AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Study the Effect of Zeolite on the Properties of Light Weight Concrete

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A Thesis

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STATEMENT

This thesis is submitted as a partial fulfillment of the “master of science” degree in Civil Engineering, Faculty of Engineering, Ain shams

University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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DEDICATION

To My Dad, My Mum, My Brothers & My husband

My family that has a great effect on my life,

All my love to them for their care and support

Study the Effect of Zeolite on the Properties of Light Weight Concrete

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ABSTRACT

In the last years, researches succeed in producing light weight concrete with purpose of reduce the dead load of structural elements, thus reducing the costs of whole structure through allowing the designer to reduce the dimensions of structural elements and therefore reducing the amount of steel reinforcing, as well as improving the purposes of thermal and acoustic insulation.

Light weight concrete can be produced by one or more of the following methods such as producing finless concrete that consists of cement, water and coarse aggregate. Another method is by using lightweight aggregate, or by inserting gas or air bubbles into concrete mixture or adding foam materials for the mixture. In this study, lightweight concrete is produced by using zeolite as an aggregate and bubble generating agent by heated zeolite sample for 2 hr at 550^{o}C. and study the effect of calcined zeolite on the properties of light weight concrete. Where zeolite has pozzolanic characteristics and can improve the properties of concrete. Many researchers have conducted deep studies on how to enhance the properties of concrete and reported that using pozzolanic materials proved to be effective in promoting its strength due to their pozzolanic reaction which reacts with excess calcium hydroxide (CH) forming extra calcium silicate hydrate (C-S-H) gel which enhances the interfacial transition zone (ITZ) among aggregates and cement blends resulting in promoting concrete strengths. Zeolites are crystalline alumina silicates with uniform pores, channels and cavities, this cavities occupied by cations of different elements. In this study, coarse aggregates were replaced with coarse zeolite larger than or equal to 5 mm and fine aggregates were

replaced with fine zeolite less than 5 mm. and thus concrete contains cement, water, superplasticizer and zeolite (coarse and fine). A laboratory study was conducted to determine the effect of zeolite on the production of lightweight concrete on both the properties of fresh concrete (by produce test of workability).and the properties of hardened concrete (by produce tests such as compressive strength, tensile strength, flexural strength, bond strength, sorpativity test , ultrasonic pulse velocity . Using different percentages up to 100%. The results have shown several important conclusions. Usage of calcined zeolite decreases the unit weight of concrete. Relatively lower specific gravities (2.1) pore structures of zeolite could be attributed to unit weight reductions. As well as the ability of zeolite to generate bubbles within the concrete mix. And showed improvement in physical and mechanical properties when increase the amount of coarse aggregates (coarse zeolite) and reduce the amount of fine aggregates (fine zeolite). Compressive strength, flexural strength, tensile strength and bond strength. And therefore affects the strength negatively. Results of compressive strength showed that Zeolite has high pozzolanic effect where the ratio between compressive strength at 7 days and 28 days was 2.7 and the ratio between compressive strength at 90 days and 28 days was 1.27.

Key **Words:** Natural zeolite, clinoptilolite, Light Weight Concrete, Compressive strength, flexural strength, tensile strength, bubble generating.

PUBLICATIONS

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CHAPTER ONE: INTRODUCTION

1.1 General

Concrete is one of the most important and common materials in the construction industry. Whereas Concrete is given sufficient strength, It is economic in comparison to other construction materials such as (steel and Timber for construction) and It is also feature by the availability of materials used in it. However, there are deficiencies in the use of concrete such as it needs a high weight to reach the required strength. The Increase in own weight leads to the large dimensions of structural elements and the amount of reinforcement bars becomes high then the cost becomes high. so in the previous years, researches succeed in producing lightweight concrete with purpose of reduce the dead load of structural elements, thus reducing the costs of whole structure through allowing the designer to reduce the dimensions of structural elements and the amount of steel reinforcing, in addition to improving the purposes of acoustics and thermal insulation [1]. Where normal weight concrete with a density in the range of 140 to 150 lb/ft (2240 to 2400 kg/m3) [2] as compared to LightWeight Concrete can be produced with various densities from 300 kg/m3 to 1850 kg/m3 [3-4]. Many researchers have referred that using pozzolanic materials (fly ash- silica fume- metakaolin) due to its pozzolanic reaction which reacts with excess CH forming extra C-S-H gel which enhances the ITZ among aggregates and cement blends resulting in promoting concrete strengths [5-7]. As well the use of pozzolanic materials has acquired attention due to rigid environmental instructions to recycle discarded material. Zeolite is among the pozzolan materials and has the ability of generate bubble in concrete mixture .so this thesis studied the pozzolanic effect of locally available zeolite in Egypt. and studied the usage of calcined zeolite in production of lightweight concrete as a bubble generating agent and as an aggregate. Natural zeolite is a type of