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Structural evolution of algerian bentonite through sodium activation: An in-depth XRD approach

Rania Chebani, Kamel Daoud

Laboratory of Transfer Phenomena, University of Science and Technology Houari Boumedienne, Algiers, Algeria



Clays, especially bentonite, are pivotal in the pharmaceutical industry as excipients and active ingredients. Montmorillonite, the main bentonite constituent, undergoes modifications by adsorbed cations, particularly sodium and calcium, in interlayer spaces. This study aims to convert calcium bentonite from Algeria into sodium-activated bentonite, exploring structural modifications with varying Na_2CO_3 ratios.

Collected from renowned deposits in western Algeria (Hammam Boughrara Maghnia, M'Zila Mostaganem), three samples underwent activation with Na_2CO_3 ratios ranging from 2% to 8%. Characterization, primarily employing X-ray diffraction (XRD), facilitated the analysis of post-activation structural modifications.

Montmorillonite was the primary component in both Maghnia and Mostaganem samples. Maghnia included accessory minerals Orthoclase, Albite, Quartz, and Calcite, while Mostaganem featured muscovite, quartz, dolomite, and calcite as additional minerals.

A detailed analysis of XRD patterns for calcium bentonite activated at different Na_2CO_3 ratios reveals significant variations. A decrease in peaks indicates a notable incorporation of Na^+ in some samples, while others reach saturation. These results, closely tied to the basal d_{001} spacing of montmorillonite, provide insight into post-activation structural adjustments, supported by a thorough reference to the literature and establishing crucial links between our empirical findings and established theoretical concepts.

The study emphasizes the mineral diversity of western Algerian bentonite, highlighting variations linked to geographical location and activation ratio. Enriching our understanding of activated bentonites, these findings suggest promising opportunities for targeted applications, such as excipients (disintegrants, drug release modulators...), active ingredients (antacids, gastrointestinal protectants, dermatological protector...), and in the cosmetic industry for crafting creams, powders, and emulsions, in medicine and beyond [1].

References:

1. F. Bergaya, B.K.G. Theng, G. Lagaly, Chapter 11 Clays, Elsevier, 2006: p. 623.