

## EFFECT OF CALCIUM NITRATE BASED ACCELERATOR AND STEAM CURING TEMPERATURE ON THE COMPRESSIVE STRENGTH

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### 1. INTRODUCTION

Currently, initial steam curing temperature at atmospheric pressure is increasingly used in precast concrete element, in order to speed up the production efficiency<sup>1)</sup>. Effect of temperature on the different properties of concrete is substantial. Increasing the steam curing temperature has a good effect on early strength of concrete, but it has a negative effect on later strength of concrete<sup>2,3)</sup>. Calcium chloride one of the Admixture that used for this purpose as set and hardening accelerator. The most cost-effective accelerator for all Portland cement concrete is calcium chloride. Though there has been disagreement over the use of calcium chloride in reinforced concrete in assessment of the possibility of corrosion. In many civil Engineering codes prevent its use for concrete embedded metal<sup>4)</sup>.

#### 1.1 Research Significance

The Study aims to prepare a reference for obtaining the high early Compressive strength for precast concrete element by using the chemical accelerator (Calcium Nitrate Based Concentrate 45% weight), with high steam curing temperature.

### 2. EXPERAMINTAL STUDY

Tests were performed on the specimens from various mixes considering to the W/C=30% with normal cement. CN accelerator admixture was added in four series having CN dosage of 0%, 0.5%, 2% and 4% by weight of cement. Specimens Subjected for 0.5 and 2.5 hours pre curing time at room temperature, and for 5hours in steam curing chamber at 60C°.The Mortar specimens were tested for 8 hours, 7 days and 28 days compressive strength, the result obtained determined which the compressive strength of specimens with 4% accelerator with high steam temperature 60C° is higher than control specimens for early and later age.

Table 1. Material used

Materials		Properties
Cement	N	Ordinary Portland Cement,Density3.16g/cm <sup>3</sup> , specific surface area 3340 cm <sup>2</sup> /g
Fine Aggregate	S	River Sand from Kanagawa density 2.65g/cm <sup>3</sup> (Sturated surface-dry condation)
Admixture	CN	Accelerator (Calcium Nitrate based concentrate 45% weight )
	SP	High-performance AE Water reducing agent delay type( UE)

### 3. RESULT AND DISCUSSION

#### 3.1 Influence of Accelerator Admixture [Pre-curing =2.5(hr)]

For precast concrete industries the early strength gain is more important for demoulding, and increase the production level. In this experimental investigation, it was observed, which the compressive strength for early and later age of specimens by increasing the accelerator dosage increased, it means that the CN accelerator is setting and hardening admixture, so the rate of improving the strength gain of specimens with 4% accelerator is obvious, from the figure 1 and 2 comparing the 4% and 0% accelerator at the same condition showed that The compressive strength with 4% at different age (8hr, 7 Days and 28 Days) are higher than 0%. (79.3%, 60.5% and 47.6%) respectively.

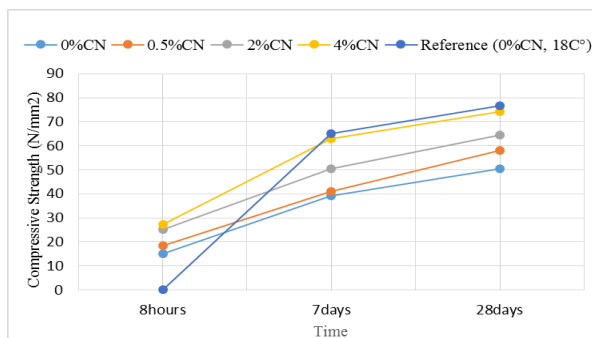


Figure 1. Variation in Compressive Strength

#### 3.2 Effect of Steam Curing Temperature, pre-curing =2.5(hr)

From the Result in figure 1 it is observed that the steam curing temperature has a positive effect on the early compressive strength, but the adverse effect on the later strength it is due to the rate of cement hydration. Compared the strength of specimens with 0% accelerator at steam curing temperature 60C° and control specimens (0% accelerator and air curing) the  $\Delta\sigma$  was found for early strength (8 hour) to be 6220%.

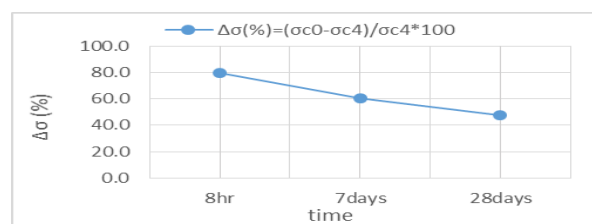


Figure 2.  $\Delta\sigma$  (%) for 4% and 0% accelerator

Keywords: Accelerator Admixture, (Calcium Nitrate & Calcium Nitrite), Steam Curing Temperature, Mortar, Strength, Pre Cast Concrete, Contact address: Tokai Univ. 4-1-1 Kitakaname, Kanagawa, Japan, Tel: 0463-58-1211 FAX.0463-50-204

### 3.3 Influence of Accelerator Admixture [Pre-curing = 0.5(hr)]

The Experimental investigation observed that the compressive strength for those of specimens that exposure to 0.5hour pre-curing time at ambient temperature 20C° coupled with increasing the dosage of accelerator admixture from the figure 3 it has seen that the early and later age compressive strength for 4% to 0% accelerator admixture the higher result was found for 4% than 0%, at early age 90%, for 7 days 41.9%, and for 28 days 32.5%.

### 3.4 Effect of Steam Curing Temperature, pre-curing =0.5(hr)

To understand this subject from the result, it has compared the strength of specimens with 0% CN accelerator that exposure in steam curing temperature at 65C° for 5(hr) and strength of reference specimens with 0% CN accelerator at Air Curing at room temperature. From the result in figure 3, It is observed that the early compressive strength at age 8(hr) 5454% is higher than the compressive strength of control specimens. And the later strength is low. It is due to high rate of cement hydration in high temperature.

### 3.5 Effect of pre-curing time 0.5 hour and 2.5 hours on the compressive Strength of early and Later Age

Experimental investigation indicates that pre-curing time has an effect on the strength gain of concrete. From the figure (5and6) it has seen which the compressive strength at (early and later) Age of specimens that exposure to 2.5(hr) pre-curing time is slightly higher than the compressive strength of those which travelled in to pre-curing for 0.5 hr. From the result in figure 6 it has seen that the 8 hour strength of specimens which exposure in 2.5 (hr) pre curing time 7.4% over than the strength of specimens with 0.5(hr) pre-curing time.

## 4. CONCLUSIONS

The influence of (Calcium Nitrate & Calcium Nitrite) Accelerator Admixture, steam curing temperature, pre-curing time, and combined effects of steam curing temperature on compressive strength of Mortar with water/ cement ratio = 30% was investigated. From the results of the study presented earlier, the following conclusions are offered:-

CN accelerator has a significant effect on the early and later age compressive strength of Mortar among the four series of dosage accelerator the early and later age compressive strength with 4% accelerator by pre-curing time 2.5(hr) at different ages (8 hour, 7 Days and 28 Days) are Higher than 0 % accelerator ( 79.3%, 60.5% and 47.6%) respectively.

The combine effect of temperature and admixture in compressive strength of specimens for early and later age is obvious with high compressive strength in early and later age.

Early and later Compressive Strength for those of Specimens which exposure to pre-curing time 2.5 hours are higher than early and later compressive strength of those specimens which travelled at pre-curing time for 0.5 hour.

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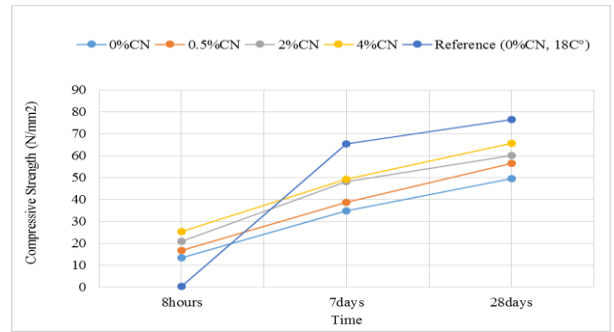


Figure 3. Variation in Compressive Strength

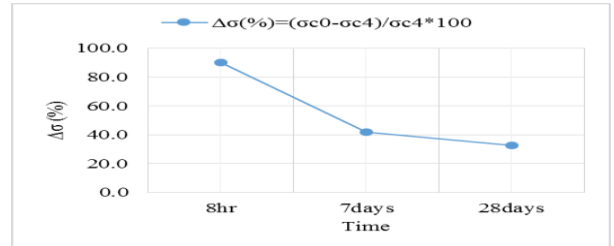


Figure 4.  $\Delta\sigma$  (%) For Admixture 0% and 4%

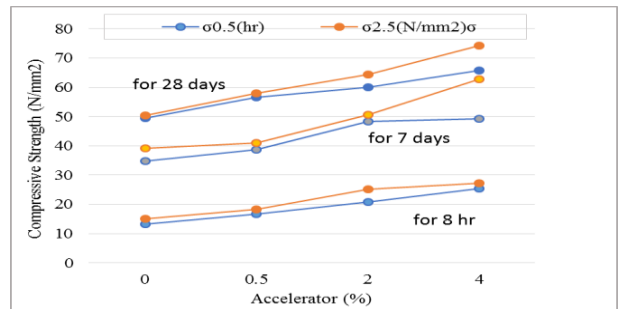


Figure 5. Variation in Compressive Strength based pre-curing time

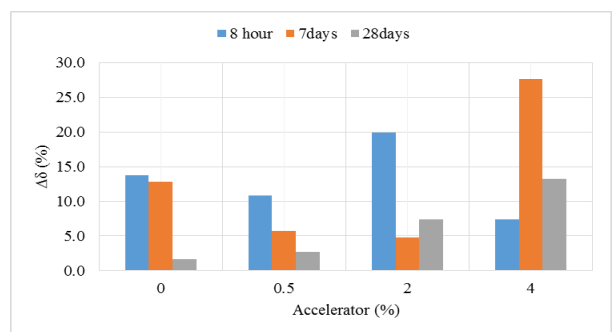


Figure 6.  $\Delta\sigma$  (%) For procuring time 0.5 and 2.5hour