CHARACTERIZATION OF CONCRETION SAMPLE FROM ŽUŽNJE, NORTH MACEDONIA

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ABSTRACT

A concretion represent a compact mass of matter formed from mineral precipitation around some kind of nucleus which is often organic (e.g. leaf, tooth, piece of shell or fossil). It is found in sedimentary rock or soil. The subject sample is dark gray in color and has been collected from Zhuzhnje (North Macedonia), with dimensions 45 cm height and 80 cm length in rippled ellipsoidal shape. The mineralogical composition of the concretion shows predominantly presence of ankerite as the main mineral phase. The sample demonstrated presence of quartz and dolomite. SEM depicted irregular shapes, while EDS results revealed the following element composition (wt%): C (25.27%), O (61.98%), Mg (0.46%), Si (11.91%), Ca (0.37%).

Keywords: concretion, ankerite, quartz, dolomite

Introduction

The composition and characteristics of rocks and Earth materials can be discovered through laboratory experiments, the development of theoretical models based on the properties of materials as well as the study of rocks and their structures.
In this research is done the characterization of the physical-mechanical properties as well as the research of the mineralogical composition of a stone sample found in the village of Zhuzhnje in the region of Reka (Figure 1).
The main purpose of this research is to determine the mechanical properties by ultrasound method (non-destructive method) and compression test (destructive method) on the stone sample as well as identification, mineralogical determination of crystalline compounds by XRD method, and determination of chemical composition by means of EDS analysis.

Methods

The use of the ultrasound method is done in order to be able to determine the speed of the ultrasonic wave, which passes through the sample, where we can then find the Young module for longitudinal waves, in order to determine if the sample is anisotropic; an important property for evaluating stress measurements. [1] [3] [4]
The compression test method is used to determine the pressure and force exerted on the sample under consideration. Compression test is a mechanical test that gives the maximum amount of compressive load that a material can hold before breaking. [2] [6]
From X-ray diffraction (XRD) and Energy Dispersive X-Ray Spectroscopy (EDS) analysis we get information on the type of minerals present in the sample and the chemical composition of the sample, while from the images taken by the electron scanning microscope (SEM) we get information about the topography (surface characteristics) of the substance or product, morphology (shape and size of particles), composition - microanalysis (elements and compounds of which the substance or product consists, particles) as well as the way (orientation) how the components in it (atoms) are arranged. [5] [7] [8] [9]

Results and Discussion

The sample used for the ultrasound analysis has a length of 12 cm and a density of 2768.36 kg / m3, it is shown in figure 2.a. In Table 1 above we have data obtained during the analysis and data which we then calculated. The values obtained for time *t* during the modification of the pulse frequency that is released to pass through the sample, we used to find the velocity of the longitudinal wave that passes through the sample and then based on the velocity found using the appropriate formulas we found the longitudinal modulus for longitudinal waves.
By means of the compression test we have determined the maximum force required to destroy the sample and the pressure which is exerted on the sample. In this analysis we took two samples, which are presented in Figure 2.b. Table 2 presents the data obtained from the compression test. Figure 3 shows the graph obtained during compression testing. During the analysis of this image we see that the tested sample is very homogeneous, as the linearity of strain and deformation can be observed.
The sample used for XRD analysis was processed down to small-dust particles, as required to be suitable for diffractometer and analysis. The granular sample is shown in Figure 2.c. Through this analysis we obtained information on the presence of some minerals found in the sample. The results obtained from XRD are shown in Figure 4. In the spectrum the minerals present in the sample are represented by: A-Ankerite, D-Dolomite and Q-Quartz. Based on the results obtained from SEM presented in figure 5 we see irregular shapes in the raw material, which are as a result of the presence of ankerite mineral in the raw material. The presence of quartz is also evident in the sample, where regular forms of this mineral can be seen.
From the EDS results obtained from the image in figure 6, we have obtained the spectrum shown in figure 7, from where we analyze that in the chemical composition of the analyzed sample appear these elements with this atomic percentage: *C (25.27%), O (61.98%), Mg (0.46%), Si (11.91%), Ca (0.37%).*

Figure. 1

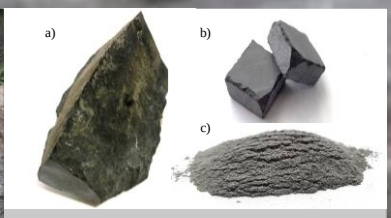

Figure. 2

Sample length s (m)	12×10^{-2}			
Sample density ρ (kg/m³)	2768.36			
Pulse Frequency (Hz)	1	2	5	10
Time t (μs)	24	24	24.1	25.1
Pulse velocity v (m/s)	5000	5000	4979.2	4780.8
Longitudinal modulus E (MPa)	69209	69209	68634.37	63273.77

Table. 1

	Sample I	Sample II
Time required (s)	500	600
The force of destruction (kN)	0143.50	0134.04
Pressure (MPa)	0235.61	0303.13

Table. 2

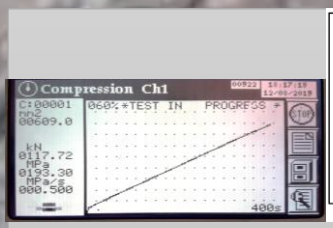

Figure. 3

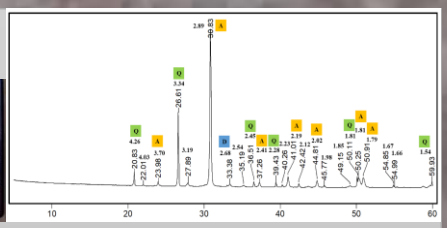

Figure. 4

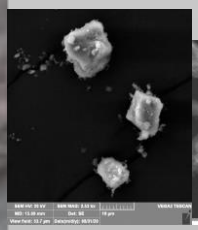

Figure. 5

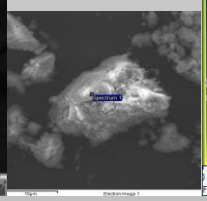

Figure. 6

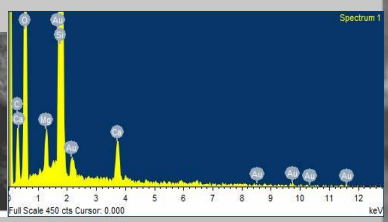

Figure. 7

CONCLUSIONS

From the analyzes performed on this sample, using all the techniques mentioned above, we have obtained certain results where each method gives a specific data.
As a result of the ultrasound method and the compression test method, it turns out that the examined sample is very homogeneous and with regular structure. The homogeneity of the sample in addition to the values obtained, can also be observed from their graphs, which show a linearity of strain-deformation behavior.
From the results we obtained from the analysis of SEM images we see that the obtained images show irregular shapes of the raw material. This is also related to the dusty state during SEM scanning.
Based on the results obtained from the XRD analysis we conclude that in the sample we have the presence of minerals such as ankerite, dolomite and quartz.
EDS analysis gives us the chemical composition of the sample (at a certain point), from where it is seen that the sample consists of elements such as carbon, calcium, silicon, oxygen and magnesium.

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