HYDROTHERMAL CHARACTERISTICS OF ARTIFICIAL POZZOLANA - CEMENT PASTES

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By

MAHMOUD AHMED TAHER
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HYDROTHERMAL CHARACTERISTICS OF ARTIFICIAL POZZOLANA - CEMENT PASTES

Board of Scientific Supervision

Approved

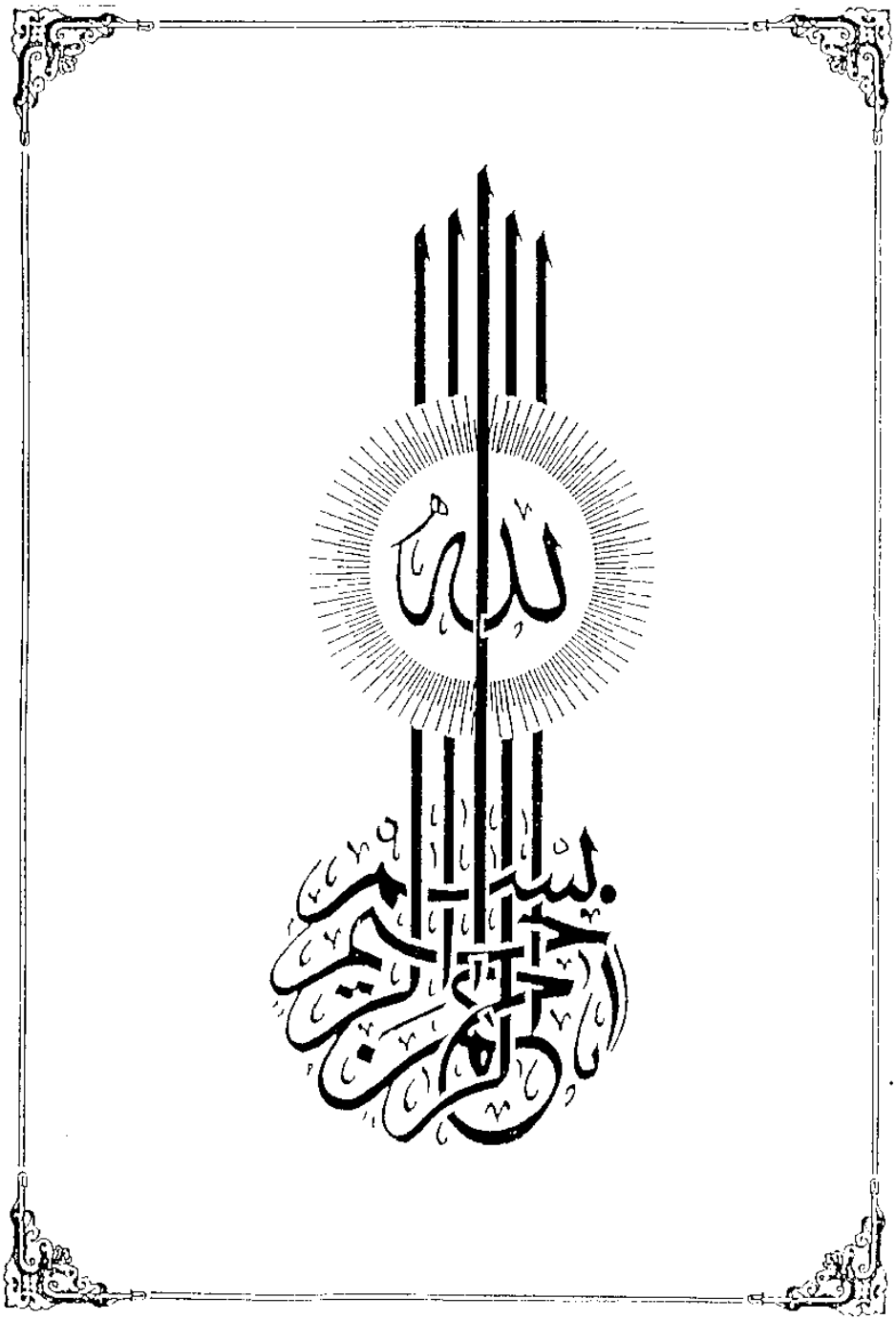
Prof . Dr . S . A .Abo- El- Enein
Prof . of . Physical Chemistry and Building Materials, Faculty of Science,
Ain Shams University, Cairo, Egypt

Prof . Dr . H.El - Didamony
Prof . of Inorg. Chem. and Head of Chemistry Department,
Faculty of Science , Zagazig University,
Zagazig, Egypt.

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

Dr . A.M. Amin
Assoc. Prof , General Organization for Housing Building and Planning Research, Cairo , Egypt.

Prof . Dr . A. F.M.Fahmy
Head of Chemistry Department



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TO THE MEMORY OF MY FATHER

TO MY MOTHER

TO MY WIFE

AND KIDS

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INTRODUCTION AND OBJECT OF INVESTIGATION

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IA- Introduction:

Pozzolana are usually defined as materials which are not cementitious in themselves,but contain constituents which react with Ca^{2+} or $Ca(OH)_2$ and form new binding compounds in the presence of water. Pozzolanas can be divided to natural and artificial. The natural pozzolanas were mostly materials of volcanic origin and certain diatomaceous earths. Chemical or physical treatment for these natural materials such as clay,shales, fly-ash will produce artificial pozzolanas.

" Pozzolanic reactivity" is defined as index of reaction degree between pozzolanas and Ca^{2+} or $Ca(OH)_2$ in presence of water at ordinary temperature,or between pozzolanas and materials which produces $Ca(OH)_2$ under the precence of water. The pozzolanic reactivity is affected by the chemical composition,crystalline structure of constituents of pozzolana,and the conditions of hydration.

Massazza[1]found that the crystalline hydrates formed in the reaction between lime and pozzolana in the presence of water where hexagonal calcium aluminate hydrate(C_4AH_x),Calcium

carboaluminate hydrate($C_3A.CaCO_3.H_{12}$),calcium aluminate monosulphate hydrate ($C_3A.CaSO_4.H_{12}$),and calcium silicoaluminate hydrate(C_2ASH_8) which were identified by XRD,DTA and electron diffraction analysis.

The hydration of $Ca(OH)_2$ and two kinds of trasses containing 50-70% of glass phase,feldspar,quartz,analcite, etc. in suspension and pastes was investigated by Ludwig and Schwiete[2],they confirm the formation of C_4AH_{13} and C_3S hydrate without gypsum;in the presence of gypsum,ettringite and monosulphate hydrate was formed.

The reaction between silica and $Ca(OH)_2$ was investigated by Greenberg[3],he concluded that the reaction could be divided to six elementary processes;that is,the adsorption of $Ca(OH)_2$ to silanol groups of silica surface,the dissolution of silica, the reaction of H_4SiO_4+$Ca(OH)_2$+C-S-H,the formation of nuclei, the growth of nuclei,and precipitation of crystals. He also emphasized that the dissolution of silica was the rate determining step of overall reaction. The rate of reaction was influenced by the surface area of silica and its free energy state,and not influenced by the concentration of $Ca(OH)_2$ above 3.6 mmol/L.

The reactivity of 6 pozzolans of different origin and composition and the microstructure of their hydrate were

studied by X-ray diffraction and SEM[4]. Two paste samples were studied,one containing 80%pozzolan+20%$Ca(OH)_2$ and the other Portland cement+20%pozzolan. The combination rate of $Ca(OH)_2$ in cement pastes was compared to the mechanical resistances of ISO mortars. According to mineralogical analysis,4 of the pozzolans are of volcanic origin (feldspars,zeolitic,viterous),another of sedimentary siliceous origin,and the last is a powder plant fly ash. The activity of these additives is a function to their chemical composition,their mineralogical nature,and their specific surface. Certain pozzolans such as fly ash, which hydrate only slightly over short periods can be activated by thermal treatment.

Campbell,Weise and Love[5],examined samples of volcanic ash from the Mount St.Helens eruption in May 1980 to evaluate: (1) possible effects on concrete by using sand and gravel aggregate containing the ash from fallout and (2) potential use of the ash as pozzolan. Ash added to aggregate improved the strength of mortar and decreased the alkali-aggregate reactivity in its natural condition. Grinding to a fineness about 5000 Blaine,however, suggested a possible use of the ash as pozzolan in concrete.

Furnier and Geoffray[6],found that beside the structure, the morphology and the chemical composition,the fineness of ground material effected on the reactivity of pyroclasts. The