ATR-FTIR and FT-Raman spectroscopic studies of Brazilian clays: smectites from Bahia and Kaolin from Paraiba

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Abstract

Smectites and kaolins were analyzed by FT-IR and FT-Raman aiming the use of those clays as products of increased values.

Introduction

Brazilian clays are natural resources which can be found in many regions of the country. Among that clays, smectites and kaolins are the most utilized for several applications, such as oil & gas and paper industries. These materials can also be applied for several new technologies, for example, nanocomposites and drugs, where their physical and chemical properties should be standardized.
In this work we investigate three samples of Brazilian clays: two natural smectites from Bahia (A01 and A02), and one natural kaolin from Paraíba (A03). Samples were first analyzed by XRD diffraction to access their structure, and then submitted to ATR-FTIR and FT-Raman spectroscopies to investigate the characteristic vibrational modes of clayminerals.

Results and discussion

XRD diffractograms results showed that A01 might be constituted by montmorillonite (d_{001}=14.99Å); A02 by montmorillonite (d_{001}=15.01Å) and kaolinite (d_{001}=7.01Å); and A03 is mainly constituted by kaolinite (d_{001}=7.40Å). The results obtained by this technique agree with the literature where typical montmorillonite structure[2] is showed, Fig.1. Therefore, ATR-FTIR and FT-Raman were performed in an attempt to identify the species presents in the samples A01, A02 and A03.
The ATR-FTIR and FT-Raman spectra of the samples contain OH stretching vibrations (3800-2800 cm^{-1}), H-O-H deformation vibrations from absorbed water (1700-1550 cm^{-1}), Si-O stretching and OH vibrations (1200-800 cm^{-1})[1].
The A02 spectra is similar to that of A03 and very different of A03, indicating that A02 is a mixture of clays containing montmorillonite and kaolinite in very similar proportions; A01 spectra showed only a peak characteristic of montmorillonite. A primary difference between ATR-FTIR and FT-Raman can be found at 3100-2800 cm^{-1} for A03 sample and the differences in this spectral region are attributed to changes in Si-O polymerization. In table 1 it is observed that some peaks correspond to OH stretching vibrations.

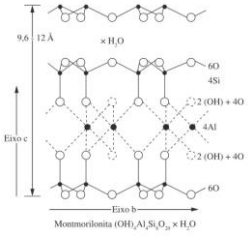

Fig 1. Typical montmorillonite structure.[2]

Table 1. Some peaks observed in the FT-IR spectra

Spectral modes	Frequencies (cm^{-1})		
	A01	A02	A03
OH stretching	-	3690	3677
OH stretching	-	3690	3653
OH inner group	3620	3620	3620
Adsorbed water	3400	3400	-

Conclusions

The XRD diffractograms of analyzed samples indicated that A01 and A02 are smectites, while A03 is kaolin. FTIR and FT-Raman analysis permitted identification of OH characteristic stretching vibrations for the three samples, confirming XRD data, and indicating that A01 is a mixture of clays, while A02 and A03 are pure clays.

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Farmer, V.C. 1974. The layer silicates: Ch 15. In Infrared Spectra of Minerals. V. C. Farmer, ed. London: Mineralogical Society, 331-363; 2Johnston et al., Am.Min. 1998, 83,75.
[2]Anadão, P; Wiebeck, H.;Valenzuela-Dias, F.R.Polimeros,21,5,443-452,2011.