
Effect of the Presence of Aluminum ions in Iron Solutions on the Formation of Iron Oxyhydroxides (FeOOH) at Room Temperature Under Acidic Environment¹

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Abstract: The hydrolytic behavior of Fe solutions at room temperature under acidic conditions was investigated. In the presence of Al ions, with Cl and NO₃ as associated anions, the Fe hydrolysis began almost instantaneously and a crystalline β -FeOOH (akaganeite) was formed in the AlCl₃/FeCl₃ system within a short period. Initially the particles were small with large surface area. However, with time the particles grew in size and the surface area decreased. After about 42 days of equilibration, the akaganeite particles grew to 60– 300 nm long, 10– 50 nm wide and with a surface area of 55 m²/g, which is similar to other reports for akaganeite prepared at higher temperatures. In the NO₃ system [Al(NO₃)₃/Fe(NO₃)₃], lepidocrocite (γ -FeOOH) and goethite (α -FeOOH) were formed. In a mixed anion system (Cl/NO₃) solid phases identified were akaganeite (β -FeOOH) and lepidocrocite (γ -FeOOH). The introduction of poly-nuclear hydroxy-Al along with monomer Al in Cl and NO₃ systems of Fe affected the quantity and quality of the solid phase. The crystallinity of β -FeOOH formed in the presence of polynuclear hydroxy-Al ions in a Cl-system was more disordered than when it formed in the presence of monomer Al-ions alone. In NO₃ systems, polynuclear hydroxy-Al hindered the formation of goethite (α -FeOOH). Our experiments showed that Fe oxyhydroxides crystallize readily under acidic conditions in the presence of Al ions and the data also indicated that the Cl was essential for the crystallization of akaganeite, whereas goethite was formed in those systems when Cl was absent.

Key Words: Akaganeite • Aluminum • Hydroxy-aluminum ions • Iron hydrolysis • Transmission electron microscopy • X-ray diffraction

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