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Abstract

The Effects of Different Temperature Conditions on Marble Properties †

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Introduction: The term marble derives from ancient Greek and has the meaning of "shining stone". Marble is a rock that is formed through the metamorphic processes of sedimentary rocks, such as dolomite and limestone. In its pure state, marble should consist only of calcite crystals and have a chemical composition of 56% calcium oxide and 44% carbon dioxide. This is true only from a theoretical point of view, because there may be other foreign elements that can affect the color, shade, and design. Some of the components that can be found are: quartz, pyrite, graphite, feldspar, and iron oxides [1,2]. Materials and methods: The samples were exposed to two different types of treatments: 25 freeze–thaw cycles (according to SR EN 12371) and 3 cycles of exposure to high temperature (400 °C for 1 h). The analyzed samples were: Italian Carrara marble, Rușchița pink marble, and Albești white marble. The aestetic parameters before and after treatment were measured using Chromameter Konica Minolta CR-410, Binocular Stereomicroscope Euromex and Glossmeter HG268. The freezing coefficient was determined with the following equation % $\mu g = (M2 - M3/M1) \times 100$, where M_1 = mass before FT cycles, and M_3 = mass after i numbers of FT cycles, respectively M_2 = mass of the samples introduced in distilled water and dried with a cloth. Results: Following the freeze–thaw cycles, small differences in chromatic parameters could be observed ($\Delta E = 2.2$ for Italian Carrara marble and $\Delta E = 7.2$ for Rușchița pink marble). The freezing coefficient for all the samples presented low values (0.016–0.029%). Following the exposure to high temperature treatment, the samples showed high differences in chromatic parameters ($\Delta E = 43.47$ for white marble) and significant changes in gloss. The surfaces of the samples showed cracks and microcracks. Conclusions: Based on the results of this study, the following conclusions can be drawn. Exposure to freeze-thaw cycles can lead to apparition of cracks and microcracks on the outer part of the marble, starting from the discontinuities included in the rock and the faces between the different minerals that form the stone. Exposure to high temperature will lead to a loss in adhesion between the superficial grains at the sample's surface.

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