Evaluation of the Acidity of Pillared Montmorillonites by Pyridine Adsorption

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Abstract: Two series of pillared clays were prepared from a purified montmorillonite (95%) from La Serrata of Nijar, Spain, and polycations of Al and Zr using various methods. The effect of both the pillaring cation and the procedure of preparation on the physicochemical characteristics of the resulting materials was studied. Changes in texture were determined by X-ray diffraction (XRD) and N_2 adsorption at 76 K and changes in acidity were determined by thermogravimetry following pyridine adsorption at room temperature and further desorption at a constant heating rate of 10 K min^{-1} in the range of 298 – 623 K. The relation between the size and charge (n/q) of the pillaring cation, which is dependent on the degree of cation hydrolysis, is the main factor affecting pore size and acidity of the synthesized materials. The pH of the pillaring solution affects the stability of the parent clay and the properties of the pillared clay. Below a pH of 3 and depending on contact time, the montmorillonite may delaminate and partially dissolve to produce products that affect the properties of the resulting materials. Microporosity increases for both Al or Zr-pillared clays. For Zr-pillared clays, microporosity is accompanied by changes in the mesoporosity and macroporosity as a result of clay delamination. Acidity dramatically increases by pillaring, especially strong acidity, and the acid strength distribution depends on starting salt concentration, aging time, and temperature.

Key Words: Acidity • Al-Pillared Montmorillonite • Mesoporous Materials • Pyridine Adsorption • Zr-Pillared Montmorillonite

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