Chapter 23
Organobentonites with Crystalline Layer Separation Used for Adsorption in Water Treatment

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ABSTRACT

In this chapter, the surface modification of a natural bentonite was performed with surfactants of different ionic nature: HDTMA and TX100 as cationic surfactant and nonionic surfactant, respectively. The results show the successful modification of sodium bentonite with an ionic surfactant and a non-ionic surfactant. It was observed that the modification of bentonite with HDTMA and TX-100 was carried out by different mechanisms. HDTMA on the external surface causes the decreasing in surface area and changes in surface charge. In the case of the clay modified with Triton X-100, surface changes were small. Despite this, it verified the existence of TX-100 in the outer area of the bentonite.

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INTRODUCTION

Nowadays the development of societies involves adverse environmental impact and the mode of life, compromising the environment for future generations. Pollution prevention is a priority but, once it is present in the ecosystem is necessary to carry out its remediation. The adsorbent materials of impurities present in water have been widely studied as one of the options. One of the most important factors to take into account in the choice of the adsorbent material is the type of contaminant that should be removed. An important trend in researches that deal this issue is to improve the performance of traditional materials and new materials.

The clays are used one such adsorbents, they have the advantage of being a natural material of low-cost, abundant and with large specific surface area. The clays are phyllosilicate of colloidal dimensions. The smectites are a group of clays type 2:1, that is, composed of a layer of octagonal aluminum between two layers of silica tetrahedra. The smectites have an expandable structure, where all the surface layers are available for hydration and ion exchange. The bentonite is the commercial name of a clay that is mainly composed of montmorillonite, which belongs to the group of the esmectites, and can contain other clays in smaller proportions. Recently, there is a growing interest in the use of natural clays such as kaolinite, montmorillonite and saponin for the removal of heavy metals and a wide variety of organic pollutants present in aqueous solutions.

The bentonites have a hydrophilic nature and need a pre-treatement to increase their affinity with hydrophobic adsorbates. For this reason, organic molecules are exchanged with the cations present in the interlaminar spaces of clays, increasing the hydrophobic interactions with non-polar molecules in aqueous medium. These modified clays are called organic clays.

This study was focused on changes in a natural bentonite with one ionic surfactant and one non-ionic surfactant. The syntheses of organic bentonites were by three methods with different thermodynamic conditions to evaluate the efficiency of modification: into environmental conditions, into an autoclave and into supercritical conditions.

The modification of clays with ionic surfactants to standard conditions has been widely studied due to the satisfactory results in removal of organic compounds present in water. In terms of the modification with non-ionic surfactants, there is little information available. In this study, Na-bentonite was amended with HDTMA as ionic surfactant, and with Triton X-100 as non-ionic surfactant. To characterize the adsorption of surfactants in the bentonite different characterization techniques were used, such as: XRD, BET, DSC, and FT-IR. As one of the characterizations, the adsorption of phenol was carried out since it is a priority pollutant due to their toxicity and accumulation in the atmosphere. This chapter presents a detailed analysis of the results obtained during the structural and surface characterization of the natural bentonite, as well as its modification with surfactants.

BACKGROUND

Bentonite is a commercial name of a clay belonging to the family of the smectite with a high content of montmorillonite (Giese et al., 2002). The smectite are expandable type 2:1clays. They are shaped by an octagonal aluminum layer between two layers of silica tetrahedra. The forces that maintain the layers joined are relatively weak, where there are interlaminar spaces that expand with the increase in the water content within the inner layers. The cationic hydration between the structural units is a unique property of the smectite type clays. This process depends on the balance between the electrostatic attraction cation-layer and the hydration energy of the cation. When layers of water are interspersed and the separation between the layers