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Microstructural characterization of clays extracted in Paraguay by X-ray diffraction with a view toward industrial applications

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Clays are materials characterized by a large surface area, chemical and mechanical stability, and a high cation exchange capacity. These have made them gain significant importance worldwide in recent decades, enabling their application in many industrial sectors. Clay deposits and reserves in Paraguayan soil have not yet been fully exploited or studied for their identification and classification into advanced materials issues. They are mainly used in local handicrafts and the structural elements for civil construction. Currently, there isn't industrial development or scientific research that projects the local clay for industrial applications of high-added value, for example, in the production of nanoclays. This work is a preliminary study that aims to characterize local clays and demonstrate the possibility of applying them in high-added value products, diversifying the opportunities for using Paraguayan clays at the level of advanced materials. To begin this study, samples were taken from two popular artisan areas. The samples were collected from the cities of Pirayú and Tebicuary, duly stored, and taken to the laboratory for subsequent characterization. Before characterizations, the samples were sieved to remove possible impurities. The lamellae characteristic of the clay materials could be observed by SEM; FTIR was used to identify the functional groups and their vibrational states, applying the KBr technique. The chemical composition was determined by EDXRF. The identification of the phases present and their respective percentage were obtained using the XRD powder diffraction. Finally, a semiquantitative analysis was carried out to determine the percentage of phases present in each sample using the Reference Intensity Ratio - RIR method. The results from both the Pirayú and Tebicuary samples showed similar quantities of quartz, kaolinite, and muscovite phases and distinct titanium oxide phases, anatase (Pirayú), and rutile (Tebicuary). The Pirayú sample presented a higher rate of quartz and equal percentages of kaolinite and muscovite. The titanium oxide phase was identified in a higher percentage in the Tebicuary sample. From the results obtained, it can be affirmed that local clay has great potential in applications in advanced materials once processed according to the intended application.