ADLERSHOFER KOLLOQUIUM Analytik

Topic: Understanding and Predicting the Environmental Dispersion of Iron Oxide Nanoparticles: A Comprehensive Study on Synthesis, Characterization, and Modeling

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Summary: Iron Oxide Nanoparticles (IONPs) are highly versatile and widely used nanomaterials due to their distinctive properties. Despite their utility, the environmental distribution of these nanoparticles poses a pressing concern, presenting a challenge in comprehending the generation of reactive oxygen species (ROS) and their unpredictable impact on both micro and macro fauna/flora due to their chemical composition. This study outlines strategies for assessing the dispersion of IONPs in environmental media, employing controlled parameters such as pH, hardness, temperature, and exposure time within aquatic systems. Iron-based nanoparticles – hematite, goethite, and magnetite – were synthesized and characterized using chemical and morphological analytical techniques to facilitate this investigation. Exploring the influence of environmental parameters on total iron dispersion, a model was developed through a central composite rotatable design (CCRD). The synthesized IONPs, all below 100 nm in size, exhibited distinct morphologies, with nano-hematites and magnetites presenting spherical structures, while goethite manifested as nanorods. The predictive capability of the CCRD models, encompassing linear, quadratic, and combinatorial effects, demonstrated impressive accuracy: 76.4%, 93.6%, and 99.9% for nano-hematite, goethite, and magnetite, respectively. These findings reinforce our comprehension of iron-based nanoparticle behavior, emphasizing the interplay between environmental parameters and suspension stability. In the event of unforeseen contamination, the developed models emerge as valuable predictive tools, offering insights to evaluate the potential impact of IONPs in aquatic systems. This research enhances our understanding of nanoparticle dynamics and provides a proactive approach to safeguarding aquatic ecosystems from unexpected challenges.