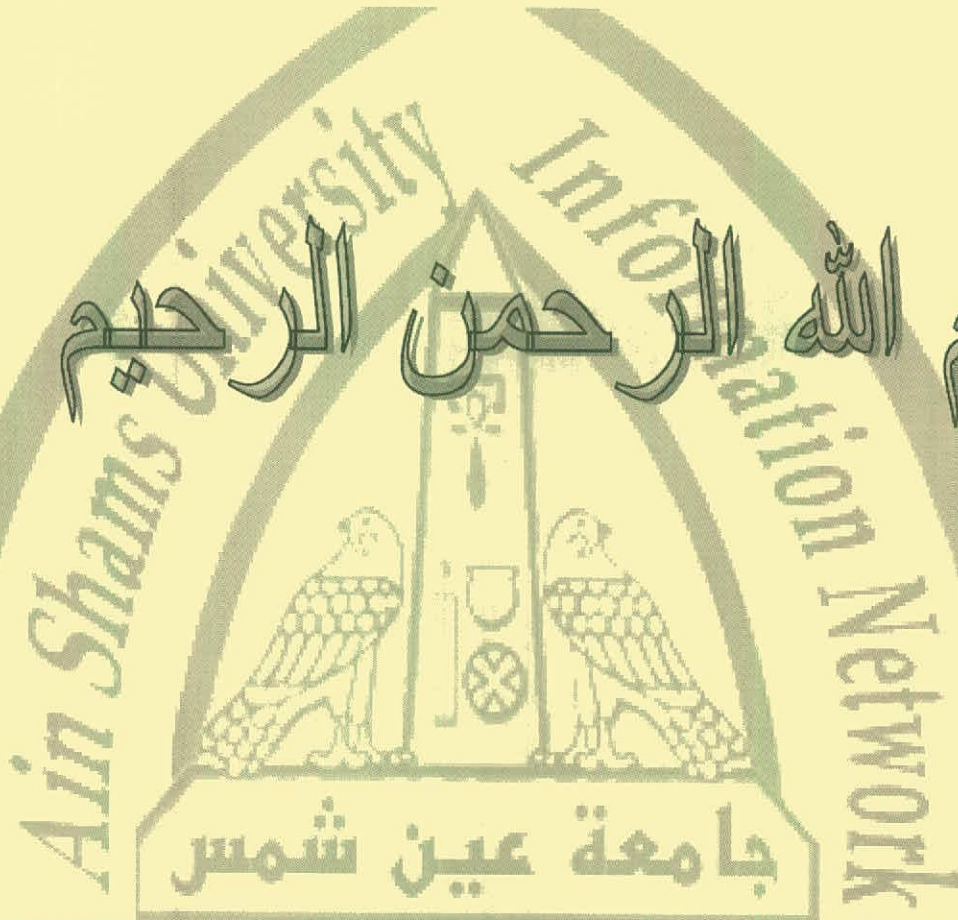




شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



شبكة المعلومات الجامعية  
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# شبكة المعلومات الجامعية التوثيق الالكتروني والميكرو فيلم





شبكة المعلومات الجامعية

# جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

## قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها  
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# بعض الوثائق الأصلية تالفة

# بالرسالة صفحات لم ترد بالاصل



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# **EFFECT OF SOME CONCRETE ADMIXTURES ON THE SILICA FUME BLENDED CEMENT PASTES**

*A Thesis*  
**Presented to**

*Faculty of Science*  
*Zagazig University*

*By*

**MOHAMED AHMED HASSAN HEIKAL**

*For*

**The Degree of Doctor of Philosophy  
In  
Science, Chemistry**

**1996**

# **EFFECT OF SOME CONCRETE ADMIXTURES ON THE SILICA FUME BLENDED CEMENT PASTES**

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#### **ARABIC SUMMARY**





# CHAPTER I

# **CHAPTER 1**

## **1. INTRODUCTION**

### **1.1. Introductory Notes:**

Admixtures for concrete are defined as materials other than hydraulic cement, water, or aggregates that are added immediately before or during mixing. Admixtures are added to modify the properties of fresh or hardened concrete in such a way as to make it more suitable or economical for the job at hand.

Admixtures can be classified into the following categories: chemical, mineral, air-entraining, and miscellaneous admixtures (used for special purposes such as grouting, coloring, flocculating, damp proofing, corrosion inhibition, .. etc.).

Chemical admixtures are classified into: water reducers / retarders, superplasticizers and accelerators<sup>(1)</sup>.

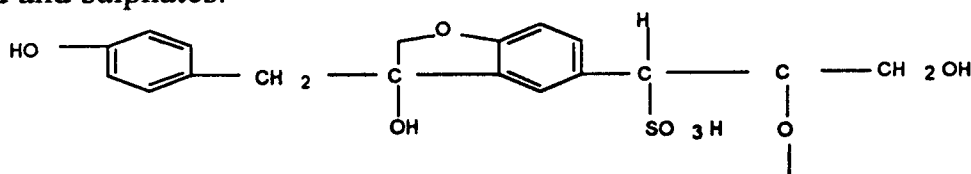
### **1.2. Water Reducers/Retarders:**

A water reducer can be defined as an admixture that reduces the amount of mixing water of concrete for a given workability. It improves the properties of hardened concrete, and in particular, increases strength and durability. The reduction of mixing water must be at least 5%. However, the commercial water reducers can reduce mixing water up to 10-15%.

There is another mode of the use of these admixtures, involving reduction of both water and cement, so that, workability and strength of concrete containing admixtures are similar to the control concrete. Besides allowing cement saving, these admixtures are capable of reducing the heat of hydration, a property that is useful for concerning in hot climates or massive structures.

If water reducer is added without modifying mix properties, concrete workability improves, in this case acts as plasticizer. This is particularly useful for placing concrete in areas of high steel contents that require a more workable concrete.

There are many types of water reducers or retarders. These are water soluble organic compounds. The main compounds used in the manufacture of water reducers can be divided into four groups. The first one contains Ca, Na or  $\text{NH}_4$  salts of lignosulphonic acids. The second group contains the hydroxy carboxylic acid generally as Na,  $\text{NH}_4$  or triethanolamine salts. The carbohydrates belong to the third group. All the water reducing admixtures are generally offered by supplier as an aqueous solution with a specific gravity in the range of 1.10 to 1.30 g/ml. The lignosulphonate molecule may have an average molecular weight of approximately 20000 to 30000 with the molecular weight distribution varying from a few hundreds to 100000(2,3). The lignosulphonate molecule is very complex and may be visualized as a polymer of a substituted-propane unit with hydroxyl ( $-\text{OH}$ ), methoxy ( $-\text{OCH}_3$ ), phenyl ring ( $\text{C}_6\text{H}_5$ -) and sulphonic acid ( $-\text{SO}_3\text{H}$ ) group. Lignosulphonate is obtained as a waste liquor during the process for the production of paper-making pulp from wood whose composition includes about 20-30% of lignin. It contains a complex mixture of sulphonation products of lignin, decomposition products of cellulose and lignin, various carbohydrate and free sulphurous acid and sulphates.



Structural unit of lignosulphonate molecule

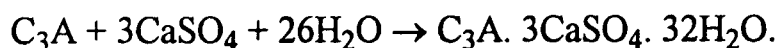
In the lignosulphonate salts used as admixtures, a metal or ammonium cation replaces hydrogen in the sulphonic group. Calcium or



sodium salts are the most widely used cations in water reducer formulation. Calcium lignosulphonate is however, cheaper than sodium lignosulphonate.

The effect of lignosulphonate on the Portland cement hydration is very complex as the cement components can affect each other during hydration. Thus, the influence of the admixture on cement hydration depends on the composition and in particular on  $C_3A$ , alkali and sulphate content. Other parameters are surface areas, lignosulphonate composition, molecular weight, sugar content, dosage of the admixture, and mixing procedure<sup>(4)</sup>.

Addition of sodium lignosulphonate results a very early acceleration of  $C_3A$  hydration, according to equation:



because of the absence of  $Ca(OH)_2$  in solution<sup>(5)</sup>. Lignosulphonate inhibits the release of  $Ca(OH)_2$  from  $C_3S$  hydration and, at the same time, the highly alkaline solution reduces the solubility of any  $Ca(OH)_2$  present. Calcium lignosulphonate containing sugars accelerates the  $C_3A$  hydration and inhibits the  $C_3S$  hydration during the first 2-3 hours<sup>(6)</sup>. Assuming  $C_4AF$  behaves similar to  $C_3A$  and that the  $\beta$ - $C_2S$  hydration is negligible during the first few hours, it could be concluded that the addition of lignosulphonate may accelerate the initial set of Portland cement with high aluminate/ $C_3S$  ratio, and may retard the initial set of cements with low aluminate phase/ $C_3S$  ratios.

The effect of sodium lignosulphonate superplasticizer on the hydration of Portland cement type V have been investigated by XRD and FTIR Techniques<sup>(7)</sup>. The results of these studies indicate that the superplasticizer inhibits the hydration reaction as demonstrated by the reduction of the formation of  $Ca(OH)_2$  as well as lower degree of polymerization of silicate anions.