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Structure and reactivity of synthetic Co-substituted goethites

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Abstract

A set of synthetic goethites were prepared from Fe^{3+}- and Co^{2+}-nitrate solutions in alkaline media with a Co/(Co + Fe) ratio (x_{Co}) up to 10 mol%. The structural characterization of the resultant solid phases was carried out by X-ray diffraction (XRD). XRD analyses showed that in preparations with x_{Co} <10 mol%, Co-substituted goethite was the only crystalline phase present. Atomic and cell parameters for the samples synthesized were obtained by the Rietveld refinement of the XRD data, and showed that the unit cell in the goethite-like phase is contracted as a function of x_{Co}. Little deviation from the Vegard rule was observed for all unit-cell parameters. Cobalt substitution produces an increase in the surface area of the goethite, as well as an increment in the dehydroxylation temperature. The acid dissolution of all Co-goethites showed an increase in dissolution rate with the Co content, and a congruent behavior was observed. The activation energy for dissolution was obtained two samples. A modified first-order Kabai equation best describes the dissolution data.

Keywords: Co-goethite, isomorphous substitution, Rietveld refinement, acid dissolution