



## Effect of Natural Zeolite-Pozzolan on Compressive Strength of Oil-Polluted Concrete Marine Structures

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Received 13 November 2016; Accepted 26 December 2016

### Abstract

Oil pollution into the concrete composed materials, leads to decrease the compressive strength of the constructed structure. In the present study, effect of using a natural pozzolan named Zeolite on concrete structures was tested in different marine conditions. A fixed amount of oil equal to 2% of sand weight was added as the pollution into the concrete composed materials. Natural Zeolite was added into the concrete instead of cement to the mix design with weight percentages of 10, 15 and 20. After preparing and curing, concrete specimens were placed into the three different conditions: fresh water, tidal, and sea water environments. Results of compressive strength tests showed that replacement of natural Zeolite instead of cement significantly increased compressive strength in comparison with control specimens, in all environments. Adding 20% natural Zeolite increased the compressive strength to its highest values about 60-85% higher than control specimens.

*Keywords:* Compressive Strength; Tidal and Sea Water Environments; Oil Polluted Sand; Natural Zeolite; Marine Concrete Structures.

### 1. Introduction

Concrete is one of the most applicable materials in construction projects. Some effective factors on the compressive strength ( $f_c$ ) of concrete are W/C, compaction degree; type of cement, aggregate grade, mixing method, placement, curing method and presence of contaminants [1]. Oil polluted aggregates into the concrete leads to decrease the  $f_c$ . Oil pollution in concrete can be occurred in two major ways: Oil can be penetrated into the concrete as mixed by raw materials (along with fine and coarse aggregates) or in the case of being the oil around the concrete structure, it can penetrate into the pores of the concrete. Reducing the prosity of marine concrete structures is an effective way to increase the life time of the project [2-5]. To improve the mechanical properties and durability of the mortar and concrete, Natural Zeolite (NZ) can be selected as a concrete pozzolan. The important advantages of using on concrete properties, are high  $f_c$ , high tensile, modulus of elasticity, enhanced durability, low permeability to chloride and water intrusion, increasing abrasion resistance, resistance to chemical attacks from chlorides, acids, nitrates and sulfates. The positive effects of NZ on various properties of concrete were presented in several researches such as: Canpolat et al.; Albayrak et al.; Ikotun et al.; Perraki et al.; Ahmadi et al.; Karakurt et al.; Jitchaiyaphum et al.; Ramezaniapour et al. and Trník et al. [6-14].

Ayininual et al. examined the effects of diesel oil and bitumen on  $f_c$  of concrete. They made the concrete specimens, with marine sands with 2, 5 and 10% of diesel oil and bitumen also was used. W/C was assumed fixed. 28-day  $f_c$  of concrete was about 77.4% to 96.8% for diesel oil and for bitumen  $f_c$  was about 26.2% to 76.2% compared to conventional concrete specimens [15]. Al-Jalawi et al. examined the effects of oil and diesel on concrete properties with high efficiency. They observed that petroleum products have an unacceptable effect on the properties of high-performance concretes and found that slump, workability and  $f_c$  of specimens compared to Control Specimen (CS)

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