

Modified H-Kenyaite With TPT Silane for Cadmium Adsorption from Aqueous Solution

A. A. Pinto*, D. L. Guerra, C. Airoldi

Instituto de Química – Universidade Estadual de Campinas, 13084-971, Campinas, São Paulo, Brasil.

* alane24@gmail.com

Abstract – The silicic acid Kenyaite, $\text{Na}_2\text{Si}_{22}\text{O}_{45}\cdot 10\text{H}_2\text{O}$ comprise a defined class of compounds with distinct layered arrangement, whose structures permit not only intercalation but also immobilization reactions. In this investigation, lamellar sodium kenyaite was synthesized using hydrothermal condition as previously described¹. Na-kenyaite sample was converted to acidic form (H-Kenyaite) and was submitted to immobilization reaction with N-3-trimethoxysilylpropyldietylenetriamine (TPT). The modified matrix, denominated HKni-3N, was characterized 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 1.34 mmol g^{-1} .

A variety of crystalline inorganic layered compounds have been employed as host nanomaterials for favorable organic substance insertions inside the lamellar spaces, with the aim to achieve inorganic–organic supramolecular systems. Such system will have applications in many fields, such as chemical surface modifications with functionalized agents, catalysis, toxic substance removal from the environment etc¹. The silicic acids kanemite, kenyaite, makatite, octosilicate and magadiite comprise a class of compounds with distinct layered arrangements.

Na-Kenyaite, $\text{Na}_2\text{Si}_{22}\text{O}_{45}\cdot 10\text{H}_2\text{O}$, has been synthesized at mild condition as reported in literature¹. The synthesized H-Kenyaite was characterized by XRD, FTIR and TG. The FTIR spectrum of H-Kenyaite agrees with those reported elsewhere¹. The IR stretching bands at $3400\text{-}3200$, 1100 and 900 cm^{-1} was associated to O-H of adsorbed water, Si-O-Si and Si-OH, respectively. The H-Kenyaite was organofunctionalized with N-3-trimethoxysilylpropyldietylenetriamine silane (TPT), $(\text{CH}_3\text{O})_3\text{Si}(\text{CH}_2)_3\text{NHCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2$, using toluene as solvent. The resulted material is called Hkni-3N and the anchoring (TPT) inside the lamellar spaces is proved by solid state NMR for ^{29}Si and ^{13}C nuclei, that shows the presence of Q and T groups [figure 1(a) and 1(b)]. The x-ray diffractogram of HKni-3N indicated a good crystallinity, with characteristic peaks of lamellar material [figure 1(c)].

The obtained organofunctionalized lamellar material (HKni-3N) was used for cadmium cation removal from aqueous solution. The available nitrogen atoms from TPT silylating agent inside the lamellar space of HKni-3N, showed maximum adsorption value 1.34 mmol g^{-1} of Cd^{2+} removal. The adsorption isotherm was investigated at pH 6.0 and 298 ± 1 K, using batchwise method^{2,3}. The modified matrix demonstrated ability in cadmium removal from aqueous solution.

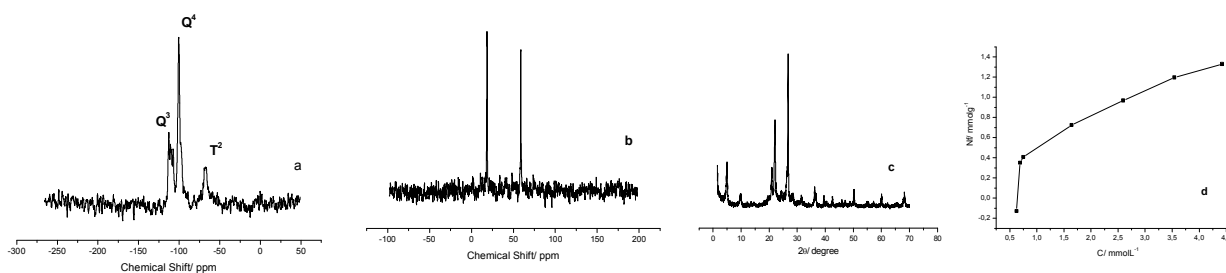


Figure 1: ^{29}Si NMR spectra of HKni-3N (a); ^{13}C NMR spectra of HKni-3N (b); XRD of HKni-3N (c); Adsorption isotherms for Cd^{2+} (d).

References

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