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Synthesis and characterization of Al-pillared and cationic surfactant modified Al-pillared Algerian bentonite

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Abstract

Al-pillared and a cationic surfactant modified Al-pillared montmorillonite were prepared by reacting a purified bentonite from deposits in Maghnia and Mostaghanem (in the West of Algeria), with a solution of aluminum chlorohydrate alone or with both Al-chlorohydrate and cetyl trimethyl ammonium bromide (CTAB) solutions. The most favorable conditions for producing the Al-pillared and the CTAB-modified Al-pillared montmorillonite were established as follows: an OH/Al molar ratio of 1.8; an Al/bentonite ratio of 4 mmol/g; a CTAB/bentonite ratio of 2 (w/w). The Al-pillared clays have a basal spacing of about 1.8 nm and a surface area between 250 and 300 m^2/g. A good thermal stability was found at 500°C. The CTAB modified Al-montmorillonite showed a greater basal spacing of about 2.1 nm, but it was reduced down to 1.4 nm upon heating to 500°C when the CTAB was adsorbed on the Al-hydroxy-montmorillonite prior the calcination and to 1.8 nm when it was adsorbed on the calcined pillared solid. The BET surface area of CTAB modified Al-montmorillonite was much lower than that of Al-pillared clays.

Keywords: Bentonite; Al-pillared montmorillonite; CTAB-modified Al-pillared montmorillonite; Cationic surfactant

1. Introduction

Interest in the synthesis of pillared smectite clays has grown with the advances in intercalation chemistry, which offers the possibility to make them potential catalysts and adsorbents.

This new type of molecular sieves is structurally different from zeolites. In zeolites, the pore size is defined by six to twelve membered rings of oxygen atoms, which give open framework structures, whereas in the pillared smectite the pore size is defined by the narrowness of the interpillar spacing and the dimensions of the intercalating agent [1–3].

One way to increase the thermal stability is to insert robust inorganic pillars, and as a consequence, to keep the individual layers apart, and the interlayer space available for adsorption [4]. The robust intercalating cations may be different oxypolymers such as $[Al_{13}O_4(OH)_{24}(H_2O)_{12}]^{7+}$, $[Si(OH)_4]$, $[Cr(OH)_{3-x}]_n^{nx+}$,... etc.

Recently, Zeilke et al. [5] have shown that these pillared clays might be applied as recyclable adsorbents for organic pollutants. But their affinity for the latter in comparison with activated carbon is low. However, if the Al-pillared products are brought into contact with solutions containing

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