%, respectively, the effect of magnesium on some of the durability properties of concrete such as compressive strength, & weight compared with similar samples. He concluded the strength loss and weight losses is less when compared with similar samples and ms samples
4. **SADAQATULLAH KHAN, MUHAMMAD FADHILNURUDDIN, TEHMINAAYUB,* AND NASIR SHAFIQ(2014):**In this paper he had compared normal and high-strength concrete reactivity of using of different admixture by replacing the cement, he substitute admixture in cement such as fly ash,metakaoline,silicafume,ggbs, & rice husk ash (RHA). Decreases workability, and setting time of concrete and increases the reactivity and heat of hydration with presents of chemical admixture, Micro filler admixture acts vise versa to chemical admixture.

III. MIXPROPORTIONS

Table 1: Below table is describe about mix proportions of fly ash and the quantity of material in kg/ m³

| Materials | Control | FA 10% | FA 20% | FA 30% | FA 40% | FA 50% |
|-------------------|---------|-----------|-----------|-----------|-----------|-----------|
| Cement | 550 | 495 | 440 | 385 | 330 | 275 |
| Fly ash | - | 55 | 110 | 165 | 220 | 275 |
| Water/Powder | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Sand | 880.9 | 880.9 | 880.9 | 880.9 | 880.9 | 880.9 |
| Coarse aggregate | 714.42 | 714.42 | 714.42 | 714.42 | 714.42 | 714.42 |
| Super plasticizer | -- | 1.00% | 0.95% | 0.90% | 0.85% | 0.80% |

Table 2: Below table is describe about mix proportions of GGBS and the quantity of material in kg/ m³

| Materials | Control | GGBS 10% | GGBS 20% | GGBS 30% | GGBS 40% | GGBS 50% |
|-------------------|---------|-------------|-------------|-------------|-------------|-------------|
| Cement | 550 | 495 | 440 | 385 | 330 | 275 |
| GGBS | - | 55 | 110 | 165 | 220 | 275 |
| Water/Powder | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Sand | 880.9 | 880.9 | 880.9 | 880.9 | 880.9 | 880.9 |
| Coarse aggregate | 714.42 | 714.42 | 714.42 | 714.42 | 714.42 | 714.42 |
| Super plasticizer | -- | 1.20% | 1.30% | 1.40% | 1.50% | 1.60% |

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IV. EXPERIMENTAL RESULTS

4.1 DISCUSSION OF WEIGHT LOSS IN NaCl & MgSO₄

TABLE 5: FLY ASH TEST RESULT IN NaCl

| Material | Weight loss (kg)28 days | | | Weight loss (kg)56days | | |
|-------------|-------------------------|------------------------|----------------|-------------------------|------------------------|----------------|
| | Before immersed in NaCl | After immersed in NaCl | % of Reduction | Before immersed in NaCl | After immersed in NaCl | % of Reduction |
| Fly ash 0% | 2.455 | 2.386 | 2.8 | 2.410 | 2.326 | 3.5 |
| Fly ash 10% | 2.400 | 2.354 | 1.9 | 2.400 | 2.345 | 2.3 |
| Fly ash 20% | 2.410 | 2.357 | 2.2 | 2.440 | 2.372 | 2.8 |
| Fly ash 30% | 2.425 | 2.364 | 2.5 | 2.420 | 2.345 | 3.1 |
| Fly ash 40% | 2.425 | 2.355 | 2.9 | 2.435 | 2.352 | 3.4 |
| Fly ash 50% | 2.435 | 2.355 | 3.3 | 2.400 | 2.309 | 3.8 |

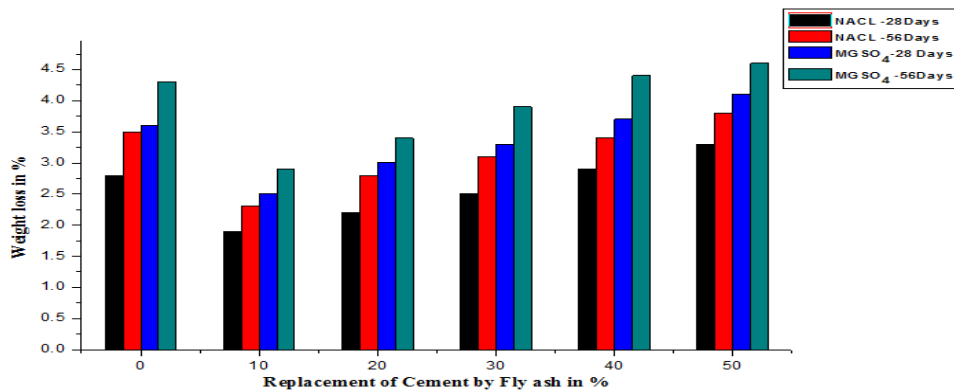
TABLE 6: FLY ASH TEST RESULT IN MgSO₄

| Material | Weight loss (kg)28 days | | | Weight loss (kg)56days | | |
|-------------|--------------------------------------|-------------------------------------|----------------|--------------------------------------|-------------------------------------|----------------|
| | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % of Reduction | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % of Reduction |
| Fly ash 0% | 2.410 | 2.323 | 3.6 | 2.455 | 2.349 | 4.3 |
| Fly ash 10% | 2.430 | 2.369 | 2.5 | 2.440 | 2.369 | 2.9 |
| Fly ash 20% | 2.420 | 2.347 | 3.0 | 2.430 | 2.347 | 3.4 |
| Fly ash 30% | 2.435 | 2.355 | 3.3 | 2.425 | 2.330 | 3.9 |
| Fly ash 40% | 2.445 | 2.355 | 3.7 | 2.425 | 2.318 | 4.4 |
| Fly ash 50% | 2.450 | 2.350 | 4.1 | 2.435 | 2.323 | 4.6 |

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GRAPH 3 : FLY ASH TEST RESULT FOR NAcl& MgSO₄

TABLE 7: GGBS TEST RESULT IN NAcl

| Material | Weight loss (kg)28 days | | | Weight loss (kg)56days | | |
|----------|-------------------------|------------------------|----------------|-------------------------|------------------------|----------------|
| | Before immersed in NaCl | After immersed in NaCl | % of Reduction | Before immersed in NaCl | After immersed in NaCl | % of Reduction |
| GGBS 0% | 2.455 | 2.386 | 2.8 | 2.410 | 2.326 | 3.5 |
| GGBS 10% | 2.415 | 2.364 | 2.1 | 2.400 | 2.347 | 2.2 |
| GGBS 20% | 2.410 | 2.350 | 2.5 | 2.420 | 2.345 | 3.1 |
| GGBS 30% | 2.405 | 2.340 | 2.7 | 2.435 | 2.355 | 3.3 |
| GGBS 40% | 2.420 | 2.345 | 3.1 | 2.415 | 2.330 | 3.5 |
| GGBS 50% | 2.435 | 2.350 | 3.5 | 2.450 | 2.354 | 3.9 |

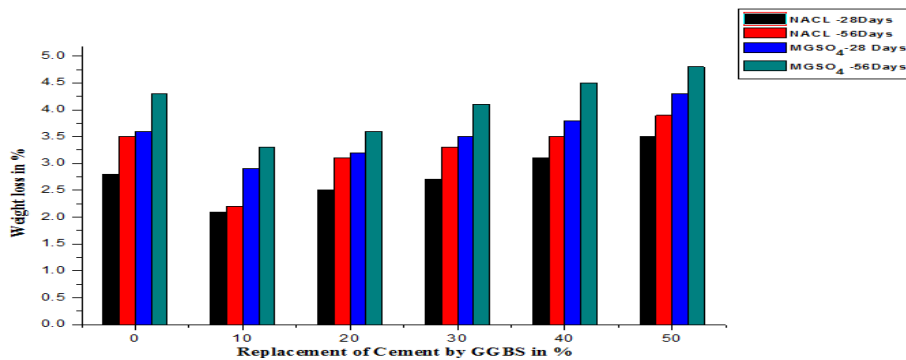
TABLE 8: GGBS TEST RESULT IN MgSO₄

| Material | Weight loss (kg)28 days | | | Weight loss (kg)56days | | |
|----------|--------------------------------------|-------------------------------------|----------------|--------------------------------------|-------------------------------------|----------------|
| | Before immersed in MgSO ₄ | After immersed in Mgso ₄ | % of Reduction | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % of Reduction |
| GGBS 0% | 2.410 | 2.323 | 3.6 | 2.455 | 2.349 | 4.3 |
| GGBS 10% | 2.425 | 2.355 | 2.9 | 2.425 | 2.345 | 3.3 |
| GGBS 20% | 2.420 | 2.343 | 3.2 | 2.440 | 2.352 | 3.6 |
| GGBS 30% | 2.435 | 2.350 | 3.5 | 2.435 | 2.335 | 4.1 |
| GGBS 40% | 2.415 | 2.323 | 3.8 | 2.420 | 2.311 | 4.5 |
| GGBS 50% | 2.450 | 2.345 | 4.3 | 2.435 | 2.318 | 4.8 |

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GRAPH 4:GGBS TEST RESULT FOR NACL& MgSO₄

4.2 DISCUSSION OF RESIDUAL STRENGTH IN NACL& MgSO₄

TABLE 9: FLY ASH TEST RESULT IN NACL

| Material | Residual Strength (N/mm ²) 28days | | | Residual Strength (N/mm ²) 56days | | |
|-------------|---|------------------------|----------------|---|------------------------|----------------|
| | Before immersed in NaCl | After immersed in NaCl | % of Reduction | Before immersed in NaCl | After immersed in NaCl | % of Reduction |
| Fly ash 0% | 41.00 | 39.00 | 4.87 | 41.00 | 38.00 | 7.31 |
| Fly ash 10% | 48.00 | 46.00 | 4.16 | 52.00 | 49.00 | 5.76 |
| Fly ash 20% | 46.00 | 44.00 | 4.34 | 49.00 | 46.00 | 6.12 |
| Fly ash 30% | 45.00 | 43.00 | 4.44 | 47.00 | 44.00 | 6.38 |
| Fly ash 40% | 42.00 | 40.00 | 4.76 | 44.00 | 41.00 | 6.81 |
| Fly ash 50% | 39.00 | 37.00 | 5.12 | 40.00 | 37.00 | 7.50 |

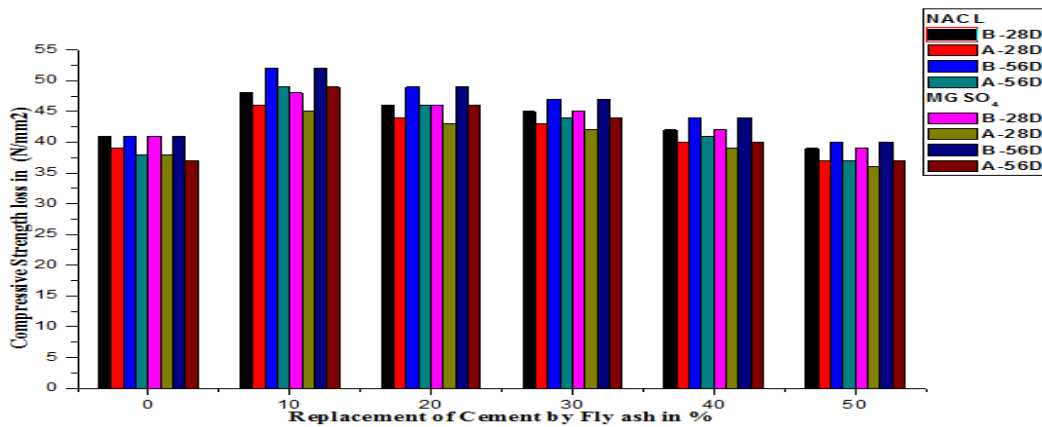
TABLE 10: FLY ASH TEST RESULT IN MgSO₄

| Material | Residual Strength (N/mm ²)28days | | | Residual Strength (N/mm ²)56days | | |
|-------------|--|-------------------------------------|----------------|--|-------------------------------------|----------------|
| | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % Reduction of | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % Reduction of |
| Fly ash 0% | 41.00 | 38.00 | 7.57 | 41.00 | 37.00 | 9.75 |
| Fly ash 10% | 48.00 | 45.00 | 6.25 | 52.00 | 49.00 | 6.09 |
| Fly ash 20% | 46.00 | 43.00 | 6.52 | 49.00 | 46.00 | 6.75 |
| Fly ash 30% | 45.00 | 42.00 | 6.66 | 47.00 | 44.00 | 7.37 |
| Fly ash 40% | 42.00 | 39.00 | 7.14 | 44.00 | 40.00 | 8.09 |
| Fly ash 50% | 39.00 | 36.00 | 7.69 | 40.00 | 37.00 | 8.67 |

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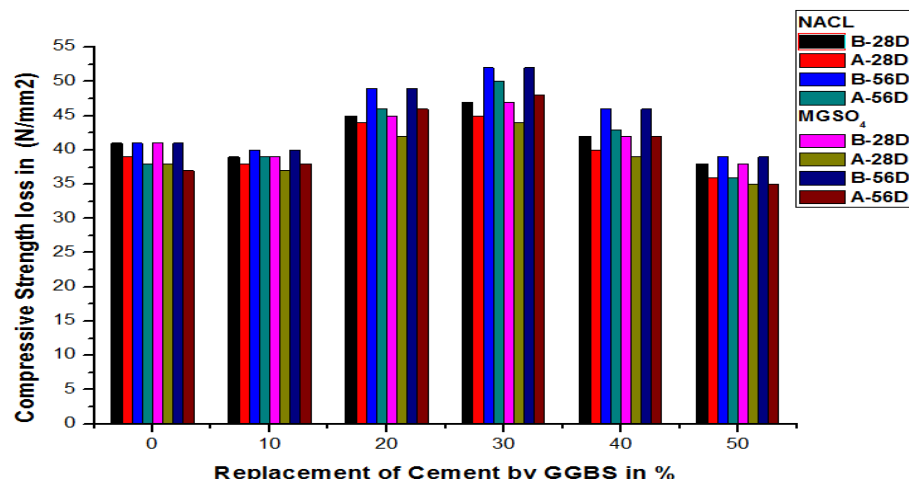
GRAPH 5: COMPARED THE RESIDUAL STRENGTH IN FLY ASH FOR NaCl & MgSO₄

TABLE 11: GGBS TEST RESULT IN NaCl

| Material | Residual Strength (N/mm ²)28 days | | | Residual Strength (N/mm ²)56days | | |
|----------|---|------------------------|----------------|--|------------------------|----------------|
| | Before immersed in NaCl | After immersed in NaCl | % of Reduction | Before immersed in NaCl | After immersed in NaCl | % of Reduction |
| GGBS 0% | 41.00 | 39.00 | 4.87 | 41.00 | 38.00 | 7.31 |
| GGBS 10% | 39.00 | 38.00 | 2.56 | 40.00 | 39.00 | 5.00 |
| GGBS 20% | 45.00 | 44.00 | 4.44 | 49.00 | 46.00 | 6.12 |
| GGBS 30% | 47.00 | 45.00 | 4.25 | 52.00 | 50.00 | 5.76 |
| GGBS 40% | 42.00 | 40.00 | 4.76 | 46.00 | 43.00 | 6.52 |
| GGBS 50% | 38.00 | 36.00 | 5.26 | 39.00 | 36.00 | 7.69 |

TABLE 12: GGBS TEST RESULT IN MgSO₄

| Material | Residual Strength (N/mm ²)28 days | | | Residual Strength (N/mm ²)56days | | |
|----------|---|-------------------------------------|----------------|--|-------------------------------------|--------------|
| | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % of Reduction | Before immersed in MgSO ₄ | After immersed in MgSO ₄ | % of Reduced |
| GGBS 0% | 41.00 | 38.00 | 7.57 | 41.00 | 37.00 | 8.31 |
| GGBS 10% | 39.00 | 37.00 | 5.12 | 40.00 | 38.00 | 5.00 |
| GGBS 20% | 45.00 | 42.00 | 6.66 | 49.00 | 46.00 | 6.12 |
| GGBS 30% | 47.00 | 44.00 | 6.38 | 52.00 | 48.00 | 7.69 |
| GGBS 40% | 42.00 | 39.00 | 7.14 | 46.00 | 42.00 | 8.69 |
| GGBS 50% | 38.00 | 35.00 | 7.89 | 39.00 | 35.00 | 10.25 |



GRAPH 6: COMPARED THE RESIDUAL STRENGTH IN GGBS FOR NaCl & MgSO₄

V. CONCLUSION

1. The compressive strength values of specimen immersed in chloride and sulphate solution were tabulated. From the result we can observe that compressive strength of specimen decreases strength of the solution increases.
2. The mechanical properties of concrete for 10% fly ash replacement, is very high compared to 20% 30% 40% 50%. Percentage is varies 5.76% to 23.6%
3. The maximum compressive strength. 520 kn achieved, when cement is replaced with 10% of fly ash
4. When cement is replaced with 30% of GGBS achieved the higher compressive strength, compared with 20% & 40%, Percentage is varies 5.76% to 11.53 %
5. The chloride resistance (NaCl) of SCC is effect is higher when compared with 0% replacement admixture at the curing period of 28,56 days
6. The sulphate resistance (MgSo4) of SCC is effect is higher when compared with 0% replacement admixture at the curing period of 28,56 days
7. The sulphate resistance (MgSo4) of SCC effect is higher when compared with the chloride resistance (NaCl)

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BIOGRAPHY

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