Influence of Engineering Geological Properties of Silica Aggregate on the Engineering Features of Artificial Stone

Niloufar Babaadam*, Ali Uromeihy, Mohammad Reza Nikudel
Dept. of Engineering Geology, Tarbiat Modares University

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Extended Abstract

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Introduction

Artificial stone is a type of building material that consists of natural aggregates, binders, such as cement or polymeric resin and some additives. The aggregates used for the production of the artificial stone are generally supplied from the wastes and scraps of quarries and industrial stone manufactories. Accordingly, the produced rock has a significant economic value.

The mixing design includes more than 80% of natural aggregates and less than 20% additives and binders, such as various types of polymer resin or cement. Due to the fact that artificial stones are designed purposefully and according to engineering patterns, so the stone has different designs and colors and thus can meet the diversity of consumer desire and is an appropriate alternative for natural stones in the building industry. Due to a large number of various rock mines and industrial workshops in Iran, it has the ability to produce artificial stones.

Material and method

The purpose of this paper is to investigate the effect of silicate aggregates on the properties of artificial stones, the aggregates of the three types of natural stone tuff, andesite and granite were selected. The basis of this selection is the mineralogical variety, the textural diversity and the easy accessibility of these three stone types. The binder used in the manufacture of these artificial

stones is an unsaturated polyester resin, accounted for 11% of the samples. The crushed and graded samples were poured into the mold after mixing with resin from 85% to 15% and were subjected to a compression pressure of 12 MPa for 24 hours.

Results and discussion

The summary of the results of the experiments carried out in Table 1 is presented.

Table 1. Summary of the results of the experiments on the samples

Rock type		Water absorption percentage	Point load index	Uniaxial compressive strength	Brazilian tensile strength	Weight loss (5 cycles)
Tuff	Natural	4.84	10.57	145	21.53	-0.0172
	Artificial	11.48	6.19	63	12/66	-0.0126
Change rate		▲	▼	▼	▼	▼
Andesite	Nature	1.35	10.48	84	12.83	0.0046
	Artificial	8.47	1.83	34	5.86	-0.0417
Change rate		▲	▼	▼	▼	▲
Granite	Nature	3.01	1.82	41	10.10	-0.0032
	Artificial	0.42	3.56	51	10.34	0.0083
Change rate		▼	▲	▲	▲	▼

By reviewing the results, it can be seen that the sample of artificial granite has all the desired indices of a building stone. In comparison to natural granite, the percentage of water absorption and its weight loss is lower; conversely, the point load index, uniaxial compressive strength, and tensile strength of the Brazilian are more. Electronic image observations also show more homogeneity between resin and aggregates but on the other hand, artificial tuff and andesite haven't got favorable indices, in comparison with natural stones.

Conclusion

The conclusion of the research can be summarized as follows:

The following results were obtained by the preparation of three samples of artificial stone from three types of natural stones: Tuff, andesite and granite, and performing physical and mechanical tests and studying the mineralogical and texture characteristics of the stones:

Mineralogical studies by a polarizing microscope and XRD irradiation analysis showed that the texture of both tuff and andesite contains unstable minerals such as opal and glass materials (amorphous), alongside other minerals. On the other hand, they have a microcrystal texture that includes abundant empty spaces. In contrast, granite is mainly composed of quartz, feldspar and biotite minerals, and the stone fabric has a coherent crystalline structure.

Artificial granite has all the desired indices in comparison to natural granite. That way, the percentage of water absorption and its lost weight are reduced; on the contrary, the point load index, uniaxial compressive strength, and Brazilian tensile strength increase. While artificial tuff and andesite's indices are not favorable in comparison to natural stone. On the other hand, their water absorption has increased, while their resistance index is lower than the natural stone. The lost weight of these two samples also shows varying conditions.

SEM electronic images taken from the artificial granite sample show good homogeneity between resin and aggregate compared to natural granite while artificial andesite and tuff specimens show the presence of empty spaces and dispersed resin materials.

Thus, it is concluded that the artificial stone samples made from granite aggregates are more suitable for mineralogical, physical and engineering properties than andesite and tuff.

Keywords: Artificial stone, polymeric resin, aggregate

*Corresponding Author: n.babaadam@modares.ac.ir