INFLUENCE OF DIFFERENT CHEMICAL ADMIXTURES IN ACHIEVING HIGH EARLY STRENGTH CONCRETE

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HIGHLIGHTS

- To survey out various firms which are using high early strength concrete and chemical companies producing various admixture.
- To evaluate optimum dosage of the chemicals to be used in an optimum manner by testing fresh concrete properties (slump test and penetration resistance test).
- Analyzing the mixes with respect to strength on 1,3,7 and 28 days under moisture and chemical curing.

ABSTRACT

This project mainly revolves around the identification of high early strength mix felicitous on both the early strength and durability aspects. High early strength concrete is fundamentally developed to provide a better solution to early housing and rehabilitation projects. As we all know the desideratum for expeditious and solid construction is inductively authorized so the prefabricated construction has paced up. The type of concrete used in this type of construction should be compatible in order to counteract all the issues to assure solid construction. Investigation in this project focus primarily upon various industrial based accelerating admixtures which are dispensed in concrete mix in various dosage to obtain a high efficient mix. This mix is casted into cubes and cured under chemical and moisture curing. Fresh concrete properties like slump for work ability and penetration resistance to analyze very early strength are done. Compressive strength vs age graphs are plotted in order to identify the optimum dosage of admixtures and to obtain a comparative results of various admixtures. The result obtained showed accuracy in terms of best suitability of admixture and curing condition of mix.

Keywords - accelerators, chemical curing, penetration,slump, compressive strength

1. INTRODUCTION

Concrete is the most widely used product all over the world as most of the construction is dependent upon concrete in its variable forms. The concrete as we know is any product or mass made by amalgamation of different constituents viz cement, aggregates, admixtures and water. These products in different ratios contribute to variants of concrete. The properties of concrete are influenced not only by the properties of the constituents phases but also by the existence of their interfaces. This certifies the concrete is not only dependent upon the materials and its variability but also on other various interfaces like curing methods, temperature etc. When these all constituents are placed in different forms and allowed to cure, hardens into a rock like mass. The hardening is caused by the hydration of cement ie the cement molecules release energy in the vicinity of water. The key to producing a strong, durable and uniform concrete lies in the careful control of its basic and process components.

As we discussed concrete exists in variant forms with alteration in various constituents and conditions. High early strength concrete is one of the major concrete used in construction industry now days as it imparts high early strength which is needed in high pace and efficient construction. The major point of difference in this type of concrete is due to its efficiency in initial period. The strength gain involves faster interaction of water and cement particles which ultimately turns out to be accelerated hydration of cement. Basically in hydration, high early strength comprise of more Ca and SO_4 quantity which accelerates the production of Calcium hydroxide (CH), Calcium silicate gel (CSH) and Calcium aluminate hydrates (CAH) and imparts strength in minimum amount of time[2]. To gain early strength the concrete elements cement, aggregate, admixtures and water cement ratio should be chosen adequately and nominally which is mixed in optimum dosage to achieve the desired characteristics. The resulting concrete should gain strength in very early amount of time and durability aspect should also be given utmost weight-age while designing the concrete as majority of repairs and precasted materials fail due to lack of durability. The major acceleration property to high early strength concrete is mainly imparted by accelerators. The accelerators are categorized by the presence and absence chloride ion. Chloride ion accelerators are cheap and easily available but unable to prove its efficiency in long term durability aspects and act as poisons to reinforcement. Non chloride accelerators could be of various organic or inorganic components like nitrates of calcium and sodium or amines, carboxylic acid. Now, the accelerators are also revolutionized and the chemical companies are producing hybrid accelerators which are blended mixtures of various components and chemicals resulting into an effective strengthened, workable and durable mix.

Tae-Beom Min et al.(2008) has successfully studied the compressive strength of precast concrete (high early strength concrete) which is formulated with 2 type of cements i.e. OPC and High early strength cement. Locally available crushed aggregates and sand is used is used in the samples. Calcium formate powdered form is used as accelerator and poly carboxylic ether is used as super plasticizer .Curing is done at 20° C and 10 MPa compressive strength is obtained at initial hours. Whereas, One of the major HES has been engendered by Highway department of California[7], which needs the rehabilitation of damaged highway .In this report they have utilized very efficacious material in concrete i.e. CSA (calcium sulphonate cement) which imparts very early strength. They needed the expeditious track,vigor and durable repair which can commence the road in 6 hours .Thus , very early vigor CSA provided them 13.8 MPa at 6 hours which is ample to surmount the quandary .It is proved to be better and cost efficacious than asphalt panels.

F. Cassagnabre et al. studied that Curing method and temperature also plays an major role in obtaining the early strength of concrete. Adoption of curing methods depends upon the characteristics of the project. Majorly in precast industries water bath and steam curing is adopted to get initial high result. Chemical curing is also an effective manner to induce very high early strength. Temperature adjustments are also done in mixes as it is an important variable in formation of high early strength concrete.

2. MATERIAL AND METHOD

A small survey is conducted from companies and journals about the basic working and formation of HES concrete and various outputs are used to formulate the proceedings of the projects. Four types of concrete mix are produced i.e. one control sample using basic super plasticizer and other sample using accelerator under different curing conditions and various comparative results are deduced on the basis of fresh and hardened concrete properties.Project is carried out in a batching plant under technical supervision.

2.1 Materials

The selection of material plays a major role as it should comply with environmental condition and nullifies all failure aspects. Locally available materials are adopted in the project. The quality of the

material is given main priority as the project is carried out in an RMC plant under technicians.The materials from there respective source are mentioned in Table 1.

MATERIAL	**SOURCE**
Cement	PENNA OPC 53
20 mm	LOCALY AVALAIBLE
12.5 mm	
R sand	
Varaplast 123 (Control sample superplacsticizer)	Aakarsh Chemical
Sika Viscocrete HDP20 (Accelerator X)	SIKA Chemicals
Plastol Ultra 209 (Accelerator Y)	EUCLID chemicals
Masterset AC 100 (Accelerator Z)	BASF chemicals
PERMA CURE WB WHITE (curing agent)	PERMA const. aids Pvt ltd

2.2 Specimens and methodology

Various samples are prepared with different dosage of admixtures and super plasticizer. Table 2 represents the quantity of dosage mixed and number of samples casted for each specimen.

The optimum amount of accelerator to be allowed in the mix is verified by using different ratios of the accelerator. The samples are also tested for two curing condition i.e. moisture curing by putting specimens into wet gunny bags and sprinkling of water is done constantly after few hours to provide industrial type curing and not directly putting inside water bath .The other type of curing chemical curing is done by applying curing agent at each face.

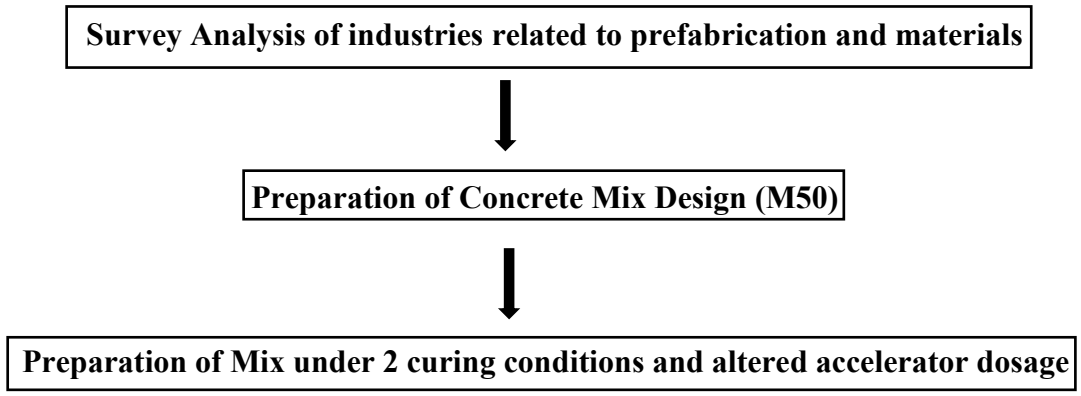
Fresh concrete properties are tested as to ensure the concrete is consistent, workable and durable enough to resist the future deterioration. In this project, each sample is tested for its fresh properties and various experiments are carried out

- Slump test for consistency according to IS7320:1974
- Penetration test for durability and strength gain according to IS8142:1976

M50 strength mix are tested to for 1,3,7 and 28 days and the effect of accelerator is verified by comparing both the samples on the basis of fresh concrete properties and compressive strength. For each day 3 samples are tested except 1 day as the mix is demoulded initially couldn't undergo curing

directly. The slump test and penetration resistance test is carried out to compare the fresh concrete property.

TABLE 2 - QUANTITY OF DOSAGE OF ACCELERATOR ADOPTED			
SAMPLE	**ACCELERATOR**	**DOSAGE(BY WEIGHT OF CEMENT IN %)**	**NUMBER OF SAMPLES FOR 1,3,7 AND 28 DAYS AND BOTH CURING CONDITION**
A	CONTROL SAMPLE	NONE	24
B1	X	0.5	24
B2	X	0.7	24
B3	X	0.9	24
B4	X	1.1	24
C1	Y	0.5	24
C2	Y	0.65	24
C3	Y	0.8	24
C4	Y	0.95	24
D1	Z	0.5	24
D2	Z	0.7	24
D3	Z	0.9	24
D4	Z	1.1	24



Testing fresh Concrete Properties Tests (Slump and Penetration resistance)

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Testing the prepared cubes for 1,3,7,28 days

3. EXPERIMENTAL RESULTS

3.1 Slump test results

Slump Test is related with the ease with which concrete flows during placement and most widely used test to check the consistency. According to 7320:1974 slump using various apparatus is checked. Table 3 depicts various values of proposed samples.

RETENTION TIME	**INITIAL**	**30**	**60**	**90**	**120**
SLUMP SAMPLES	**SLUMP VALUES**				
A	150	135	125	100	90
B1	100	75	60	50	25
B2	150	140	130	110	100
B3	190	180	170	140	125
B4	NO SLUMP		200	190	180
C1	110	100	90	80	65
C2	160	150	140	125	110
C3	200	170	160	150	145
C4	NO SLUMP		240	200	180
D1-D4	140	130	125	120	110

3.2 Penetration resistance test

This is carried out to check initial strength at very initial level and it complies to IS:8142:1975 using various methodology to be adopted and the interval of 3 hours is kept in this project to maintain

uniformity in all the samples and values are represented in Kg f using 16 mm^2 needle area.Figure from 1 to 4 depicts the values obtained at very initial state of concrete hardening.

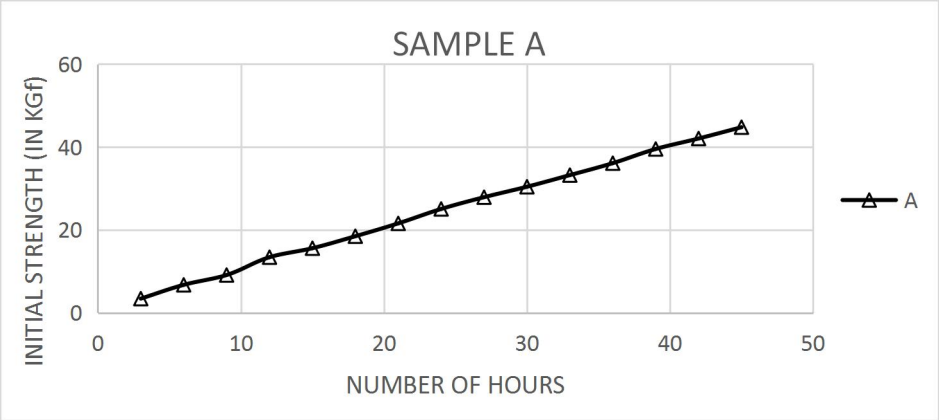


Figure (1) - Sample A penetration resistance test results

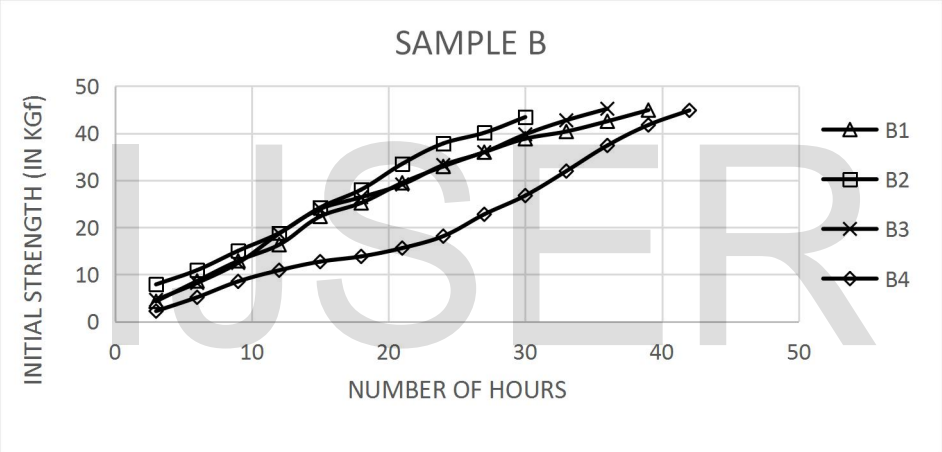


Figure (2) - Sample B1 - B4 penetration resistance test results

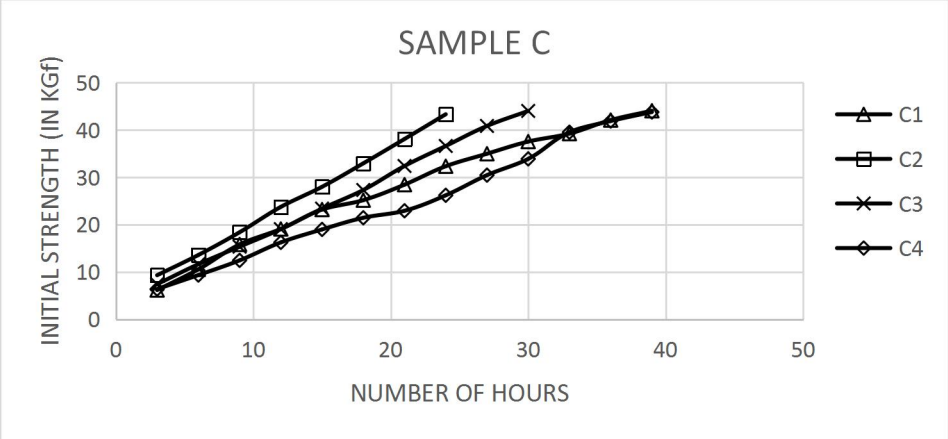


Figure (3) - Sample C1-C4 penetration resistance test results

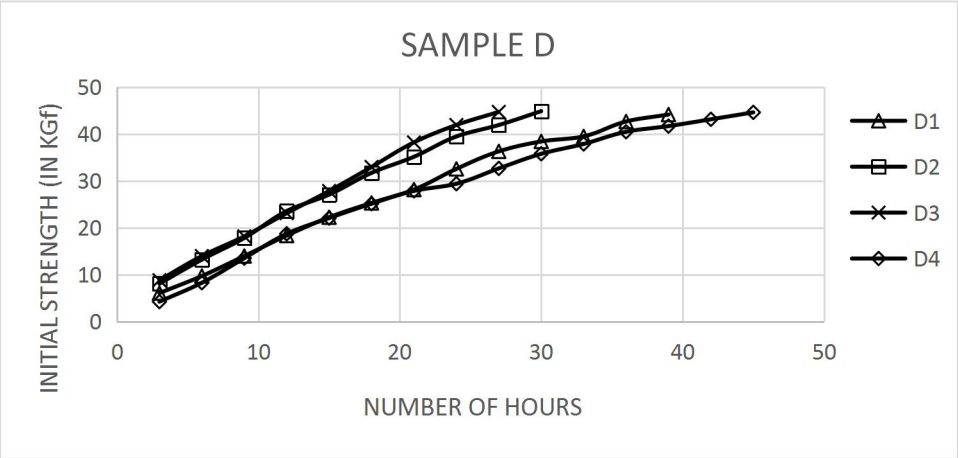
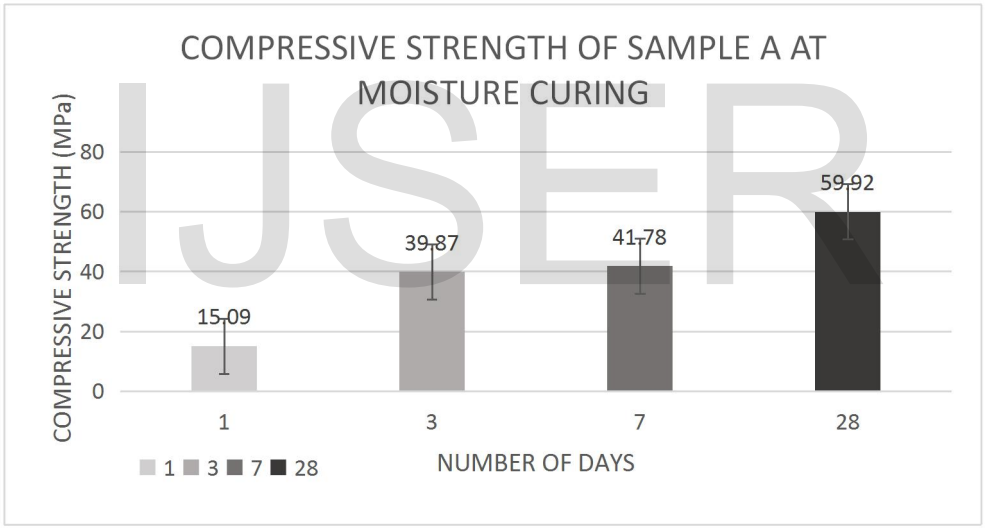


Figure (4) - Sample D1-D4 penetration resistance test results

3.3.Compressive strength

The compressive strength of various concrete mix are tested using UTM (Universal testing machine) and results are depicted in terms of MPa. Figure 5 to 8 depicts the compressive strength for 1,3,7 and 28 days.



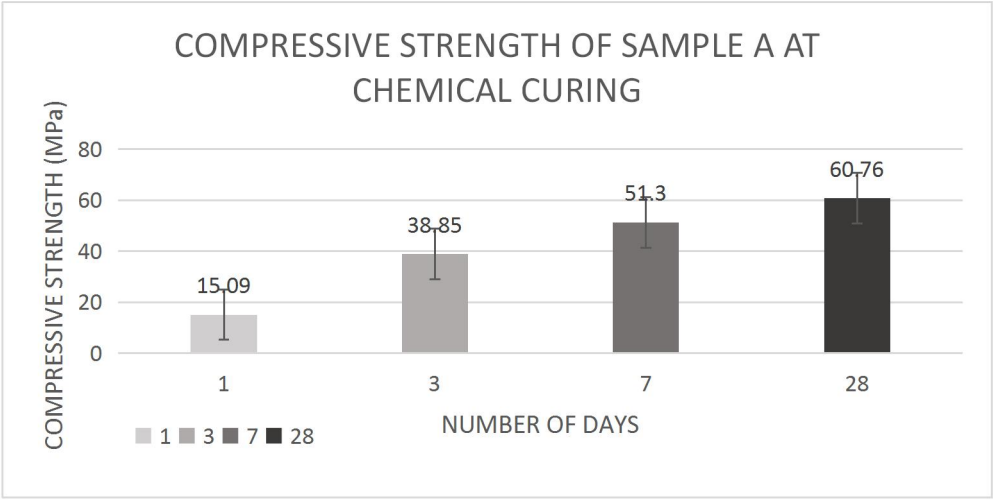
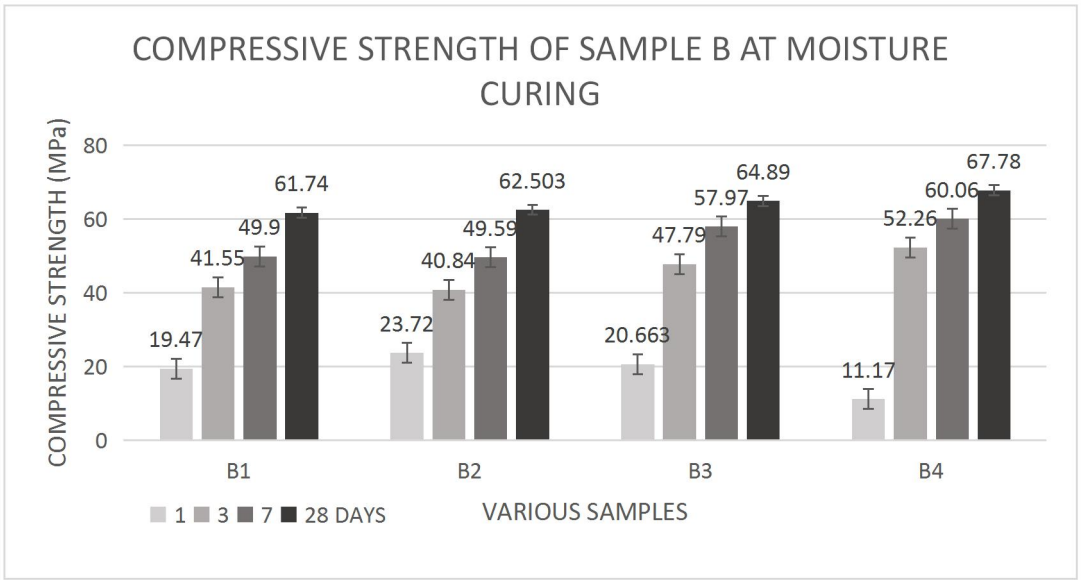


Figure (5) - Sample A Compressive strength results



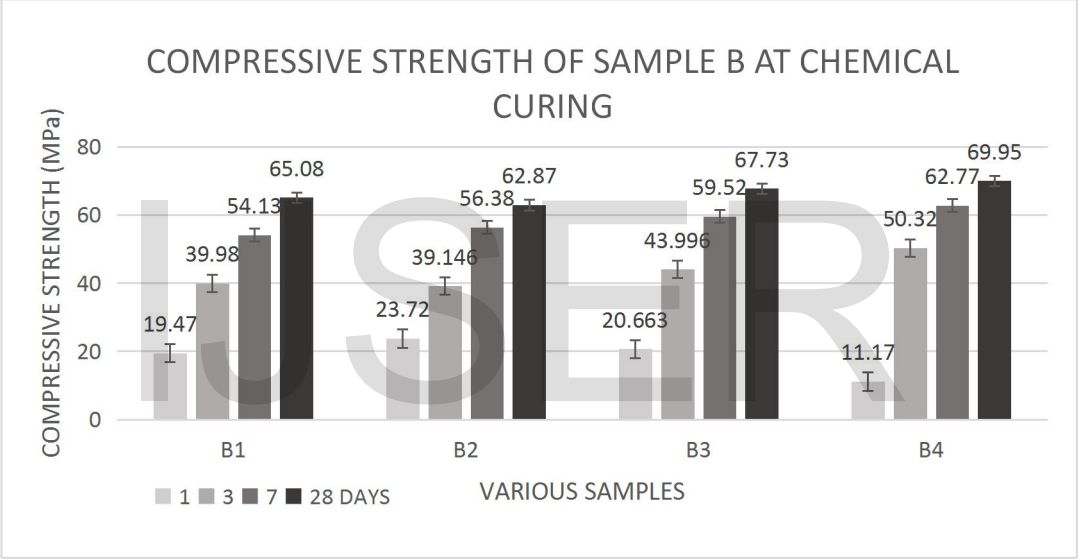
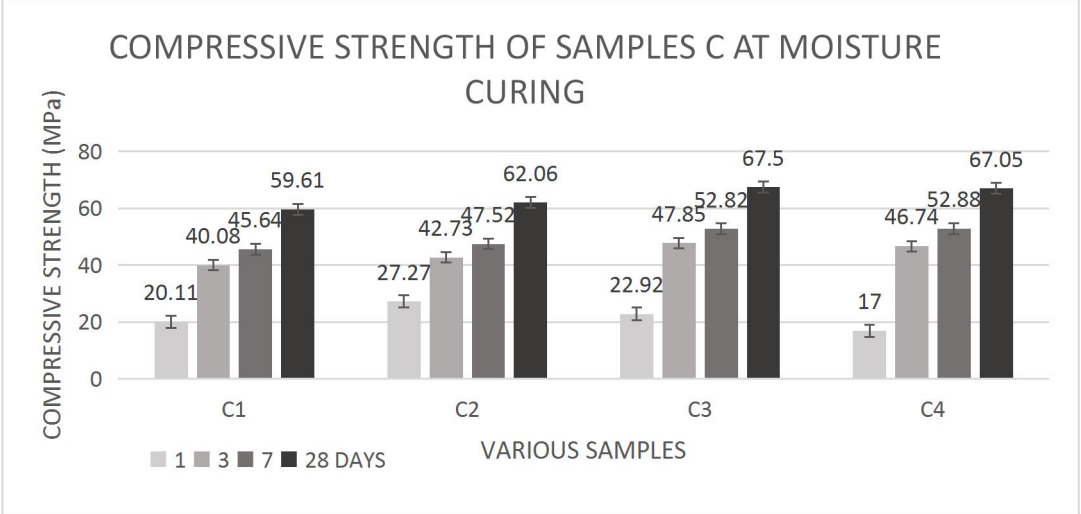


Figure (6) - Sample B Compressive strength results



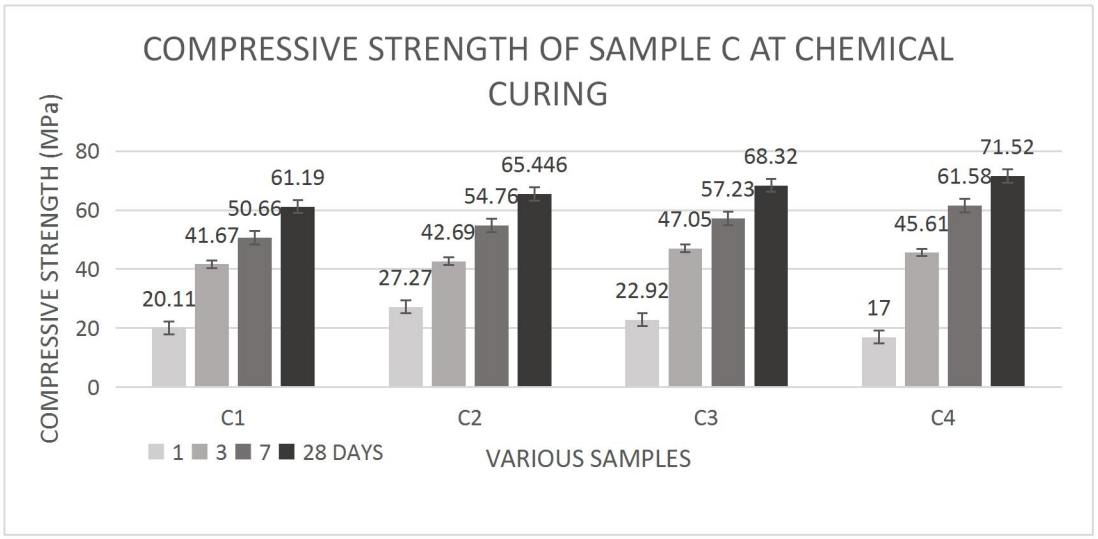
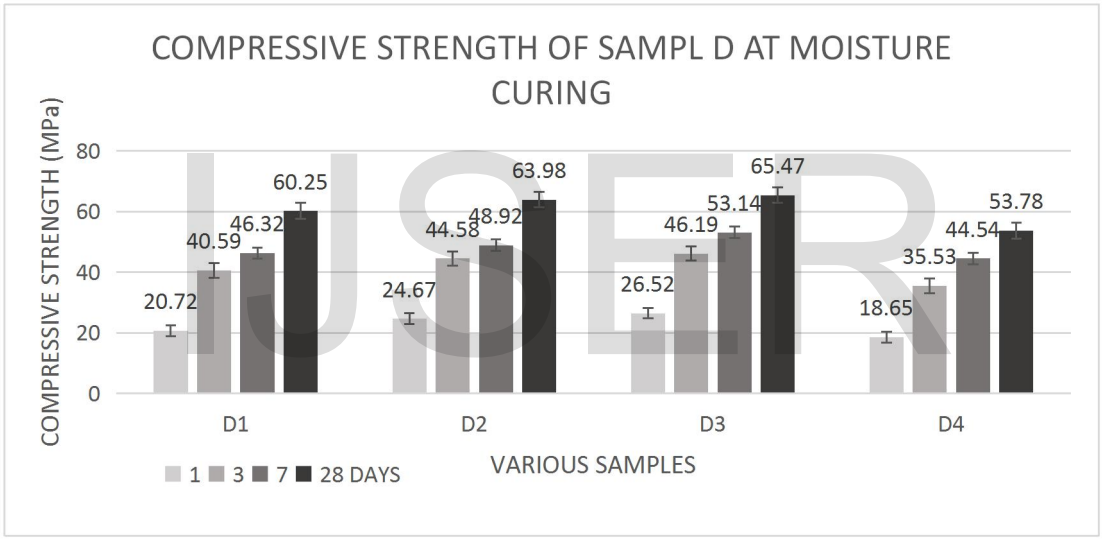


Figure (7) - Sample B Compressive strength results



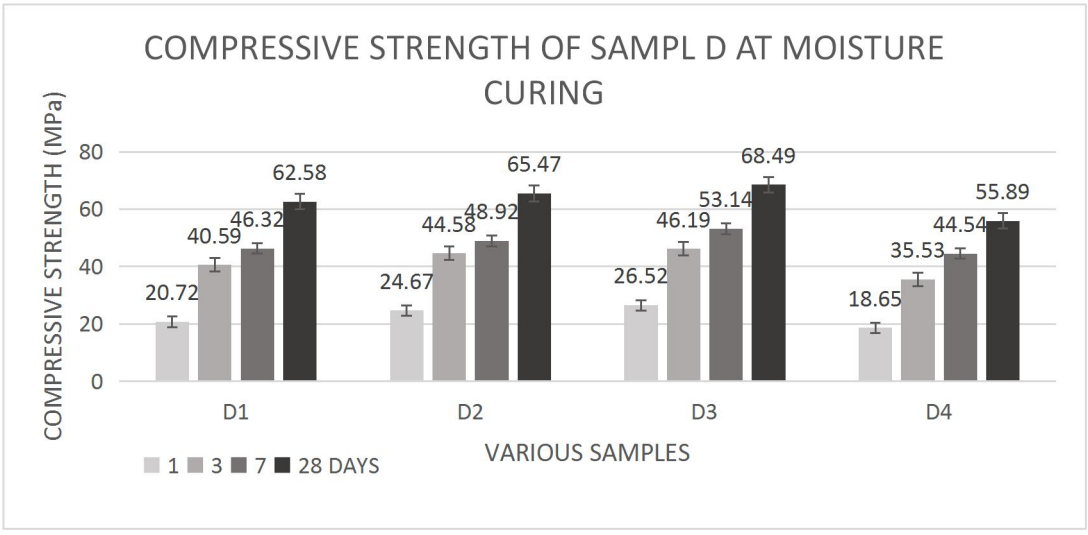


Figure (8) - Sample D Compressive strength results

3.4 Comparative study of moist curing and chemical curing of samples

This comparative study figure 9 just illustrates the difference in hike of strength due to usage of chemical curing method. The samples are displayed to just evaluate the difference in chemical curing which same for all the samples.

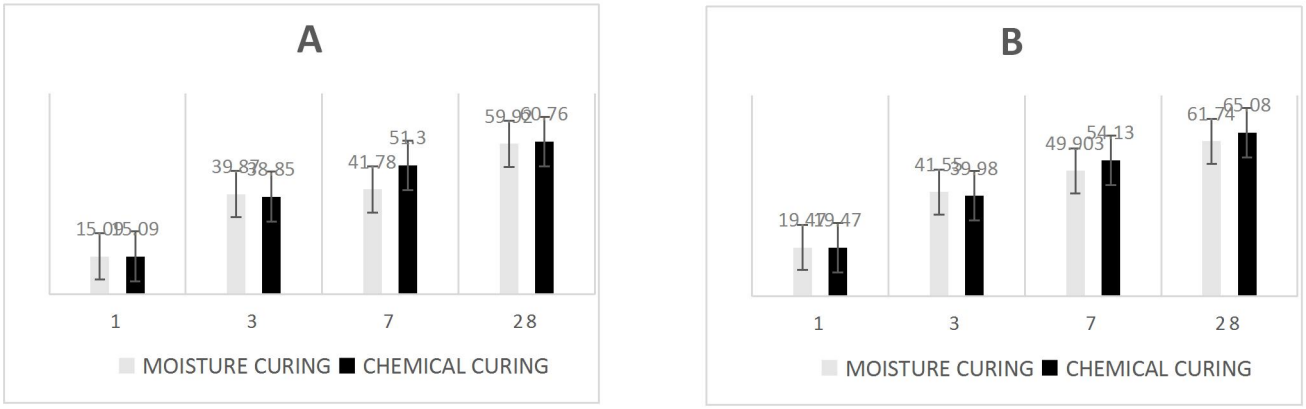
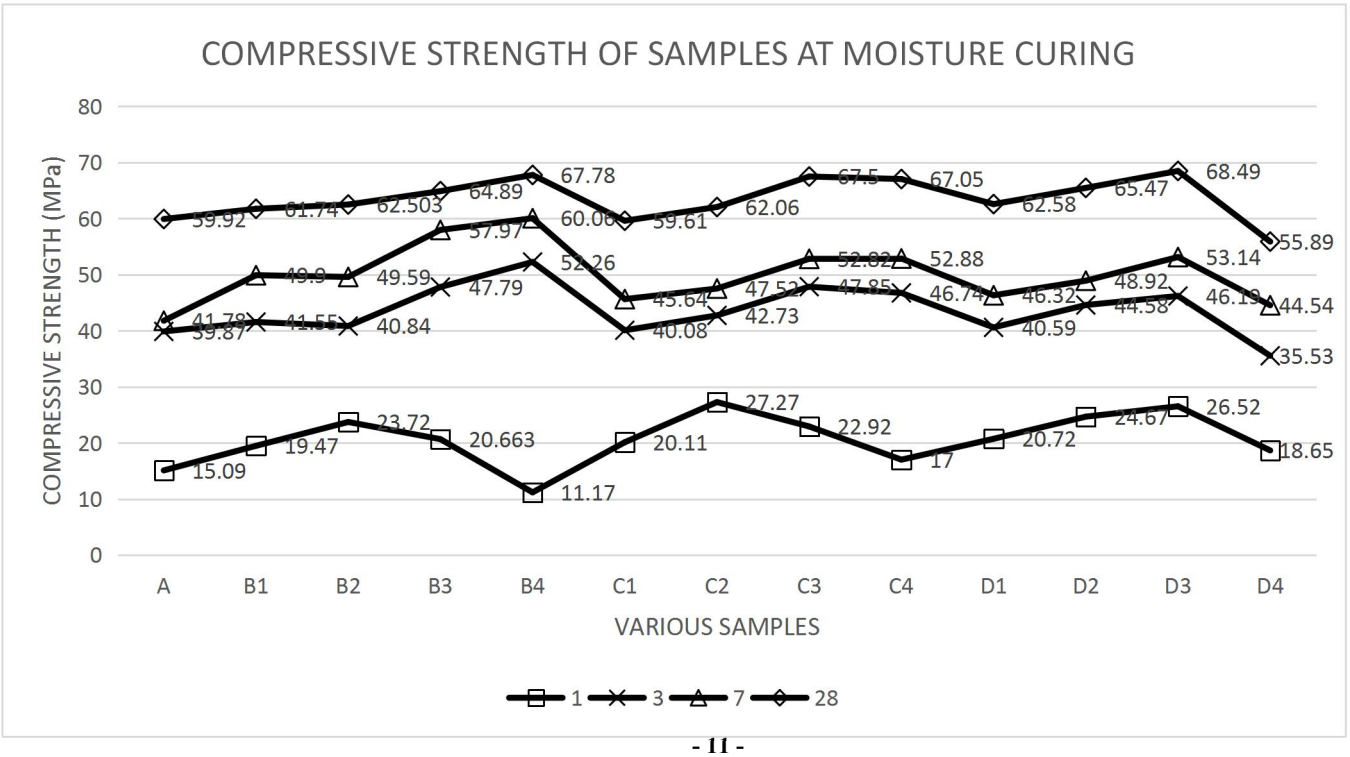


Figure 9 - Illustrating difference of chemical curing over moisture curing

3.5 comparative study of sample A vs B vs C vs D

This comparative study figure 10 illustrates the comparison of strength of various accelerators having optimum dosage under both the curing conditions and specified days.



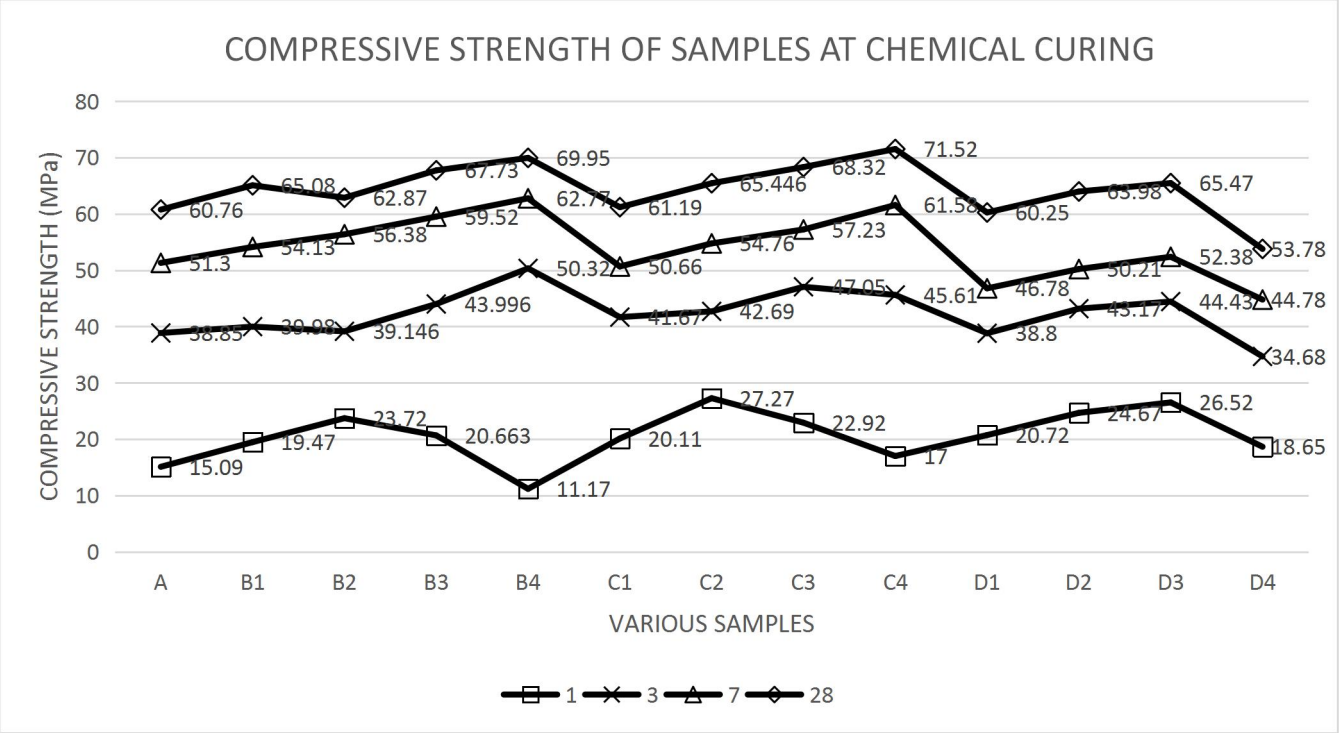


Figure 26 - Illustrate the comparitive results of various sample

4 CONCLUSION

1. The mix design formulated justifies the high early strength concrete and hence a well workable and durable concrete casts are obtained.

2. The control sample gave the optimum slump and penetration resistance and 0.7% accelerator X, 0.65% of accelerator Y and 0.9% of accelerator Z satisfy the efficient requirement to be used in the industry.

3. In terms of very early strength, the penetration resistance test the major strength gain is seen in sample B, C and D at early hours. But Samples C have slight 4 to 5% more gain than sample B and D.

4. The major rise is seen in sample C in the 1 day strength also, when all the samples are compared and sample C turned out be more efficient in later stages also.

5. Adoption of chemical curing turned out to be more liable as most of the strength is gained up to 7 days and additional curing is not required in normal temperature conditions.

6. The chemical curing is better option in terms of strength gain as no extra effort is to be put after applying and is very efficient in term of industrial use.

7. As compared to efficiency in terms of work and cost Sample C is more suitable as compared to sample B and sample D. As in sample D cost is more as super plasticizer is added extra to gain work ability.

5 ACKNOWLEDGEMENT

This project is carried out in RMC plant with supervision of concrete experts at “SGP SHRII RMC ENTERPRISES”

The chemicals are offered by SIKA INDIA,PERMA CHEMICALS, EUCLID CHEMICALS AND BASF.

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