Available online at www.CivileJournal.org

Civil Engineering Journal

Vol. 6, No. 5, May, 2020

Microstructural and Compressive Strength Analysis for Cement Mortar with Industrial Waste Materials

Zahraa Fakhri Jawad [a], Rusul Jaber Ghayyib [a], Awham Jumah Salman [a*]

[a] *Al-Furat Al-Awsat Technical University, Najaf, Kufa, Iraq.*

Received 06 December 2019; Accepted 02 March 2020

Abstract

Cement production uses large quantities of natural resources and contributes to the release of CO_2. In order to treat the environmental effects related to cement manufacturing, there is a need to improve alternative binders to make concrete. Accordingly, extensive study is ongoing into the utilization of cement replacements, using many waste materials and industrial. This paper introduces the results of experimental investigations upon the mortar study with the partial cement replacement. Fly ash, silica fume and glass powder were used as a partial replacement, and cement was replaced by 0%, 1%, 1.5%, 3% and 5% of each replacement by the weight. Compressive strength test was conducted upon specimens at the age of 7 and 28 days. Microstructural characteristic of the modified mortar was done through the scanning electron microscope (SEM) vision, and X-ray diffraction (XRD) analysis was carried out for mixes with different replacements. The tests results were compared with the control mix. The results manifested that all replacements present the development of strength; this improvement was less in the early ages and raised at the higher ages in comparison with the control specimens. Microstructural analysis showed the formation of hydration compounds in mortar paste for each replacement. This study concluded that the strength significantly improved by adding 5% of silica fume compared with fly ash and glass powder.

Keywords: Cement Replacements; Fly Ash; Silica Fume; Glass Waste; Recycling Materials; Compressive Strength.

1. Introduction

Production of cement implicates a high consumption of energy and therefore is responsible for almost (7%) of the world's (CO_2) emission. It's well known that (CO_2) is the main contributor to the greenhouse influence and subsequently being responsible for the global warming of the earth. Thus, research upon the usage of by-product cementing materials, like silica fume, metakaolin, fly ash, waste glass and rice husk ash in place of cement has been increased in concrete technology [1].

Currently, researches on sustainable development on concrete have been carried out on the following aspects: extension of "concrete structure and development of low-carbon concrete material and structure [2]. Contemporary mixed cement types also use pozzolan as a cement replacement material or a mineral additive that is inter-ground or mixed with Portland cement. Pozzolans are defined as "Siliceous or Siliceous-Aluminous materials that have a slight or no cementitious effect, but due to their fine separated shapes and with the existence of moisture. They are chemically reacting with the calcium hydroxide under normal temperature to produce compounds having cementitious characteristics [3]. Krishnaraj et al. (2017) explored the influence of fly ash on the durability characteristics and compressive strength of the mixed cement mortar. The compressive strength test results and the (SEM) analysis

* Corresponding author: awhamjumah@yahoo.com

http://dx.doi.org/10.28991/cej-2020-03091524