

The Influence of Engineering Geological Properties of Carbonate Aggregates on Artificial Stone Properties

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Extended Abstract

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Abstract

This study aimed at evaluating the effect of calcic aggregates of engineering geological properties on the artificial stones properties, non-resin cemented and then, to make a comparison between the engineering properties of artificial and natural stones. To investigate the effect of calcic aggregates properties on artificial stones, seven samples of building stones including black limestone, three samples of marble (Chinese stone, marble and crystalline marble) and two samples of travertine and onix were used. Engineering geological properties of the samples were then determined. In the next stage, after designing mould for constructing artificial stones, aggregates with the same grading and mixture design were provided. Then two samples including coarse and fine grained artificial stones were made for all of the mentioned aggregates under the same vibration, pressure and vacuum conditions. Next physical, strength and durability tests were conducted, and the obtained results were compared. The results of engineering parameters showed that Hojjat Abad travertine artificial stones have similar engineering quality to own natural stone and Crystalline Marble and Turan Posht travertine artificial rocks have about 11 to 32% increase in quality but Chinese stone, Black limestone, onix and marble have a 6 to 33% lower quality than own natural stone. However, the samples made of other stones in view of the compared parameters related to artificial stones have lower quality than natural stones; however, they are placed in the acceptable range as building materials.

Introduction

Given the variation of construction materials, the importance of the economy in its supply and large use of natural stone mines and the

production of seemingly unusable slags, it is necessary to reuse these slags. One of these reusing methods is to make artificial stones and its application as construction materials. Rock powder, aggregate, a small amount of cement or resin and other chemicals are used for producing artificial stone. In this study, carbonate minerals, rock powder and white cement in the first phase are mixed and wet. Then, in the next stage, to form the sample in a cubic mold, they have been compacted under three physical processes of vibration, vacuum and pressure. The aim of this study is to investigate how to make artificial stone, to evaluate the engineering properties of artificial rock and the effect of limestone engineering properties on artificial stone properties of non-resin cement and then comparing the properties of artificial rocks made with natural stones

Material and methods

In this study, in order to investigate the effect of calcic aggregates properties on artificial stone properties, seven samples of building carbonate rocks including crystalline marble, two samples of marble, black limestone, and two samples of travertine and onix were used.

Engineering geological properties of the used samples were then determined. In the next stage, after designing mold for constructing artificial stones, aggregates with the same grading and mixture design were provided. Then two samples including coarse and fine grained artificial stones were made for all of the mentioned aggregates under the same vibration, pressure and vacuum conditions. After construction, physical, strength and durability tests were conducted, and then the results were compared.

Results and discussion

Investigation of the effect of engineering geological properties of carbonate aggregate on artificial stone properties showed that the artificial stones made of travertine aggregates have higher quality than natural travertine in terms of physical, strength and durability properties. Due to the existence of pores on the surface of travertine aggregates, the used cement can result in reducing effective porosity and increasing strength and durability in the artificial stones.

In Table 1 a proposed research has been used for rating rock engineering parameters based on the degree of importance for building stones. Then, according to this table, the score of each natural stone and related artificial stones were determined. For building stones, the importance of durability and strength is more than the density. Also, the density shows its effect on durability. At the same time, with increasing the percentage of water absorption, the durability of rock has decreased. Therefore, the rocks with less water absorption are more important.

Table 1. Scoring of building stones based on the engineering parameters

Parameters	Description	Excellent	Good	Marginal	Poor
		Total score	100	75	50
Water absorption (%)	Range	0-2	2-3	3-5	>5
	Score	25	20	15	10
Unit weight (kN/m ³)	Range	>24	22-24	18-22	<18
	Score	15	10	5	3
Uniaxial compressive strength (MPa)	Range	>50	40-50	30-40	<30
	Score	20	15	10	4
Tensile strength (MPa)	Range	>20	15-20	10-15	<10
	Score	20	15	10	4
Durability (%)	Range	<1%	1%-2%	2%-3%	>3%
	Score	20	15	10	4

The total score of fine-grained artificial stones (65%) is almost similar, indicating that the type of carbonate grains does not affect the characteristics of fine-grained artificial stones, but the total score of coarse artificial grains are in the range of 58 to 74%. This range of score indicates that structural weakness, especially the cleavage surface, porosity, lamination, vein and acetylolite of aggregates have more influence on engineering properties in coarse-grained artificial rock.

Conclusion

Comparison between the engineering properties of artificial and natural stones were studied. The following conclusions were drawn:

- The artificial stones of Hojjatabad travertine have similar engineering quality with their natural stone.
- Both Crystalline marble and Turan Posht travertine artificial rocks have about 11 to 32% increase in quality but Chinese stone, black limestone, onix and marble have 6 to 33% decrease in quality compared to natural

stone but in acceptable ranges when they are considered as construction materials.

- The samples made of other rock samples have lower quality than natural stones; however, they are placed in the acceptable range as building materials.

Keywords: Building stone, Artificial stone, Aggregate, Calcic, Engineering Geological properties

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