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Durability of Mortars Modified with Calcined Montmorillonite Clay

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Abstract

This study aims to evaluate the performance of mortars containing locally available Pakistani montmorillonite (Mmt) clay mineral as partial replacement of cement in various curing environments. The local montmorillonite clay in "As is" (20˚C) and "heated" (100˚C, 200˚C, 300˚C, 400˚C, 500˚C, 600˚C, 700˚C, 800˚C, 900˚C & 1000˚C) conditions was incorporated in mortar cubes as partial replacement of cement. Montmorillonite clay of all the temperatures was replaced by 15%, 20%, 25%, 30% and 35% of cement mass in mortar cubes. The Strength Activity Index (SAI) was calculated to determine the optimum activation temperature for the clay. Compressive strengths of the controlled mix and montmorillonite modified mortars were evaluated under the Sodium Sulfate (SS) (5% solution) and mixed (Sodium Sulfate + Sodium Chloride (SCS)) (5% +3.5% solution) curing environments to study its durability performance. Upon thermal treatment montmorillonite clay showed maximum activation at 800˚C temperature. Mortar containing (800˚C) calcined montmorillonite clay with 25% cement replacement exhibit competent compression results. Moreover, up on exposure to aggressive environments, montmorillonite clay mortars performed better than the control samples. The mortar cubes exposed to Sulfate environment (SS) were more damaged in compression than that exposed to mixed environment (SCS), for all replacement levels and time exposures.

Keywords: Montmorillonite Clay; Calcined Clay; Corrosive Environment; Sodium Sulfate Environment; Sulfate Attack; Chloride Attack; Durability.

1. Introduction

Concrete and mortar are the most-utilized man made construction materials around the world. These are made from naturally available materials, which made it a famous construction material since long. Beside many advantages durability of concrete and mortar in various corrosive environments are of a primary concern. Concrete durability can be defined as its ability to resist any attack when exposed to different environments [1]. Durability means to meet the requirements of strength, stability and serviceability throughout its service life [2]. For a durable concrete selection of materials and its mix design is of prime importance [3]. The main disadvantage of concrete is its porous micro structure, through which water and other harmful chemical infiltrates that deteriorate the concrete thus damaging its health. Being a permeable material, concrete allows the penetration of harmful agents like acids, alkalis, carbon dioxide and chlorides

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