11th International Conference
on Advanced Materials

Rio de Janeiro Brazil
September 20 - 25

ICAM2009

Modified Kenyaite With TPT Silane for Cadmium Adsorption from Aqueous Solution

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Abstract – The silicic acid Kenyaite, $Na_2Si_{22}O_{45}.10H_2O$ comprise a defined class of compounds with distinct layered arrangement, whose structures permit not only intercalation but also immobilization reactions. In this work, lamellar sodium kenyaite was synthesized using hydrothermal condition as previously described[1]. Na-kenyaite sample was converted to acidic form and was submitted to immobilization reaction with N-3-trimethoxissilypropyldietylenetriamine (TPT). The modified matrix, denominated HKni-3N, was caracterizated by different techniques (XRD, FTIR, NMR), and was used for cadmium cation adsorption isotherm process investigated at 298 ± 1 K, using batchwise method. The maximum value of adsorption was 1.81 $mmolg^{-1}$.

A great variety of crystalline inorganic layered compounds have been employed as host nanomaterials due to favorable organic substance insertions into the interlayer nanospaces, with the purpose to synthesize inorganic–organic supramolecular systems, which enable applications in many fields, such as chemical surface modications with functionalized agents, catalysis, toxic substance removal from the environment or compound preparations based on guest polymer intercalation into the layered nanostructures[1]. The silicic acids kanemite, kenyaite, makatite, octosilicate and magadiite comprise this defined class of compounds with distinct layered arrangements.

H-Kenyaite, $Na_2Si_{22}O_{45}{\cdot}10H_2O$, has been synthesized at mild condition. Throughout combining different experimental techniques (XRD, FTIR, TG) were possible to analyse the properties and thermal behaviour. The x-ray difratogram indicated a good crystallinity, with characteristic peaks of lamellar material. The FTIR spectrum of Na-kenyaite agrees with those reported elsewhere[1], which bands are associated with the vibrations of stretching of water and Si-O-Si groups.

It was also explored the performance of a synthetic H-Kenyaite in chemically modified form by adsorption process. The chemical modification was developed through organofunctionalization with N-3-trimethoxisilylpropyldietylenetriamine silane (TPT), $(CH_3O)_3Si(CH_2)_3NHCH_2CH_2NHCH_2CH_2NH_2$. The resulted material was denominated HKni-3N, and was caracterizated by ^{29}Si and ^{13}C-MAS/NMR (figures 1 and 2) and chemical analysis too. The anchoring of alkylsilylgroup in lamellar structure is proved through modified matrix spectrum. This modified matrix was used for cadmium cation adsorption isotherms process investigated at pH 6.0 and at 298 ± 1K, using batchwise method[2,3].

The available nitrogen atoms from TPT agent, the maximum adsorption value (1.81$mmolg^{-1}$) for HKni-3N matrix suggested that these basic reactive centers were introduced in H-Kenyaite structure. The degree of adsorption depends on the combination of the reactive basic centers and the corresponding Cd^{2+} properties. The modified matrix demonstrated ability in cadmium removal cadmium from aqueous solution.

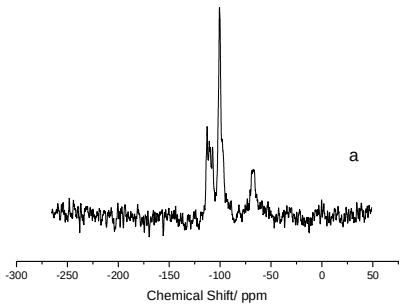

Figure 1: ^{29}S1 NMR spectra of HKNi-3N.

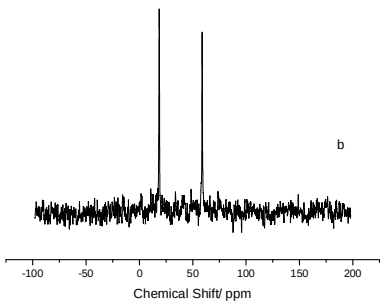

Figure 2: ^{13}C NMR spectra of HKNi-3N.

References

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