



Conversion of Waste Marble Powder into a Binding Material

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Abstract

In the marble industry, a lot of marble is wasted in the form of odd blocks of various sizes and slurry consisting of water and micro-fine particles. The slurry on drying converts into powder. Both slurry and powder have adverse effects on the environment. This research is focused on the gainful utilization of waste marble powder (WMP) by converting it into a valuable binding material. For this purpose, WMP and clay were collected, and their physical and chemical properties were determined. A mix of WMP and clay was prepared and burnt at a temperature around 1300 °C. The burnt mix was ground to powder form to get marble cement (MC). The MC was then used in mortar. The compressive and flexural strengths of mortar cubes and prisms were determined. Apart from this, X-ray diffraction (XRD) analysis, thermogravimetric analysis (TGA) and scanning electron microscopic (SEM) analysis were also carried out. The chemical composition showed that the MC has 52.5% di-calcium silicate (C₂S) and 3.5% tri-calcium silicate (C₃S). The compressive strength of MC mortar after 28 days curing is 6.03 MPa, which is higher than M1 mortar of building code of Pakistan (5 MPa). The compressive strength of MC mortar after one year is 20.67 MPa, which is only 17% less than OPC mortar.

Keywords: Marble Powder; Binding Material; Cement; Mortar; Mechanical Properties.

1. Introduction

Marble stone has been used for construction and decoration purposes since a very long time [1]. Its demand has increased exponentially in the last few years and is growing further. Pakistan is one of the largest marble producing countries in the world. It has around 300 billion tons of known reserves of marble, and the actual reserves can be much more [2]. In Pakistan, about one million ton of marble stone is quarried and processed in marble factories annually. During quarrying operations, blasting technique is mostly employed, which results in the wastage of approximately 50 percent of marble stone [3]. The waste generated in quarries is in the form of odd rocks of various sizes [4]. However, there is no proper way to dispose of the waste, and thus the waste remains scattered in the vicinity of the quarries.

The raw marble blocks of large sizes are taken from the quarries to the marble processing units to produce marble tiles and other valuable stones of different dimensions and shapes [5]. Pakistan has numerous marble processing units with a sheer variety of machinery and equipment employed for the processing of these stones. During the cutting and polishing of the raw marble blocks, waste is also produced as a by-product. The waste is in the form of odd blocks of

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