PalArch's Journal of Archaeology of Egypt / Egyptology

THE USE OF SPENT RUBBER GRANULES IN THE PRODUCTION OF SCULPTURE WORKS

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Muntadhar Sahib Rouah , Mohammed Hamza Al Mamouri , AqeelHussein Al-Anawy , The Use Of Spent Rubber Granules In The Production Of Sculpture Works , Palarch's Journal Of Archaeology Of Egypt/Egyptology 18(8). ISSN 1567-214x.

Keywords: Spent Rubber; Spent Rubber Granules; Sculpture Works.

Abstract:

Tires were recycled and turned into powder. This powder was used in a mixture of polyester resin, cement and some colored oxides in the production of sculpture works after studying its mechanical properties that qualify it for this purpose. The mixture was in proportions (38% of rubber granules) and (47% of polyester resin) and (12% of cement), (2% of hardener) and (1% of colored oxides), where the mixture was examined by means of erosion agents to give the best values of shock, hardness, water absorption and mechanical wear. Atmospheric conditions on it to note when irradiating some mixtures, the hardness values differ from one mixture to another according to the proportions of the ingredients, and we concluded the use of these mixtures in the production of sculpture works.

1. Introduction:

The interest in the recycling of waste has become a very necessary matter that most countries of the world are interested in, in the production of energy [1] and in the production of some overlapping materials, which provides a service to the industry [2], and from these wastes, is the recycling of spent tires and transforming them into materials that can be used in industrial [3], scientific and technical applications [4], including plastic arts sculpture [5], which we worked on converting it into a material that enables us to work in the production of sculptural works [6], by rotating tires into powder and then mixing it with resin, cement, hardener and some colored oxides in order to produce a composite material [7].

This material has properties such as shock resistance, hardness, mechanical corrosion and not being affected by weather conditions, which qualify it for sculptural works [8].

2. Theoretical Background:

Recycled rubber is also one of the by-products of the General Company for Tire Industry in Najaf and Qadisiyah, and from the spent tires and from the various sources of spent tire collection. The scrap rubber, unlike the rubber produced from the chemical and mechanical process is recycled and can be used in the tire industry again [9].Milled rubber is the rubber that is produced through the process of shredding, cutting and grinding damaged tires into very small granules [10]. The components of scrap tires are approximately 70% rubber materials, 20% steel wire and 10% fibers [11]. During the scrap tire recycling process, the steel wires and reinforcing fibers that strengthen the tire are separated [12], and then the waste tire powder is sifted and divided into several classes based on size grading to meet the requirements of a particular application [13]. As the fine grinding of these tires takes place either by using the circumferential grinding method or by using the cold grinding [14].

3. Practical Part:

Rubber powder was prepared in three sizes (fine - medium - coarse) and polyester resin, hardener, cement and coloring oxides were added in proportions of (38% of rubber granules), (47% of polyester resin), (12% of cement) and (2% of hardener). And (1% of the colored oxides) in order to prepare the samples and prepare them to check the hardness, and to know the extent of the sample’s tolerance to external loads and stresses, the hardness is checked by means of a hardness tester (shor.D), then the samples were exposed to UV rays with a card (350 kj / h) for a period of 12 hours) And for the purpose of knowing the effect of hardness before and after irradiation, then the shock characteristic was measured using the falling dandol device, followed by the water absorption test, which is the absorbed water that occupies the pores of the body.

Also, the absorption characteristic is affected by factors including the type of materials used, and to know the percentage of water absorption of the samples, their weights are recorded with a sensitive balance, then they are placed in a container filled with distilled water with a thickness of 6 cm for 24 hours as shown in Figure (3-27) after which their weights are recorded while they are dry. The absorbance is calculated from the equation (absorption = weight after immersion - weight before immersion / weight before immersion), and the weight of the samples was measured before placing them under a shower of water at a pressure of 1 bar. The distance between the shower and the sample was 1.80 m for a period of time (20 hours) and after completion their weights were measured to determine the extent to which the samples are affected by rain showers to give the values of mechanical wear (wear).

T**able (1): The number and type of mixtures for recycled rubber, resin, cement and coloring oxides, in addition to the hardener.**

Colored	Solid	Resona	Cement	Rubber Granules	Mix

Oxide		**te**	**Powder**	**Coarse**	**Medium**	**Soft**	**Number**
C	% 2	%38	% 10			%50	1
C	%3	%44	% 11			%42	2
C	% 2	%44	% 15			%39	3
C	% 3	%45	% 14			% 38	4
1% (Zn.Tl)	%2	% 47	% 12			% 38	5
%1 ((Fe	%2	%48	% 13			% 36	6
%1(Zn.Tl)	%2	%47	%16			% 34	7
%1 (SnO)	%1	%48	%17			% 33	8
%1 Fe	%2	%47	%18			%32	9
%1 (Fe)	%3	%46	%19			%31	10
Fe 1%	3%	46%	20%			30%	11
%1 (CuO)	% 2	%48	%11		%38		12
C	% 1	%49	% 14		% 35		13
%1SiOC	% 3	% 47	% 10	% 39			14
%1 CuO	1%	50%	%12	%36			15

4. Results and Discussions:

4. 1 Discussing the Results of the Hardness test and Irradiation:

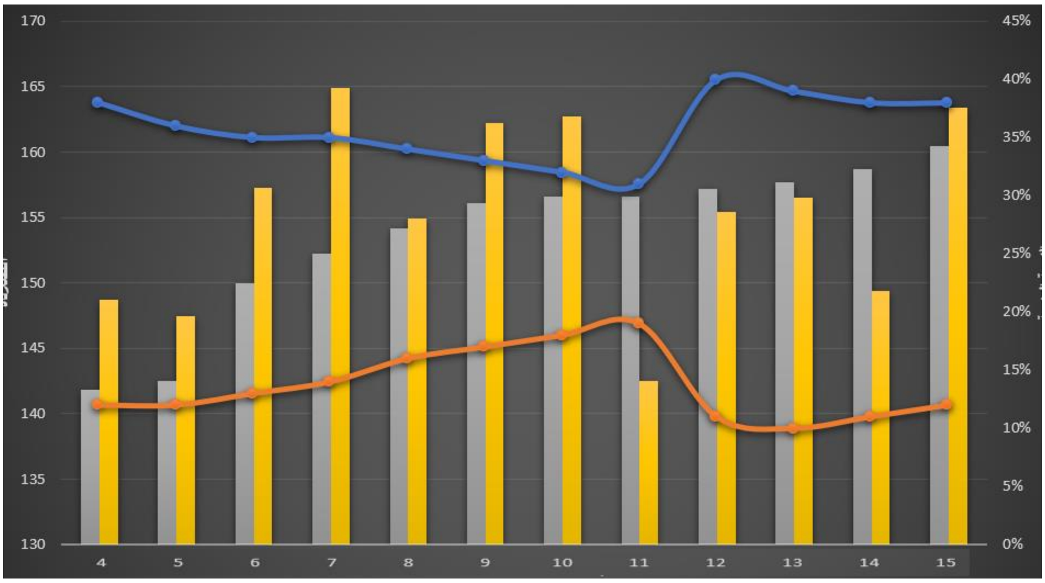

Figure (1): The graphic relationship of the hardness test before and after irradiation for mixtures and irradiation.

The hardness values depended on the percentage of cement in the mixtures, on the size of the granule and the interactions that occur during the process of mixing the components associated with the temperatures that transform the dough from the liquid state to the solid, to see a state of expansion, tensile and solidification, which leads to stresses within the sample resulting in varying values in hardness before and after irradiation, where we note that in the mixtures with small grains showed the highest average hardness values of the mixtures before irradiation as shown in the graph (1) is mixture No. (7).

The lowest mixture of values of small grains is mixture (5), and after exposure to ultraviolet rays we see Decrease in hardness values by less than what it was before irradiation and when increasing the proportions of cement as in mixture No. (11). We notice an increase in hardness after irradiation as the hardness values before irradiation are lower than after irradiation, and in mixtures with medium grains (12-13) as in Table No. (1), we see a rise in the proportions of rubber at the expense of cement with an increase in the hardness values after exposure to ultraviolet rays. As for large granules, the hardness values showed us a positive variation compared to the previous mixtures, to note that in the mixture R Qom (14). The hardness value increased after irradiation and in mixture (15). The hardness values decreased after exposure to irradiation, but this mixture gave the highest value of hardness after irradiation, despite it being affected by irradiation, and from this process we simulate the effect of weather conditions from exposure of the material to solar radiation and its effect on the hardness subject [15], [16], and [17].

4. 2. Discuss the Results of the Shock Examination

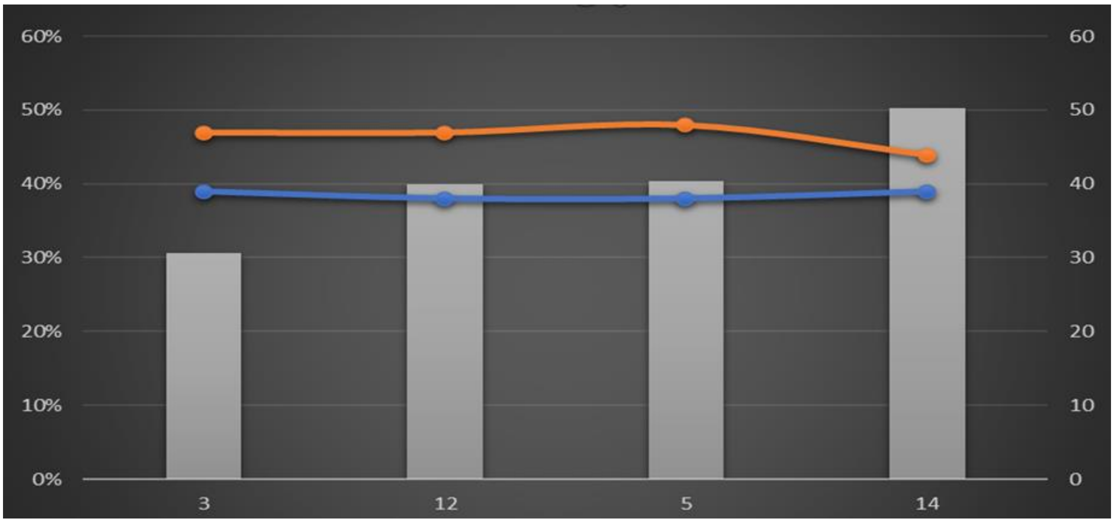

Figure (2): The graphic relationship of the shock test with the assay ratios of the mixtures (3.12.5.14).

Examination of the shock strength is one of the methods that give us correct evidence in the descriptive way about the strength of the materials and their resistance to fracture under the influence of stress. Thus, the shock strength is defined as the highest strength of the material to bear a sudden shock without breaking. The shock with the increase of the assay ratios and the results of the mixtures were as shown in Table (1) with the unit of calculation kJ / mz), to note that the highest shock value of 50.2) kJ/mz) for the mixture No. (14) with a large grain, in which the percentage of assay reached (47%) and rubber granules at a rate of (39%) as shown in Figure (2) to note the variation and decrease in shock values through assay and rubber granules in a mixture (5 fine granules and 12 medium granules) at rates of 40.3) kJ /mz, 40.0 kJ/ mz) and the lowest value (30.6) appeared in the mixture (3) of fine granule, which reached the percentage of assay (44%) and rubber granules at a rate of (39%). Through the graph it is clear that the value of the shock resistance rises when the assay material increases with the size of the resin. The grain is to note that the highest value of the shock in the first sample has increased.

This is due to the rise in the resin associated with the bridle of the large grain, reaching the lowest value, as this substance has the basis for raising the rate of increase and decrease in the rates of shock resistance and accompanying the rise in temperatures by the stiffener, through which it contributes to improving the quality of the shock values. Resin leads to a higher shock resistance, to note that the large granule has the highest rate of shock resistance, followed by the small and then the medium.

4. 3 Discussing the Results of the Water Absorption Test

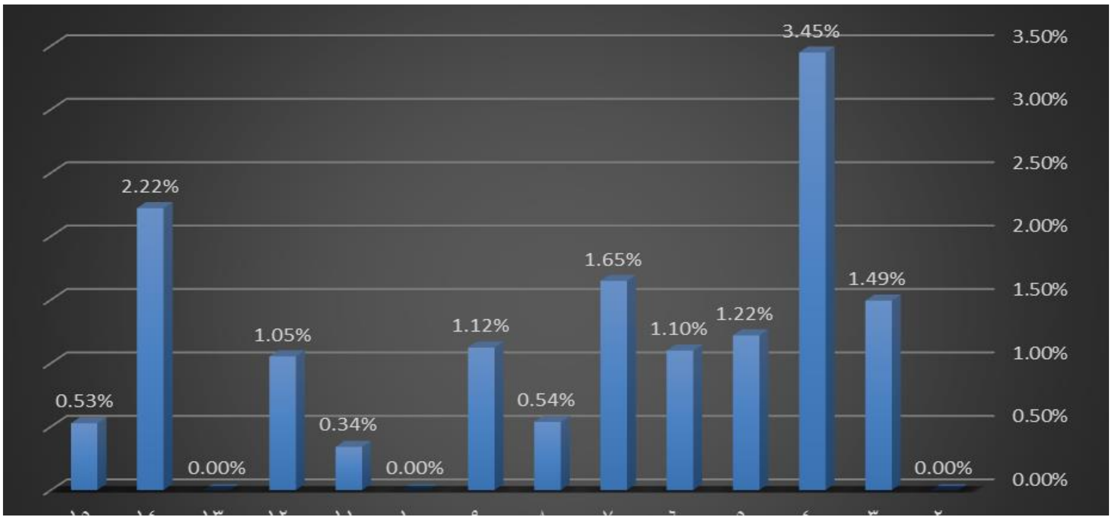

Figure (3): The graphic relationship of water absorption before and after immersion of mixtures (2-15).

The rate of water absorption of samples is different according to the size of the granules and proportions, and for the purpose of comparison with the study mixtures, according to Table No. (1), which shows the water absorption values of the mixtures, to note the extent to which the absorption varies between samples. We also see that there is a relationship between the size of the rubber granule and the proportions of resin and cement in the mixtures in relation to the absorption Water, rubber is a substance that is not easily affected by water, and the main component on which the research was based is rubber.

Chart (3) shows the extent to which the absorption rates vary between mixtures according to the size of the granule and its proportions. Each volume differs from the other in the proportions of materials and absorption values, to see that in the mixtures with granule The fineness varies, so the closer the percentage of resin to the granules and the lower the percentage of cement, the lower the absorption, as in the mixture No. (2), which showed the lowest water absorption rate by (0.00%), and the lower the percentage of the granules and the higher the percentage of resin and cement.

The higher the absorption rate as in the mixture (4) which showed the highest water absorption rate of (3.45%), as for the rest of the percentages, they vary according to the different components in relation to the granule. Particles and cement, the higher the absorption ratios, as in the mixture (12), which showed a high percentage in the medium granules at a rate of (1.05%), and the lower the ratios of the granules and the higher the proportions of resin and cement, the lower the absorption as in the mixture (13) which showed the lowest absorption rates for the medium granule in the table at a rate of (0.00%), and we noticed that the high percentage of coarse granules with the convergent rise of the resin with the decrease of cement leads to higher absorption values as in the mixture No. (14), which showed the highest percentage of absorption for the coarse granule at a rate of (2.22%), and the higher the percentage of resin and cement and the lower the percentage of granules, the lower the percentage of absorption, as in the mixture (15), which showed the lowest percentage of absorption for coarse granules at a rate of (0.53%), so it was found that the variation in water absorption rates in this material depends on the thickness of the volume.

The rubber granule that enters the mixtures and the extent of its pressure during work in the mold to cohesion of its components and reduce the pores inside the dough, and we see that the rubber granule of small size is one of the best granules for water absorption values for use in the production of sculptural works, especially that the granules medium and large are included in the sculptural work and are of high quality as well, but I preferred the small granule to reduce its water absorption, and this was shown through the experiment and tests that were conducted.

4. 4 Discussing the Results of the Mechanical Wear Test

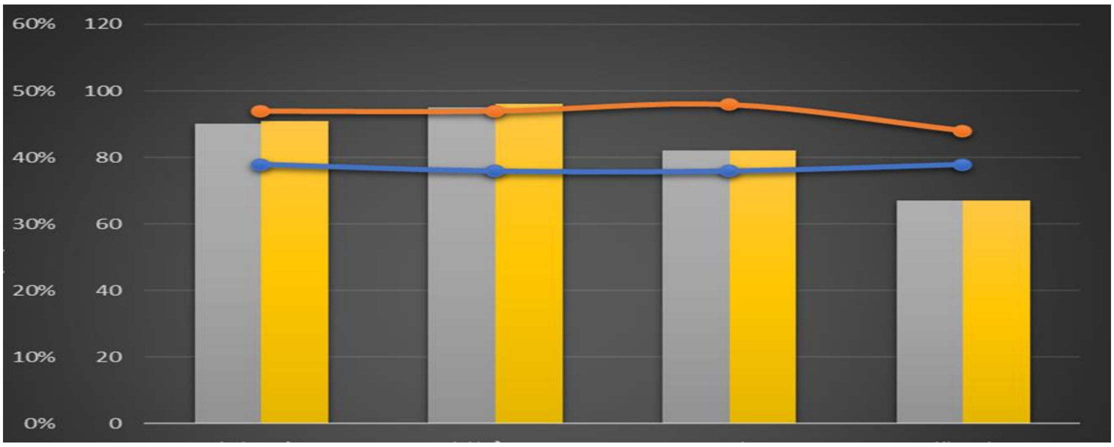

Figure (4): The graphic relationship of erosion by spraying with pressurized water with the numbers of mixtures (3-5-12-14).

Examination of spraying with pressurized water is one of the methods that give us knowledge of the sculptural works' tolerance of rain showers, and the extent of the difference in the values of testing mixtures, and through Figure No. (4), which clarified the graphic relationship of erosion by spraying with pressurized water, to note the disparity in wear between samples, although rubber in general and tires In particular, a material that has a specificity in bearing pressure and shocks, where we see the impact of the size of the granule on the stress tolerance and its relationship to the proportions of resin and cement during the mixing process.

We see that in the two mixtures (5 - 3) with fine grains and rates (38% - 39%) as shown In Table (1) of the mixtures least affected by rain showers, as for mixture (12) with medium-grained (38%) and mixture (14) with coarse-grained (39%) a similar result appeared in the values of its impact on water pressure As shown in the above-mentioned graph, where we note that the proportions of fine, medium and coarse granules in the composition of the mixtures (14-12-5-3) are very close in percentage, but different in terms of water pressure tolerance, so we conclude from that, despite the variation of simple ratios.

It turns out that Small rubber granules are one of the finest granules to bear the pressure of rain water and not the medium and coarse grains are also able to withstand rain water pressure, although they are slightly affected by pressure.

5. Stages of Work:

Before starting the process of preparing the mixtures, the mold must be prepared in terms of coating it with an insulating material for the purpose of closing the pores of the gypsum mold using paint (spray), and then using a greasy insulator that is painted with a brush. The mold rubber mixture is prepared by weighing the proportions specified in the mixing table using a sensitive scale. All materials are added in a rubber or glass container and mixed well by a mechanical mixer for a period of one to three minutes. After the mixture is ready, it must be hurried to work with it as it does not bear delay. Because of its chemical components for the speed of drying and placing it in the form of stages inside the mold and evenly with manual pressure to cohesion the components of the mixture and to highlight the details of the work, to leave the work after the completion of the casting process and directly and not to manipulate it to start the chemical reaction process to be solidified.

6. Research Applications:

7. Conclusions:

1. It is possible to recycle tires in the production of sculptures.
2. The rubber granules for damaged tires of medium size are of the finest types suitable for the production of medium-sized sculptural works. As for the rubber granule of small size, it is preferable to use it in small sculptural works to show clearer details of the work. As for large sculptural works, it is preferable to use rubber granule of large size.
3. Decreased proportions of cement powder cause a reduction in the fluidity of the material composition.
4. The hardness of the material depends on the proportions of cement powder associated with the temperatures.
5. Decreased assay levels below (39%) lead to lower shock values.

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