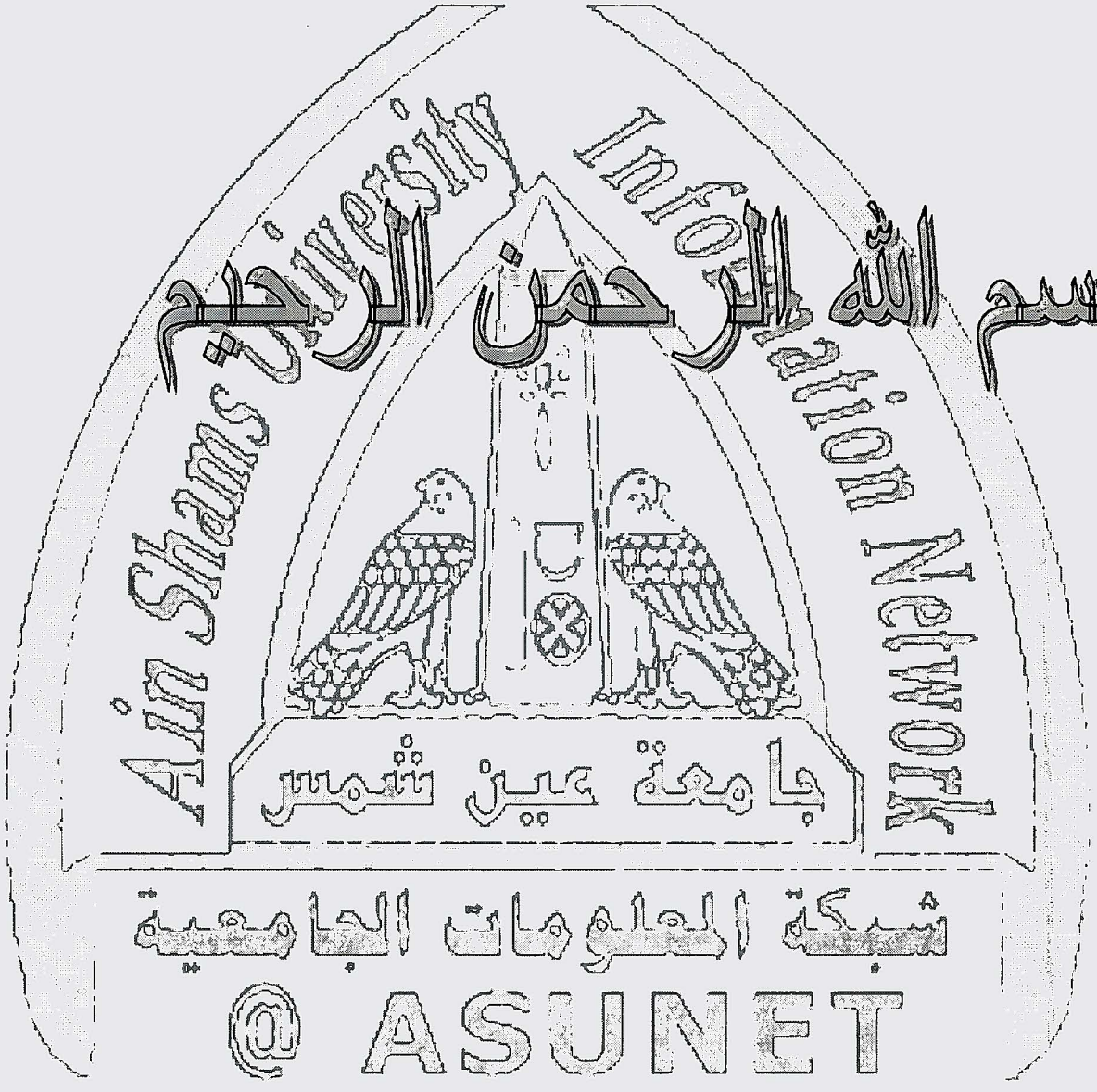
شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم



شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأفلام بعيدا عن الغبار
في درجة حرارة من ١٥-٢٥ مئوية ورطوبة نسبية من ٢٠-٤٠%

To be Kept away from Dust in Dry Cool place of 15-25- c and relative humidity 20-40%

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

بعض الوثائق الاصلية تالفة

Ain Shams University
Faculty of Science
Chemistry Department

Effect of Some Concrete Admixtures on the Physico-Mechanical Properties of the Hardened Cement Pastes

A Thesis
Submitted in Partial Fulfillment for the Requirements of the Degree of Master of Science in Chemistry

Submitted By

Mohamed El-Sayed Amin Hassan
B.Sc., Chemistry, Faculty of Science
Ain Shams University, 1997

Supervised By

Prof. Dr./ S. Hanafi
Prof. of Physical Chemistry, Faculty of Science,
Ain Shams University

Dr./ F. I. El-Hosiny
Assistant Prof. of Physical Chemistry, Faculty of Science,
Ain Shams University

Cairo-2001

١٨٠٧


بسم الله الرحمن الرحيم
«قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْحَكِيمُ »
صدق الله العظيم
«سورة البقرة -آية ٣٢»

Effect of Some Concrete Admixtures on the Physico-Mechanical Properties of the Hardened Cement Pastes

Thesis Advisors

Approved

Prof./ Dr. S. Hanafi
Prof. of Physical Chemistry, Faculty of Science,
Ain Shams University

S. Hanafi

Dr./ F. I. El-Hosiny
Assistant Prof. of Physical Chemistry, Faculty of Science,
Ain Shams University

F. I. El-Hosiny

Head of Chemistry Department

M. A. El-Kasaby

Prof. Dr. / M. A. El-Kasaby

Cairo-2001

ACKNOWLEDGEMENT

*First and foremost, I would like to thank **Allah** for giving me the opportunity and the strength to accomplish this work.*

I am deeply indebted to **Prof. Dr. S. A. Abo-El-Enein (D.Sc.)** Prof. of Physical Chemistry and Building Materials, Faculty of Science, Ain Shams University, for his indispensable advice and constructive criticism throughout the thesis

I would like to express my deep gratitude to **Prof. Dr. S. Hanafi,** Prof. of Physical Chemistry, Faculty of Science, Ain Shams University, for suggesting the problem, valuable advice, valuable discussions and criticism.

I am deeply indebted to **Dr. F. I. El-Hosiny,** Assoc. Prof. of Physical Chemistry, Faculty of Science, Ain Shams University, for his valuable assistance, guidance and continuous help during the progress of the work.

*Finally, I wish to thank my family and my friends **(Amr, Mahmoud, Asmaa, Ayman and Awaad)** who stood beside me during conducting this work.*

Abstract

In this investigation the main mechanical and physico-chemical properties of the neat and admixed cement pastes were studied; these are the neat cement paste made of ordinary Portland cement (OPC) as well as the admixed OPC pastes containing two concrete admixtures, namely Melment (M) and calcium lignosulphonate (CLS).

At the end of each hydration period, the specimens were tested for compressive strength, hydration kinetics, surface properties, X-ray diffraction analysis (XRD) as well as scanning electron microscopy (SEM). Hydration kinetics were studied by determining the chemically combined (non-evaporable) water and free lime contents at the various ages of hydration.

The main conclusions derived from this investigation are summarized as follows:

1- The admixed OPC paste prepared by using 0.5% Melment is considered as representing the optimum addition required for the improvement of the hydraulic properties of OPC pastes.

2- The various additions of calcium lignosulphonate (CLS) results in an improvement of the plastic and hardened properties of the OPC pastes leading to higher compressive strength values especially with 0.5% addition of CLS.

3- The addition of Melment (M) or Ca-lignosulphonate (CLS) to OPC pastes causes a decrease in the values of specific surface area and total pore volume as measured by nitrogen adsorption.

4- The addition of concrete admixtures (M or CLS) do not affect the phase composition of cement hydration product; these admixtures affect only the physical state and the degree of crystallinity of the formed hydrates.

List of Contents

CHAPTER I
INTRODUCTION AND OBJECT OF INVESTIGATION

CHAPTER I

INTRODUCTION AND OBJECT OF INVESTIGATION

I.A. Introduction

Chemical admixtures are defined as inorganic or organic compounds which when added to Portland cement in small amounts (usually less than one percent by weight of cement), modify the properties of the cement paste or hardened cement stone in a desired way. Some admixtures are used to improve the workability of the cement paste, and thus of concrete mixes, either by improving their plasticity or by reducing their water requirement. The latter approach can result in higher strengths of the hardening material through the use of lower water/cement (W/C) ratio. Superplasticizers (also known as superfluidifiers, super water reducers or high range water reducers) can be distinguished from water reducers by the effective deflocculation when used in the mix design. Use of Superplasticizer in concrete used in building construction improved the workability, decreased the water of consumption (10-15%) and increased the medium strength of the hardened concrete (10-15%)

I.A.1. Hydration Kinetics and Mechanical Properties:

Noguchi and Co-workers, (1974), reported an increase of early strength and a shortening of set time by an additive that contains oligosaccharides obtained by hydrolysis of waste cellulose fibers. Saito and Co-workers, (1974), reported also an accelerated hardening after addition of naphthalene sulfonate formaldehyde condensate.

Babachev and co-workers, (1974), studied the effect of different set retarders upon strength development. Generally a slightly reduced compressive

strength was found in the first few days after hardening but later on the strength reached that of cement without additive.

Lignin and its derivatives, (Martin, 1974), alone or in combination with other substances, have also a set retarding effect upon cement. The effect of a lignin based admixture upon hydration of Portland cement was studied by Collepardi and co-workers, (1974), and by Khalil, (1974), both groups came to the conclusion that the rate of hydration rather than the nature of hydration products formed was altered by these admixtures.

The group of water reducers most widely used are derivatives of lignin especially sulfate waste liquor and calcium lignosulfonate. The water reducing effect of lignosulfonates depends on the temperature of the concrete mixture at elevated temperatures, unlike normal temperature, a deterioration of the consistency may be observed, (Vavrin et al, 1974). Beaudoin and MacInnis, (1974), reported that addition of calcium lignosulfonate and of hydroxylated carboxylic acid appears not to affect the strength-dilation relation of cement pastes and has little effect upon dimensional stability of pastes subjected to a slow cooling-warming cycle. Other plasticizing agents described by Abramova et al, (1974), recently are the sodium salt of formaldehyde-salicylic acid copolymer and a condensation product of sulfonated phenols with formaldehyde and glycols, (Klingshirn et al, 1974).

Rosskopf, et al, (1975), have pointed out that the exact effect of an accelerating admixture depends on its influence on each of the individual cement compounds, particularly C_3S and C_3A. The compounds that belong to these admixtures, chlorides, and especially calcium chloride, are considered to be most effective and are most widely used. Skalny and Maycook, (1975), have written an excellent review on the influence of $CaCl_2$ on the hydration of the cement compounds. It has been concluded, (Klyusov et al, 1975), that the added $CaCl_2$ combines with the $Ca(OH)_2$ formed in the hydration of C_3S to

form the phase 3 $CaO.CaCl_2.6H_2O$ and that the amount of this phase formed increases as the hydration temperatures becomes lower. Rosskopf et al, (1975), has examined the effect of several calcium and sodium salts on the hydration of cements and also reported an accelerating effects with formaldehyde and paraformaldehyde.

Several new retarders were reported, among them a reaction product between alkanolamine-lignosulfonate and formaldehyde, (Landry et al, 1975), glucose, (Singh, 1975). The mechanism of the action of set retarders has been studied by Mariampal'skii, et al, (1975), it was concoluded that retarders such as saccaric, aldonic and uronic acids and their salts act by forming chelate compounds with Ca^{+2}. Set retarding, water-reducing admixtures, such as lignosulfonates and hydroxycarboxylic acids are known to increase shrinkage of hardened cement paste.

The group of water reducer most widely used are derivatives of lignin, particularly calcium or sodium lignosulfonates or sulfite waste liquor. A series of additional compounds was described to be effective as water reducing and /or plasticising agents, among them acrolein, (Cherkinskii et al, 1975), polyglycerol, (Goshokubo et al, 1975), a combination of anthranilic acid, formaldehyde and phenol, (Akhmedov, 1975).

A short review on the role of $CaCl_2$ in concrete, (Anon, 1976), describes the effect of $CaCl_2$ on workability, setting time, rate of setting and corrosion in concrete. The effect of other accelerators on setting time and strength development is also mentioned. It is concluded that "calcium chloride-the king of accelerators" is not yet dethroned despite occasional crimes. Addition of $CaCl_2$ to cement not only influences the hydration of C_3S but also involves interaction with the C_3A and C_4AF components.

Addition of 1-1.5% $BaCl_2$ not only has been found, (Zharov et al, 1976), to decrease the setting time by 33-50%, but also to increase significantly the