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Characteristics of the marble processing powder waste at Shaq El-Thoaban industrial area, Egypt, and its suitability for cement manufacture

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KEYWORDS

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Abstract Shaq El-Thoaban industrial cluster, East Cairo [the largest marble and granite industrial agglomeration in Egypt as well as the fourth world ranked marble and granite industrial zone] poses the most imminent hazard to the surrounding environment and the neighboring residential communities due to the huge amounts of waste resulted during the processing of the marble and granite. The objective of the current study was to link Shaq El-Thoaban industrial area-as a marble (carbonate) waste source – to the cement industries in its neighborhood. Three cement factories are located within 2–10 km far from Shaq El-Thoaban area, an advantage economically companies are appealing. Consequently, the current study investigated the characteristics of the marble powder waste generated during the processing at Shaq El-Thoaban area and its feasibility as an addition to the OPC produced at the near cement companies. Determining the physico–chemical and mechanical properties of the marble waste on the cement properties proved that 5 wt.% could be, safely, added to the cement without adverse effects on the cement properties. Addition of such modest to the cement (or replacing part of the used gypsum in the cement manufacture) could be a real energy and financial saving concept, besides, saving part of the natural resources and alleviating the environmental impact imposed by the marble processing waste.

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Introduction

During the last decades, the marble and granite industry in Egypt has significantly grown. Shaq El-Thoaban area, East Cairo, is the largest marble and granite industrial cluster in Egypt and the fourth world-industrial zone. Large quantities of marble and granite sludge are generated as byproducts

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Fig. 1 Cutting marble blocks at Shaq El-Thoaban industrial area, Cairo, Egypt.

Fig. 2 Collecting marble sludge after drying at Shaq El-Thoaban industrial area.

Fig. 3 Collecting the marble processing wastes in the rear area of a processing plant at Shaq El-Thoaban.

during the cutting and polishing processes of the blocks, Figs 1 and 2. As the waste is not discarded properly, this practice imposes tangible effects on the ecosystem (i.e. the physical, chemical and biological components of the environment) as well as imposing pollution threats to the neighboring residential communities Figs 3 and 4. This situation is challenging and should be successfully resolved.

Accordingly, a research plan has been designed by the authors to characterize the marble processing powder wastes

Fig. 4 Disposal of the marble sludge in a neighboring desert area near Shaq El-Thoaban industrial zone.

and evaluating their feasibility for incorporation as alternative raw material in some building material industries, particularly in its neighborhood, in other words, linking Shaq El-Thoaban industrial area – as a waste source – to the appropriate industries, particularly in its vicinity.

As shown in Fig 5, the major industries that, prospectively, could take advantage of the collected marble and granite waste from Shaq El-Thoaban industrial area are as follows:

– Cement industry.
– Iron and Steel industry.
– Paints industry.
– Clay bricks industry.

It is evident that, these industries are located within 2–10 km from Shaq El-Thoaban area. Accordingly, the waste does not have to be transported for a long distance to any of the industries in the area, an advantage which is economically appealing.

The first Part of the research plan is devoted to characteristic of the marble powder waste generated at Shaq El-Thoaban industrial area and its feasibility as an addition to the Ordinary Portland cement produced at the cement companies in its neighborhood.

Experimental

Materials and mixes

The marble powder waste used in this investigation is the sludge residual from the marble cutting process at Shaq El-Thoaban. The cement used is Ordinary Portland cement, grade 42.5 obtained from the "National Cement Company" at El-Tebbin, Helwan, Cairo.

Various marble powder waste mixes were prepared using OPC and various proposed ratios of marble waste in order to determine the optimum marble ratio to be used with cement. The water to binder ratio was varied (starting from 0.24) according to the used binder content. The paste was made – firstly – by hand mixing the raw materials (Passing sieve 75 μm) for 10 min and then further mixing was carried out for 5 min in a mixer. The mix with the optimum marble powder waste ratio was compared with the control (OPC).

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