Role of Tartaric Acid in the Inhibition of the Formation of Al_{13} Tridecamer Using Sulfate Precipitation

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Abstract: Polynuclear Al_{13} tridecamer species are the major hydrolyzed species of aluminum, but their occurrence in terrestrial environments has not been established. X-ray diffraction (XRD), ^{27}Al nuclear magnetic resonance (NMR), and scanning electron microscope (SEM) analyses show that the presence of tartaric acid (concentration range of $10^{-5} - 10^{-3}$ M), one of the commonly occurring low-molecular-weight organic acids, inhibits the formation of the Al_{13} tridecamer species.

In the absence of tartaric acid, the basic aluminum sulfate crystals were of tetrahedral morphology and conformed to isometric symmetry with a = 17.748 Å and space group of $P4_232$. Increasing amounts of tartaric acid [tartaric acid/Al molar ratio (R) ranging from 0.01 to 0.05] modified the crystal morphology from the tetrahedral particles of isometric symmetry (R = 0) to rod-shaped particles of monoclinic symmetry (R = 0.01) to irregularly shaped X-ray noncrystalline microparticles (R = 0.05). Failure to detect the presence of Al_{13} tridecamer, the dominant hydrolyzed species of aluminum, in terrestrial environments may be partially attributed to the presence of low-molecular-weight organic acids, which inhibit the formation of Al_{13} tridecamer species.

Key Words: Al-Hydroxy Sulfates • Al_{13} Tridecamer • Powder XRD Data • SEM • Solid-State NMR • Tartaric Acid

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