

Effect of chemical (Sodium Hydroxide, Sodium Silicate, Borax) dosage on Setting Time and Compressive Strength of GGBS mortar

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Abstract:

Initial setting time and final setting time of GGBS are evaluated varying the chemical parameters. The chemicals used are sodium hydroxide, sodium silicate and borax. In the first trial the molarity of NaOH is kept constant and the borax content is varied and graphs are plotted for the results to be tabulated. The setting time is dependent on the molarity and the borax content. The test for compressive strength of GGBS mortar is also done for varying both molarity and borax content for 7 and 28 days. It is observed that the compressive strength is also dependent on the molarity and borax content. More the molarity and borax content more is the compressive strength.

Keywords —GGBS, Compressive strength, Molarity, Setting time

I. INTRODUCTION

Concrete is one of the most widely used construction materials. The demand for concrete as construction material is on the rise. The production of cement has also increased, since cement is one of the chief constituents of concrete. Of the late, the climate change due to global warming has become a major concern. The global warming is caused by the emission of green house gasses, such as CO₂. The cement industry being one of the contributors, many efforts are being made to reduce the use of cement in concrete which include the utilisation of supplementary cementing materials such as fly ash, silica fume. Granulated blast furnace slag, metakaolin etc.

II. MATERIALS

Following materials are used for the experimental study.

- GGBS (Ground Granulated Blast Furnace Slag) of Specific Gravity 2.92
- Quarry Dust of fineness modulus 2.55 and water absorption 1.12%
- Potable water
- Sodium Hydroxide (NaOH) of varying molarity
- Sodium silicate of constant quantity
- Borax of varying quantity

III. EXPERIMENTAL PROGRAM

1. EVALUATION OF INITIAL SETTING TIME

With each varying percentage of borax content with incremental molarity initial setting time was found out and the observations are tabulated. (Table No-I)

2. EVALUATION OF COMPRESSIVE STRENGTH

Total 96 mortar cubes were cast with each varying percentage of borax content with incremental molarity. 48 were tested on 7th day and other 48 were tested on 28th day for compressive strength and the observations are tabulated. (Table No-II)

TABLE I- VARIATION OF INITIAL SETTING TIME WITH BORAX DOSAGE

Borax Dosage (%)	Molarity of NaOH	Initial setting time (Min.)	Borax Dosage (%)	Molarity of NaOH	Initial setting time (Min.)
0	2	32	1	2	117
	4	62		4	150
	6	127		6	215
	8	190		8	273
	10	254		10	334
0.5	2	85	2	2	149
	4	121		4	179
	6	191		6	242
	8	243		8	297
	10	315		10	378

TABLE I- 7th DAY COMPRESSIVE STRENGTH RESULTS

Borax Dosage (%)	Molarity of NaOH	Compressive Strength (N/mm ²)	Borax Dosage (%)	Molarity of NaOH	Compressive Strength (N/mm ²)
0	2	25.6	1	2	25.7
	4	25.6		4	26.35
	6	27.9		6	28.3
	8	30.45		8	32
0.5	2	25.7	2	2	25.8
	4	26		4	26
	6	28.3		6	29.4
	8	30.8		8	32.7

TABLE I- 28th DAY COMPRESSIVE STRENGTH RESULTS

Borax Dosage (%)	Molarity of NaOH	Compressive Strength (N/mm ²)	Borax Dosage (%)	Molarity of NaOH	Compressive Strength (N/mm ²)
0	2	27	1	2	27.2
	4	27.4		4	27.5
	6	28.3		6	29
	8	31		8	33.7
0.5	2	27.22	2	2	27.5
	4	27.3		4	27.7
	6	28.7		6	29.3
	8	31.8		8	35

IV. RESULTS AND DISCUSSIONS

Following observations made from the study

It is observed that (Fig.1) for the mix with varying percentage of borax, there is a steep increase in setting time as the molarity increases.

It is also observed that (Fig.2 & 3) the compressive strength of the GGBS mortar increases with the increase in the molarity as well as increase in the borax content.

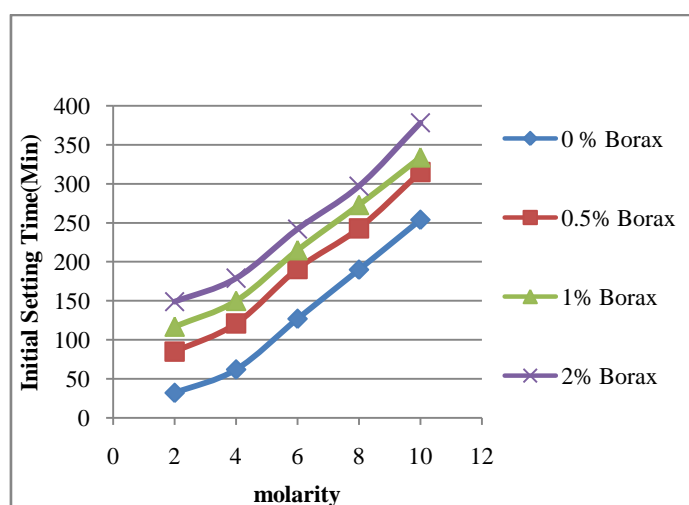


Fig.1 Variation of initial setting time with molarity of NaOH & % of borax

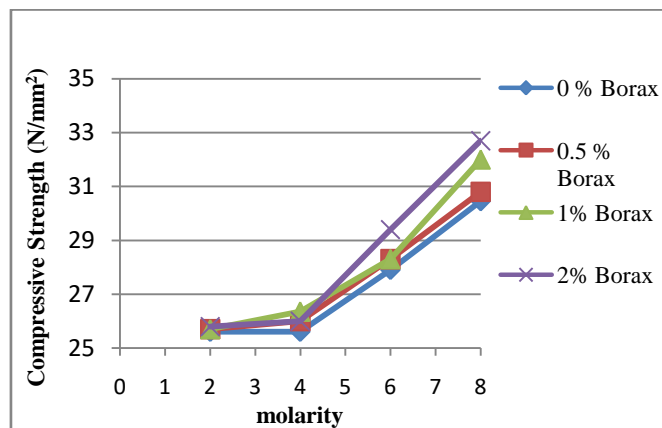


Fig.2 Variation of 7th day compressive strength with molarity NaOH & % of borax

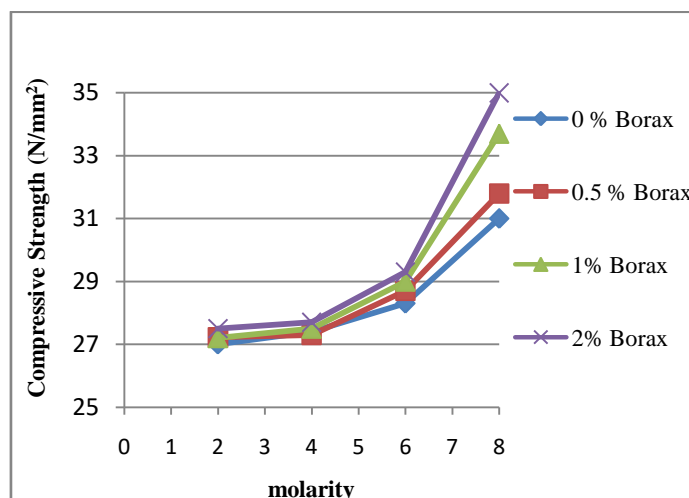


Fig.3 Variation of 28th day compressive strength with molarity NaOH & % of borax

V. CONCLUSIONS

From the results it can be concluded that,

1. Setting time and compressive strength are directly dependent on the molarity of NaOH as well as dosage of borax used. More the molarity of NaOH, more is the initial setting time and compressive strength.
2. 28th day maximum compressive strength observed was 35 N/mm² with 2% borax and 8 molar NaOH

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