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Study strength and usage of Artificial stone made with different resins and additives

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Abstract:

Artificial stone is a mixture of natural aggregate and additives such as industrial gums (resin), cement and other polymer materials. In this research, artificial stone with additives and two resins (vinyl ester and polyester resin) in order to determine the strength and type of use, mixing plan, 84% rock, 10% resin and 6% additive completely manually without the need Vacuum and pressure system was built. Artificial rocks made with additives (glass fiber, carbon fiber, plastic), and three granite granite stones (Alamut, Sefid Tekab and Nehbandan) are used to determine the physical and engineering characteristics (Brazilian Test, Point Load Test, Uniaxial Compression Test and Ultra Sonic Test) have been tested. Based on experiments, artificial stones made of precious stones, a resin of wilin ester, glass fibers, have the highest compressive strength of single axis and borehole. However, carbon-fiber samples have a tensile strength of 28% compared to glass fiber-reinforced glass samples. The samples made with plastic have the least porosity between the samples of synthetic stones. According to the above results, in environments affected by pressures, high-strength reinforced rocks (glass-fibered samples), in tensile-induced environments; high tensile strength artificial rocks (samples made With carbon fiber) and on sidewalks made of synthetic stones made of plastic due to low porosity.

Keywords: *Artificial stone, glass fiber and carbon fiber, vinyl ester and polyester resin, plastic, physical and engineering properties*

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Extended Abstract:

1. Introduction

Artificial stone is a mixture of natural aggregate and additives such as industrial resin, cement and other polymer materials. The present invention relates to a process for manufacturing boards that are especially suitable for outdoors, based on artificial stone bound only with methacrylate-type liquid resin, the main application of which is its outdoor placing: external facades, staircases and floors, and the like, also being able to be used indoors, both in kitchens and bathrooms and staircases and floors. Table 1 lists the desirable characteristics of decorative stones.

Table 1. Desirable Characteristics of Decorative Stones

No alteration	Minerals such as alkaline feldspars, lagioclases and feldsparatonides, alvin pyroxenes, if altered, such as water with appropriate pH, water and heat solids, etc., are transformed to secondary minerals and lose the texture of rocks, loose and disintegrate, and masonry.
No geological complications	The presence of joints and fissures in the rock textures, either in relatively large joints or in small joints, to *lead* reduces the strength of the stone and cannot be extracted from the slab blocks during mining.
No layering	Schistosed rocks such as shales are not suitable because of the inability to work on them and very loose.
Ability to cut, polish and polish	Stones that are pitted due to tectonic stresses, texture inconsistencies or weathering effects are less polished and will probably not sell well and therefore will not be expensive.
Hardly acceptable	The hardness of the masonry rocks varies greatly, with the hardness of the rocks varying from very low (soapstone) to more severe than steel (granite).
The charismatic beauty and color thebaine	Desirable stone has a uniform and light color and does not change color against sunlight and ambient weather.
The absence of clay layers within the rock	Filling the grains with clays in seemingly sturdy rocks greatly reduces their resistance to water. Clay compounds are more susceptible to weathering than other minerals.
Low porosity and water absorption coefficient	Porosity is one of the factors contributing to breakage and separation of stone from the surface of the building. This is usually due to water penetration through the rock pores and freezing and causing seams and crevices.
Having adequate compressive and tensile strength	For most construction work, a compressive strength of 400 kg / cm 2 is sufficient.
Proper durability	Resistance to physical and chemical weathering

2. Materials and methods

The polymeric resin, while fluid, penetrates in between the mineral particles. This not only provides cohesion but also eliminates natural porosity, which always exist in natural rock particles. Unsaturated polyester resins (UPR) and vinyl ester resins (VER) are among the most commercially important thermosetting matrix materials for composites. Although comparatively low cost, their technological performance is suitable for a wide range of applications, such as fiber-reinforced plastics, artificial marble or onyx, polymer concrete, or gel coats.The main areas of UPR consumption include the wind energy, marine, pipe and tank, transportation, and construction industries.

Carbon nanotubes have been considered as a promising means of enhancing the properties of advanced composites in a range of polymer systems. Expected property enhancements include high strength and stiffness, improved toughness, impact and through-thickness properties.

Fiber reinforced composites (FRCs) with promising mechanical, physical, chemical properties, light weight, and multi-functionality play a key role in technological advances in aerospace, automotive, energy, and offshore industries. Table 2. Shows the physical and structural properties of glass fibers, carbon fibers and plastics. Table 3. Shows the technical and molding specifications of polyester and vinylester resins (http://shimiafsoon.com).

Table 2. Physical and structural properties of glass, carbon and plastic fibers

Glass fiber (http://polymersun.com)							
Fracture strain %	**Tensile strength (GPa)**	**Elasticity coefficient (GPa)**	**Special Weight (g / cm^3)**	**Diameter of string (um)**	**Deformation Temperature (c^0)**	**Density (g / cm^3)**	**Type of glass**
3.5 -2	2-4	80	2.6	10-13	840	2.6-2.5	E
Carbon fiber (http://shimiafsoon.com)							
Fracture strain %	**Tensile strength (GPa)**	**Elasticity coefficient (GPa)**	**Special Weight (g / cm^3)**	**Thickness**	**Pattern**	**Weight (g / m^2)**	**Barcode**
1	2.6	230	1.9	0.20 ± 5 %	Twill texture	200 ± 5 %	ESA-C200T
Plastic, (Geyer et al, 2017) و www.iew.ir							
Fracture strain %	**Tensile strength (GPa)**	**Elasticity coefficient (GPa)**	**Special Weight (g / cm^3)**	**The method of analysis**	**Daily production of tehran (Ton)**		**World production (Billion ton)**
15 - 13	0.9	4	1.1	Biological & non-biological	1000		8.3

Table 3. Technical Specifications and Molding of Polyester and Vinyl Resins (http://shimiafsoon.com)

Test Method	Unit	Amount of (Violin Esther)	Amount of (polyester)	Specification	Properties
ASTM D2196	MPa.s	45 -35	600- 400	Technical	Viscosity
ASTM D1639	MgKOH /g	10	Maximum 15		Acidic number
ASTM D1259	%	62	65 - 60		Percent Solid
ASTM D2471 - 88	min	13 -10	25 - 10		Gel time
	min	17- 13	30 - 15		Baking time
	^0c	200- 170	200- 170		Maximum heat
ASTM D1544	Gardner		Maximum 1/5		Color
ASTM D1298	g / cm^3		1.1-1.2		Density
ASTM D2583	Barcol	45- 35	50 - 40	Molded resin	hardness
ASTM D638	GPa	3.5-4.5	3-2		Tensile modulus
	%	6 - 2	2.5-3.5		Elongation
ASTM D648	^0c	105 - 90	80 - 70		Deformation temperature

3. Results and discussion

Artificial rocks made with additives (glass fiber, carbon fiber, plastic), and three granite granite stones (Alamut, Sefid Tekab and Nehbandan) are used to determine the physical and engineering characteristics (Brazilian Test, Point Load Test, Uniaxial Compression Test and Ultra Sonic Test) have been tested. Based on experiments, artificial stones made of precious stones, a resin of wilin ester, glass fibers, have the highest compressive strength of single axis and borehole. However, carbon-fiber samples have a tensile strength of 28% compared to glass fiber-reinforced glass samples. The samples made with plastic have the least porosity between the samples of synthetic stones. According to the above results, in environments affected by pressures, high-strength reinforced rocks (glass-fibered samples), in tensile-induced environments; high tensile strength artificial rocks (samples made With carbon fiber) and on sidewalks made of synthetic stones made of plastic due to low porosity. Table 3 discusses the use and strength of synthetic stones.

Table 3. discusses the use and strength of synthetic stones

User				Strength			Additive	Resin	Aggregate
pavement	**Public consumption**	**Affected by compressive force**	**Affected by tensile force**	**Point load**	**Brazilian tensile**	**Uniaxial**			
							No additives	**Polyester**	Takab Granite
							Glass fiber		
							Carbon fiber		
●							plastic		
							No additives		Alamut Granite
							Glass fiber		
							Carbon fiber		
●				▼		▼	plastic		
							No additives		Nehbandan Granite
							Glass fiber		
							Carbon fiber		
●	●				▼		plastic		
							No additives	**Violin Ester**	Takab Granite
							Glass fiber		
			●		▲		Carbon fiber		
●							plastic		
							No additives		Alamut Granite
		●		▲		▲	Glass fiber		
							Carbon fiber		
●							plastic		
							No additives		Nehbandan Granite
							Glass fiber		
							Carbon fiber		
●							plastic		

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