
The Interaction of Water with Goethite (α -FeOOH) and Amorphous Hydrated Ferric Oxide Surfaces*

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Abstract: The interaction of water with synthetically prepared goethite (α -FeOOH) and amorphous hydrated ferric oxide surfaces was studied using i.r. absorption and water vapor adsorption measurements. I.R. results show that the last traces of physically adsorbed water are removed from the amorphous material by outgassing at 25° C. In contrast, goethite retains approximately a monolayer of physically adsorbed water with similar outgassing. This monolayer of water on goethite, which is presumably hydrogen-bonded at least in part with structural hydroxyls, is readily exchangeable with D₂O.

Integral entropies of adsorption were evaluated from water vapor adsorption isotherms at 15, 25 and 35° C and compared with values for mobile and immobile layers calculated through application of statistical mechanics (McCafferty and Zettlemyer, 1970). Entropy values for both the first physically adsorbed monolayer of water on the amorphous material and the second monolayer on goethite were about the same as or greater than those calculated for an immobile layer, indicating strong hydrogen bonding of water by both surfaces. The larger deviation between the entropy values for goethite and those calculated for the immobile layer may be associated with changes in the structure of the first as well as the second physically adsorbed water layers. Surface areas, calculated using the BET method, were 320 and 32 m² g⁻¹ for the amorphous material and goethite respectively. Since the unit surface activity is probably about the same for the two materials, it follows that as the amorphous material crystallizes to form goethite, there would be a reduction in total surface activity in proportion to the reduction in surface area.

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