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Antifungal effects of cement mortars with two types of organic antifungal agents

Jeongyun Do[a,*], Hun Song[a], Hyoungseok So[b], Yangseob Soh[a]

[a]*Architectural Engineering, College of Engineering, Chonbuk National University, Chonju 561-756, South Korea*
[b]*Department of Architecture, College of Engineering, Seonam University, Namwon 590-170, South Korea*

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Abstract

This study is concerned with investigating the antifungal effects of cement mortar with an organic antifungal agent on the *Aspergilus niger* which might be easily discovered in the interiors and exteriors of buildings. Two types of organic antifungal agents: isothiazoline/cabamate and nitrofuran, were used in this study for the purpose of investigating the antifungal effect of cement mortar with antifungal agent on the *A. niger* of various fungus which can be easily discovered in the interiors and exteriors of building. In addition to the investigation of the antifungal effect, the experiment of basic physical properties, such as compressive and flexural strengths, and flow test was carried out. Cement mortar with the antifungal agent of isothiazoline/cabamate exhibited the outstanding antifungal effects but the antifungal agent of nitrofuran did not give the antifungal effects to cement mortar. Although there is a very slight decrease in the strength, it is almost equal to that of cement mortar without antifungal agents.

Keywords: Antifungal effect; Mortar; Admixture

1. Introduction

1.1. Background and literature survey

Cement has been studied by numerous researchers and mortar and concrete made with portland cement have been broadly used construction materials with the structural and functional demand because they offer flexibility in application and are also capable of forming structural concrete element into a variety of shapes and sizes, and have the high natural performance such as the good compressive strength, the excellent resistance to water, and easy availability of material on site in spite of the disadvantages, such as low tensile strength, drying shrinkage or low resistance to sulfur, and the heterogeneous distribution of many solid components. Hence, a variety of the investigation and study on the physical and chemical properties and durability has been continuously carried out until now. High-performance concrete, such as ultra high strength concrete, high-fluidity concrete, and high-durability concrete, was developed and even the performance and serviceability of concrete have been excessively advanced. Nevertheless, the academic and scientific study on the influence of organisms, such as bacteria, fungus, microbial, insect, etc. on the concrete, except sulfation bacteria—aerobic bacteria oxidizing sulfuretted hydrogen (H_2S) into sulfuric acid (H_2SO_4)—has hardly been progressed in spite of the well-known fact that such organisms can adversely affect concrete [2]. According to Ramachandran, even durable concrete can, under certain conditions, suffer severe degradation by bacteria, fungi, and insects. It is pointed out that although the alkaline hydrates neutralize the initially formed acid, the fermentation or other bacterial metabolic activity, itself, continues as long as nutrients, bacteria, and moisture prevail. Prolonged exposure to such conditions results in the erosion of the surface of concrete [1].

Furthermore, fungus does harm to human in the sense that it could cause the outbreak of diseases, such as a respiratory disease, considering the resident's quality of living because various fungi are lively inhabiting in the inside and the outside of the building [2]. Only a few investigations about the antifungal effect in cement mortar or concrete exist. Method of addition and effects on the

* Corresponding author. Tel.: +82-63-270-2258; fax: +82-63-270-2285.
E-mail address: arkido@cricmail.net (J. Do).

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fresh and hardened properties of concrete and mortar was briefly introduced in the *Concrete Admixture Handbook* of Ramachandran [1], which informs the subject of bacterial, fungicidal, and insecticidal admixtures.

Nevile, through his book, *Properties of Concrete*, informed that some organisms, such as bacteria, fungi, or insects, can adversely affect concrete and it is necessary to incorporate in the mix some special admixtures which are toxic to the attacking organisms [3]. Some effective admixtures are listed in ACI 212.3R-91, which gives the addition rate ranging from 0.1–10% by weight of cement [4].

A survey of the literature showed that few investigators had been interested in the subject of the use of chemical admixtures to inhibit fungal attack. Accordingly, this paper is concerned with investigating the antifungal activities of cement mortar with organic antifungal agent and to present it as a scientific basic data.

1.2. Scope and limitations

This study is limited to the experimental examination of the addition effect of two types of antifungal agent to cement mortar on the fungus. The fungus used in this study is *Aspergilus niger*, which is frequently used in examinations about the antifungal effect of cloth, paints, fiber, plastic, etc. and might be easily detected in the interior of building in damp environments [5,6]. Cement mortar with antifungal agents for testing physical properties was cured in water until corresponding testing, but those for antifungal effect was cured with the polythene enveloped because the problem of redissolution of agent within water, and also the moisture existent in the surface of, or inside, the specimen which cured in water probably prohibited the more correct measurement of antifungal zone. After all cement mortars with antifungal agents for testing antifungal effect were stored with polythene enveloped for 28 days, it was perfectly neutralized, i.e., preprocessed, in a 10% CO_2, 20 °C, RH 65% chamber due probably to the hindrance of strong alkaline of cement mortar. With the above research scope and limitation, this study would rather be planned with the purpose to present the basic data and the index of research scope than to develop the application of the cement mortars with two types of organic antifungal agents. Plate 1 shows the procedure of this study.

2. Experimental program

2.1. Mix constituents

For the purpose of this study, ordinary portland cement as specified in KS 5201 (Specification for Portland Cements)

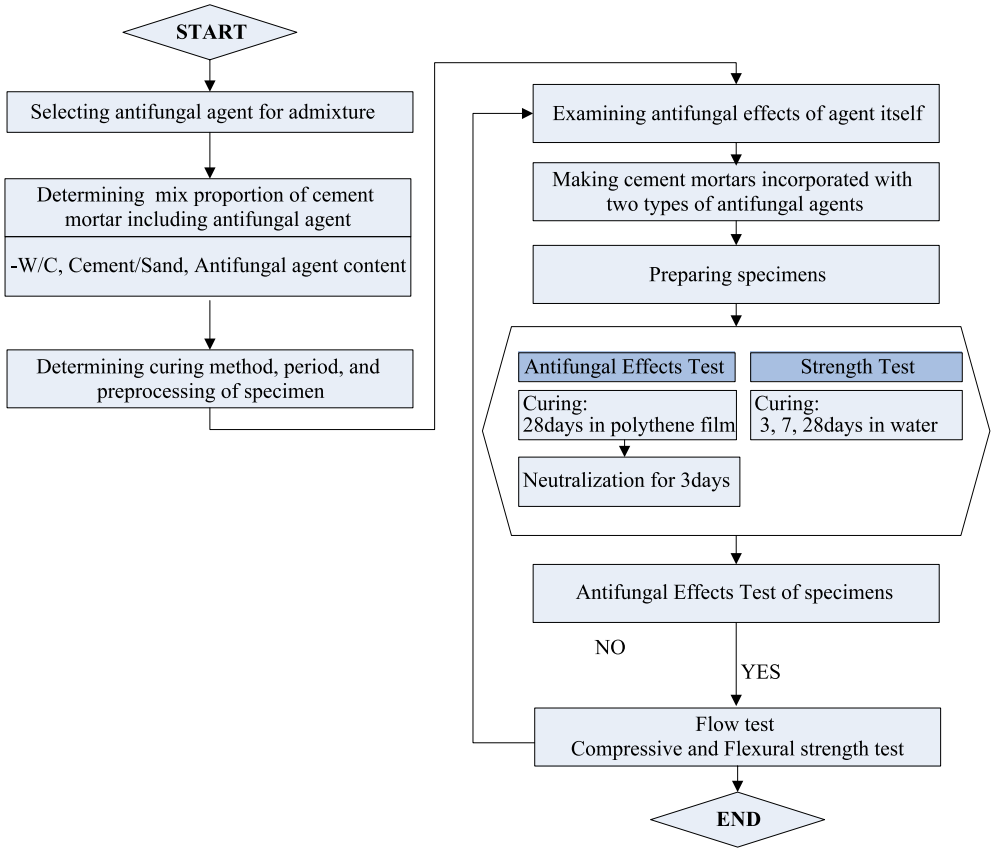

Plate 1. Study procedure.