9th International Congress on Civil Engineering, May 8-10, 2012
Isfahan University of Technology (IUT), Isfahan, Iran

An Optimal Accelerator Used In Concrete

Rahimi SH, Mortazavi SJ, Golchin A, Ghods AS
Department of Civil Engineering, Mashhad Branch, Islamic Azad University, Mashhad, Iran
shahriar.rahimi2002@gmail.com

Abstract

It has long been known that curing concrete during cold weather can result in an inferior product with substandard properties. Curing also takes much longer, adding to job costs and extending the time before the concrete surface can be used. Admixtures are those ingredients in concrete other than portland cement, water, and aggregates that are added to the mixture immediately before or during mixing. An accelerating admixture is used to accelerate the rate of hydration (setting) and the strength development of concrete at an early age. Calcium chloride (CaCl2) is the chemical most commonly used as accelerating admixture, especially for nonreinforced concrete but it results in corrosion and lack of concrete durability; In order to solve these problems Aluminum hydroxide ($Al(OH)_3$)and Aluminum Sulfate ($Al_2(SO_4)_3$) were used. In this study, a total of 252 specimens in which different amounts of calcium chloride, aluminum hydroxide ,and Aluminum Sulfate were added to concrete were made. The effect of calcium chloride and aluminum hydroxide and Aluminum Sulfate on setting time, compressive strength, hydration temperature and permeability was determined. The specimens were experimented on in different days from 2 to 90 in order to measure strength. As a conclusion Calcium chloride causes a shorter setting time and lowers costs in comparison to Aluminum hydroxide and Aluminum Sulfate. On the contrary Aluminum hydroxide and Aluminum Sulfate have no effects on corrosion and they reduce the weight of concrete, prevent alkali reactions of aggregates, and increase durability.

Keywords: concrete, accelerator, Calcium Chloride, Aluminum Hydroxide, Aluminum Sulfate.

1. INTRODUCTION

Admixtures are materials added to concrete except water, aggregate, hydraulic cement and fiber. These should be added before or during mixing [1]. Chemicals used as so are generally put into two different categories: 1- Those which have an immediate effect on water traction and effect water cement system by absorbing cement particles. 2- Those divided to their ionic materials and influence chemical reactions between cement and water from minutes to hours after adding water [2]. When calcium chloride contacts cement, both gypsum and chloride create a little calcium trisulfurlaminat and calcium chlorolaminate through some reactions.

$$C3A + 3CaSO4 + 32H2O \quad C3A.3CaSO4.32H2O$$

$$C3A + CaCl2 + 10H2O \quad C3A.CaCl2.10H2O \qquad (1)$$

When chloride calcium stops its reaction gypsum continues its process. However chloride calcium helps the hydration of silicate [3].

After all gypsum is used up, again calcium chloride makes reactions with C3A until chloride is finished.

The matter to consider is that the amount of calcium chloride should be carefully controlled since higher amounts of it can cause incredibly instant setting [4].

Main ingredients used in accelerators for an initial setting time of under 3 minutes and a final setting time of under 12 minutes which are used in shotcrete include: Chlorides, Sulfates, Hydroxides, Aluminates, silicates, etc [5].

However, the use of Calcium Chloride in concrete causes several problems, the most important of which is corrosion of bars. Other problems include reduction of resistance to sulfate attacks and increase of Alkali-Aggregate Reactions [6]. Hence non-chloride accelerators should be replaced with a material from one of the categories below:

1-Materials containing active anions such as calcium salts

2-Materials containing active cations such as aluminum

3-Organic chemicals such as triethanolamine. These aren't usually used as a sole component. [7].