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PROCEEDINGS

Edited by

Saša Stojadinović

and

Dejan Petrović

November 29th – 30th 2021

Bor, Serbia

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THE CLAY PRELIMINARY TESTING FROM MUNICIPALITY AREA OF REKOVAC

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Abstract

On the territory of Rekovac municipality, geological research has discovered clay deposit "Oparić". The sample was taken from the well core with 9 m depth, then stirred with water and sifted by wet process on a sieve with 0.063mm opening. It was obtained 71% of reflections (class + 0.063 mm) and 29% of sieves (class -0.063 mm).The chemical and X-ray analysis of the class -0.063mm was done. The results showed there is increased content of iron in the form of Fe_2O_3, which reduces the clay quality.Further research should focus on finding the iron removing possibility by magnetic concentration.

Keywords: *clay, chemical analysis, X-ray analysis.*

1. INTRODUCTION

Clay is plastic semi-bound sediment formed by diagenesis (binding) of sludge, pelitic material (grain size below 0.005 mm) transported by water and deposited in an aqueous medium.In addition to clays that become by transporting and depositing sludge material, there are also those that have become and remain at the site of decomposition of the primary material. These are residual or sedimentary clays [1]. Clays are rocks with different mineral and chemical composition.They are made of fine dispersed particles (finer than 2μm) which, in their natural state or mixed with water, give a plastic mass that retains its shape after drying, and gains the stone strength by baking.Unlike clays which are characterized by plastic properties, there are finely dispersed formations in nature without such properties, such as refractory and pottery clays. However, these clays also have a wide industrial application. Clay minerals represent a large group of related silicates.These minerals are usually deposited by surface decomposition of aluminosilicates in the parent rock or as sediments from surface waters. They are stable at low temperatures and low pressure. Clay minerals can also be products of hydrothermal solutions and hydrothermal transformation of suitable rocks.As clay constituents, minerals are usually found in aggregates with a predominance of one or more different minerals.Such aggregates are almost always fine-grained, so sometimes even microscopes cannot distinguish their individuals. In order to better and more detailed study of clay minerals, a special branch of mineralogy has been developed that deals with this, and that is clay mineralogy.Basically, clay consists of one or more main minerals (kaolinite, hydroliskuni-ilite, montmorionite and other aluminum silicates) and various impurities (quartz, zircon, apatite, garnets, iron carriers, etc.) [2]. Within silicates that are determined as clays, there are two distinguished groups: crystalline representatives (group of kaolin, pyrophyllite, montmorillonite, illite and halosite) and amorphous representatives

(allophane). All crystalline representatives are phyllosilicates. In addition to silicon, they contain aluminum and significant amounts of water.The composition differences of these minerals are mainly due to the different ratios of silicon and aluminum between the components. Impurity components appear only in traces and in small quantities [3].Phyllosilicates crystallize monoclinically and triclinically.Crystals are always plate-like, regardless of whether they are regular or not, due to a high developed base. They appear in the form of earthy, worm-shaped or irregular aggregates.The crystals show perfect fissility at the base. The sheets are flexible, but inelastic with Moss hardness 1 to 3, density 2g/cm^3 (for montmorillonite) to 2.6 g/cm^3 (for kaolin).They are in different colors: white, yellow (derived from iron), gray (from moisture or organic pigment), green, brown, etc.Phyllosilicates are characterized by having a more or less pronounced ability to adsorb many cations on the surface or between the crystal lattice layers.Clays are rocks that, depending on their purity, can have great use in various industries. Kaolinite clays are raw materials for the porcelain industry, montmorillonite for molds in the refractory industry, and impure clays are used in pottery. The clay has also use in the ceramics industry [4, 5, 6].

2. EXPERIMENTAL

2.1 Material and equipment

A sample of clay for testing was taken from the well core with 9 m depth at the Oparić site. The sample was stirred with water and sifted by wet process on a sieve with 0.063 mm opening. A mass fraction of reflections of 71% (class + 0.063 mm) and sieves of 29% (class -0.063 mm) was obtained.Having in mind that impurities in clay are concentrated in larger classes, the smaller class -0.063 mm was taken for further examination. This size is the most frequently required class for various applications. Chemical and X-ray diffraction (XRD) analysis were performed on the selected class.The atomic absorption spectrophotometer "Perkin Elmer" -Analyst 300 was used for chemical analysis. X-ray diffraction analysis was performed on an X-ray diffractometer device brand "PHILIPS", model PW-1710.

3. RESULTS AND DISCUSSION

3.1 The clay characterization from deposit "Oparić"

The chemical and XRD analysis was performed on the class -0.63+0.1 mm and the results are shown in Table 1 and Figure 1.

Table 1 - Chemical analysis of class -0.63 + 0.1 mm clay from deposit "Oparić"

Component	SiO_2	Al_2O_3	MgO	CaO	Fe_2O_3	Na_2O	K_2O	TiO_2	LoI*
%	56.00	14.72	0.462	6.29	7.93	0.803	2.63	0.335	10.78

*loss onignition (LoI)

The results of the chemical analysis show a high content of SiO_2 56% and CaO 6.29%, as well as a low content of Al_2O_3 14.72%. There is also an increase of iron content in form of Fe_2O_3 7.93%.This indicates that it is a poor quality raw material with limited use. Therefore, it is necessary to subject this raw material to certain preparation and refining processes.In order to determine which minerals are present in this sample, an X-ray analysis was performed and the obtained diffractogram is shown in Figure 1.

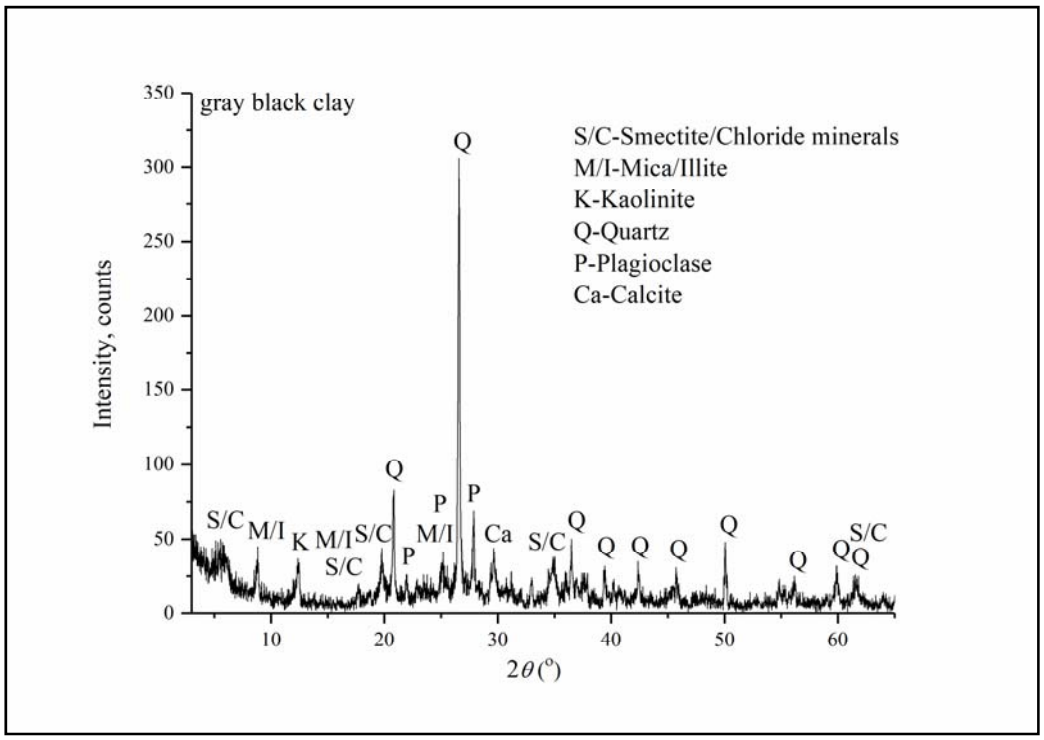

Figure 1 - Diffractogram of clay powder sample "Oparić"

In the analyzed sample the following mineral composition was determined: quartz, smectite/chlorite minerals, mica/illite, plagioclase, calcite.The clay minerals (smectites, kaolinite and illite), are the most represented mineral while quartz and plagioclase are less represented. Calcite is the least present.The results of chemical and mineralogical tests of the clay sample "Oparić" showed the presence of mixture of minerals: smectite, kaolinite and illite as well as the Fe_2O_3.The clay of this locality has a very limited use, due to the high iron content and low aluminum content.The subject of further research by the authors of this paper is to examine the possibility of smectite concentration and iron removal.The assumption is that iron can be removed by a high-gradient magnetic concentration process, but it is first necessary to determine in what form it is: is it an external Fe located between the layers of the crystal lattice of minerals or is it internally embedded in the crystal lattice of minerals.Magnetic concentration is possible to remove only Fe-bearing minerals that are physically trapped between the layers of the crystal lattice, while the removal of chemically bound Fe is impossible.

4. CONCLUSION

Based on preliminary clay quality tests of the "Oparić" site, it can be concluded that this raw material has limited application due to its chemical composition.Namely, in addition to the minerals kaolin, illite and smectite, this clay contains a high content of iron, which affects the poor clay quality and reduced its use.Iron can be removed by magnetic concentration, only if it is notchemically bound, but if Fe-bearing minerals are located between the layers of the crystal lattice of clay minerals.The removal of iron from the clay sample of the mentioned locality and the clay minerals concentration is the subject of further research by the authors of this paper.

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