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Characterization methodology for re-using marble slurry in industrial applications

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Abstract

Due to the widespread use of calcium carbonate as a raw material in a number of industrial fields, the recovery of marble waste and its processing in a marketable product is nowadays gaining an economical interest.

Marble slurry waste samples were chemically, physically, mineralogically and morphologically analyzed and the obtained data were compared with marketable micronized CaCO₃ specifications. The results have shown that marble waste could be re-used as a raw material in different industrial processes with no or light treatments.

Besides the economic benefits, transforming a waste into an important economic resource involves environmental advantages and sustainability promotion.

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1. Introduction

Dimension stone section has gone progressively widening, assuming a strategic role in worldwide economy.

The 2015 production was placed in the order of 82.6 million tons with a percentage of the waste extraction and processing amounting to over 70 % of the gross quantity [1]. In the European Union, the Italian pre-eminence was consolidated with over 30 % of volume. The quarry productions and the processing wastes related to the seven leading stone countries are reported in Table 1.

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Table 1. Quarry productions and processing wastes in the World [1].

LEADING STONE COUNTRIES	QUARRY PRODUCTION	PROCESSING WASTE
	[kt]	[kt]
CHINA	45,000	22,768
INDIA	21,000	6,285
BRAZIL	8,200	2,990
TURKEY	10,500	2,493
ITALY	6,500	2,485
SPAIN	4,750	1,641
PORTUGAL	2,700	812

The increased production of natural stone waste as well as its impact on the environment have been the main focus of debate within the scientific community. The studies are generally focused on waste minimization, according to a circular economy perspective.

Dimension stone waste is divided in two main categories: waste deriving from quarrying activities and waste deriving from processing plants.

This research is focused on marble slurry waste, consisting in fine-grained residues resulting from operations of cutting and polishing, recovered at the end of the waste water purification system, and that could be processed to be re-used as raw materials suitable for applications in other industrial sectors [2, 3], such as building industry [4, 5].

Generally, wastes are materials which the owner or holder wishes to dispose of, and, in some cases, their collection and treatment as waste is required by the public interest [6]. The term “waste” has a negative image because it qualifies a material from the perspective of the upstream activity that generated it. However, it does not in any way mean that recovery or recycling is excluded [7, 8]. The possibility to re-use the slurry is related first of all with the compliance with the regulatory framework.

The European Union defines the situation of waste with three European directives: 2006/21/EC on the management of waste from extractive industries - 2008/98/EC on waste - 1999/31/EC on the landfill of waste [9, 10, 11].

The aim of this paper is to propose a defined way to characterize marble slurry in order to obtain useful data to make a comparison with market specifications. Further goal is to enhance the environmental advantages of re-using stone waste by reducing marble waste landfills and by applying raw material replacement, thus pursuing the objective to convert natural stone waste into by-product with a renewed environmental and economic value.

2. Materials and Methods

2.1. Materials

The materials investigated have been chosen according to the aims of the research program. Two of the numerous industrial marble processing plants have been selected with a consideration to the kind of material processed, the volume of production, the accessibility and the cooperative attitude of the owners.

The two selected processing plants are located in the Orosei marble district, in the North-Eastern Sardinia, Italy (Fig. 1), where the quarrying of a highly appreciated stone variety is an important economic activity; fifteen quarries and fifteen stone processing plants currently operate in the area [12]. Part of the quarries production is processed in different plants obtaining different kinds of final commercial products [13]. As a result, a waste material consisting of very fine particles, in the form of slurry, is also produced. The investigated marble slurry samples have been collected at the end of the filter press section of the two plants selected.

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