SciMedCentral
Bringing Excellence in Open Access

Journal of Materials & Applied Science

Original Research Article

Effect of Citrate Salts of Li+, Na+ and K+ on Some Physical Properties of Ordinary Portland Cement (OPC)

Zaki N. Kadhim[1]*, Alaa K. Ibraheem[2], Mohammed J. Al-assadi[1]

[1]*Chemistry Department, College of Science, University of Basrah, Basrah, Iraq*
[2]*Um-Qsir Cement Factory, Basrah, Iraq*

***Corresponding author**
Zaki N. Kadhim, Chemistry Department, College of Science, University of Basrah, Basrah, Iraq
Tel: +964-7801397186
Email: zekinasser99@yahoo.com

Submitted: 10 December 2016
Accepted: 21 March 2017
Published: 18 April 2017

Keywords
- Compressive strength
- Citrate salts
- Ordinary Portland Cement
- Retarder

Abstract

The citric acid was used as a water reducer, setting time retarder and workable time extender admixture on ordinary Portland cement (OPC). The changes in compressive strength, permeability and rebar corrosion upon addition of this admixture were studied.

The study also explores the effects of citric acid, tri-lithium citrate, tri-sodium citrate and tri-potassium citrate on most of the physical properties of the ordinary Portland cement type 1 (OPC) produced by Basrah cement factory /IRAQ. Thus, the compressive strength, standard consistency and setting time tests were performed. The results showed increasing in compressive strength in age 28 days, when low dosages (approximately ≤ 0.2%) of all types of admixtures were used. Standard consistency results showed a correlation between amount of admixtures and reducing water demand to reach standard consistency. The Setting time test showed the low dosages of all admixtures prolonged the thickening to a certain extent, while the large amounts were caused a remarkable reduction. The increasing in strength in a small number of admixtures may be attributed to the hardened cement specimens. An improvement in permeability and rebar corrosion, also, was observed when certain ratios of admixtures have been used.

Abbreviations: OPC: Ordinary Portland Cement; **CSH:** Calcium Silicate Hydrate; **C_3A:** Tricalcium Aluminate; **CAH:** Calcium Aluminate Hydrate; **XRF:** X-Ray Fluorescence; **ASTM:** American Society for Testing and Materials

INTRODUCTION

In strictly chemical terms, hydration is a reaction of an anhydrous compound with water, yielding a new hydrated compound. In cement chemistry, hydration is understood to be the reaction of a non-hydrated cement or one of its constituent with water, associated with both chemical and physico-mechanical changes of the system, with setting and hardening when water is added to cement, paste is formed which gradually stiffens and then hardens. The stiffening of cement paste is called setting. Normal setting of cement is associated with the hydration of Alite (impure C_3S) and formation of the calcium silicate hydrate (CSH) phase and hydration of tricalcium aluminate (C_3A) where react with water immediately forming different calcium aluminate hydrates (CAH) [1]. Setting, in general, depends on type of cement and the water/cement (w/c) ratio.

Hot weather is defined as any combination of high temperature (generally above 80 degrees F (26.7°C), low relative humidity, and wind velocity tending to impair the quality of fresh or hardened concrete or otherwise resulting in abnormal properties, so concrete surface shall not be allowed to dry after placement and during the curing period by increasing the water content or by adding admixture. The water content of a freshly mixed batch of concrete has important consequences on the properties of the concrete. Addition of overload water will produce in higher porosity, lesser potency and poorer toughness. Consequently, control of the water to cement (w\c) ratio is a crucial part of process manage throughout concrete batching [2-4]. Thus, to avoid concrete from the undesirable effects of hot weather, admixtures are normally incorporated in it [1]. The effect of hot climate of south Iraq was characterized by high ambient temperature and high wind speed. This demand using water reducer and retarder admixture to improve physical properties of concrete to reduce the intensity of reduction in water content and drying shrink. However, the amount of shrink is influenced the most by removal of water from the smaller capillary void, and compressive strength is more an indication of the volume of the voids and not the pore size distribution and to offset unwanted effect of high temperature, such as acceleration of set and reduction of 28-day compressive strength, and to keep concrete workable during the entire placing and consolidation period [5]. In the literature, various water-reducers\ retarders admixtures were found such as sugars [6,7], cellulose ethers [8,9], lignosulfonic acid [10,11], citric acid [12-15], gluconates [16], dextrins [17], and calcium sulfate [18].

The retarders most widely used in practice appear to be hydroxyl carboxylic acid or citric acid and it's salts classified as water-reduce and retarder admixture (ASTM C 494 Type A, D)