

9th International Conference Interdisciplinarity in Engineering, INTER-ENG 2015, 8-9 October 2015, Tirgu-Mures, Romania

New Types of Plastering Mortars Based on Marble Powder Slime

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Abstract

The use of marble powder residue slimes that can be found in enormous amounts of about 100 tons/day (in the nearby of marble processing companies) to produce building materials represents an efficient manner of diminishing the resource consumption and of significantly reducing its negative impact upon the environment. Consequent to the drying of this product, a fine powder with various grain sizes can be obtained; the grains can be used as a partial or total of mortar aggregates. The experimental program in the present paper includes the production and proposal of more types of plaster mortars where the marble powder slime replaces the aggregate in a percentage of 25%, 50%, 75% and respectively 100% as well as a 15% replacement of the binder. Results show that 25% substitution of aggregate by marble powder provided the highest value of compression strength at 28 days and also the highest value to adhesion to the support layer. Also, plastering mortars with 15% substitution of cement by marble powder, at the age of 28 days, has a resistance to compression of 13 N/mm², approximately twice larger than that of the conventional plaster mortar. The present paper is dedicated to the study of the physical and mechanical properties of the plaster mortars in both fresh state and hardened state in their development in time.

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Peer-review under responsibility of the “Petru Maior” University of Tirgu Mures, Faculty of Engineering

Keywords: sustainable development; waste management; marble powder residue/waste; plaster mortar; physical and mechanical properties; ecological innovative materials.

Introduction

Marble is a building material which has been used since very ancient times. The marble processing industry is a widely spread industrial activity throughout the world and its extent is also linked to the production of waste and by-

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products. The storage and removal of the waste coming from the marble industry represents one of the major worldwide issues related to environment [1]. Though, at world level, the marble powder storage and the detrimental effects upon the environment are a big problem, there are a few studies on the behavior of marble powder and its reconversion in building materials.

In Romania, the marble powder waste is generated in about 100 tons/day and has a negative consequence upon environment, due to pollution, and also upon human health.

The problem of marble processing industry waste has an international concern, and it has been treated with great attention by interested researchers, in order to obtain new building materials, cheaper than those traditionally, by using of such waste and thus to eliminate the problems related to environment pollution.

Binici studied several mechanical properties of concrete with marble powder and limestone waste. Concrete with 5%, 10% and 15% marble powder and limestone was produced, where marble and limestone replaced the concrete fine part. The researcher studied the resistance to compression of the mentioned products [2].

Corinaldesi, shows that by substituting 10% sand with slime waste, an improved resistance to compression and workability can be obtained [4]. The test was made on several experimental samples where both cement and part of the aggregates was replaced.

The marble powder waste can be used not only as admixtures, but also to produce other types of building materials, such as ceramic bricks, as shown in the research made by Saboya in the paper "The use of powder marble by-product to enhance the properties of brick ceramic" who reaches the conclusion that a percentage of 15-20% marble powder could improve significantly the properties of ceramic bricks [5].

The present paper involves the use of waste sludge from marble powder (considering the context of environment sustainability and that of life quality sustainability) in order to propose some plastering mortars type CS IV where sand is replaced in various amounts (25%, 50%, 75% and 100%) by marble powder slime and then cement is replaced by 15% by marble powder slime. It also represents a well-supported study concerning the influence of the marble powder slime upon the physical and mechanical properties of plaster mortars.

2. Materials and methods

This research deals with the production of five ecological plaster mortars of type CS IV using the marble powder slime as a total or partial substitute for sand and cement, respectively. The materials used in the mortar formula are: the binder, sand, water and marble waste (to replace the aggregate or the binder). The recipes for the plastering mortars do not contain additives for the purpose of the present research.

2.1. Materials

- Cement: The binder for the mortar formulae is the Portland type cement CEM IV/B 42,5N.
- Aggregates used at preparing mortars: The sand used in the mortar formula is river sand, with granulation between (0 – 4) mm. The mortar formula required sand with a proper granulometric curve.
- Marble powder slime waste: Marble powder slime is obtained after the processing of natural rocks, by cutting, shaping and finishing the edges and surfaces in various shapes and colours. The slime used in the samples was collected from the marble company Marmosim Deva, Romania.

In Romania, there are several quarries that daily produce enormous amounts of marble powder, among which the quarried situated in Rușchița (the largest quarry in the country), Podeni, Cărpiniș, Pietroasa, Geoagiu and Bașchioi.

Before using the slime in the samples, the slime was dried, in a kiln at 105°C where it was kept until a constant weight was reached; the material was then ground and sorted out.

The main chemical components in the marble are presented in Table 1:

Table 1. Results of chemical analysis of marble powder.

Chemical compounds	CaO	MgO	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	Na ₂ O	K ₂ O	SO ₃	CO ₂
Percentage %	55.00	0.62	0.36	0.28	0.04	0.00	0.07	0.06	43.56

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