Chelator Compatibility with UV Disinfection for CEA

Chemical chelators are commonly used to stabilize metal ions in nutrient formulas that would otherwise be susceptible to precipitation due to environmental oxidation or chemical interaction. These chelators are highly variable in their type and structure, but all serve the purpose of guarding metal ions by forming complex ligand bonds that essentially engulf the ion. Examples include EDTA, EDDHA, DPTA, etc. (See Figure 1). Economic, logistic, and environmental drivers are promoting controlled environment agriculture cultivators to explore irrigation water reuse applications and associated water treatment and disinfection processes.

Ultraviolet reactors are a commonly used disinfection process in which water is exposed to UVc radiation. UVc light is the germicidal range of UV radiation spanning 100-280nm wavelengths, typically peaking around 254nm, and it disrupts microbial replication leading to cellular death. UVc radiation is non-specific in terms of the target molecules it interacts with and many organic hydrocarbons are susceptible to absorption and interaction with the 254nm photons. Organic compounds, including most chelators, tend to absorb UVc radiation and can be altered, or in extreme cases, broken down to the extent that they are no longer able to support their associated metal ion. In these cases, disassociated metal ions may precipitate and fall out of solution in the form of staining or solids deposition, greatly reducing their rate of bioavailability.

For the most part, interaction between organic chelators and UVc radiation is unavoidable and, in some cases, this limits the usefulness of UV disinfection in certain applications. Some chelators are better than others at maintaining stability when exposed to UVc. Amino acid complexes, soy-based hydroxylates and iron-sulfate complexes such as lignosulfonates have been shown to maintain functionality under UVc exposure.

Other studies have shown isomers of EDDHA as effective in maintaining the bioavailability of iron following exposure to UVc radiation. Specific factors related to water quality goals, preferred nutrient formulations and hydraulic infrastructure all play a role in selecting the most appropriate chelator type, application, and concentration.

Contact Silver Bullet Water Treatment for more information.

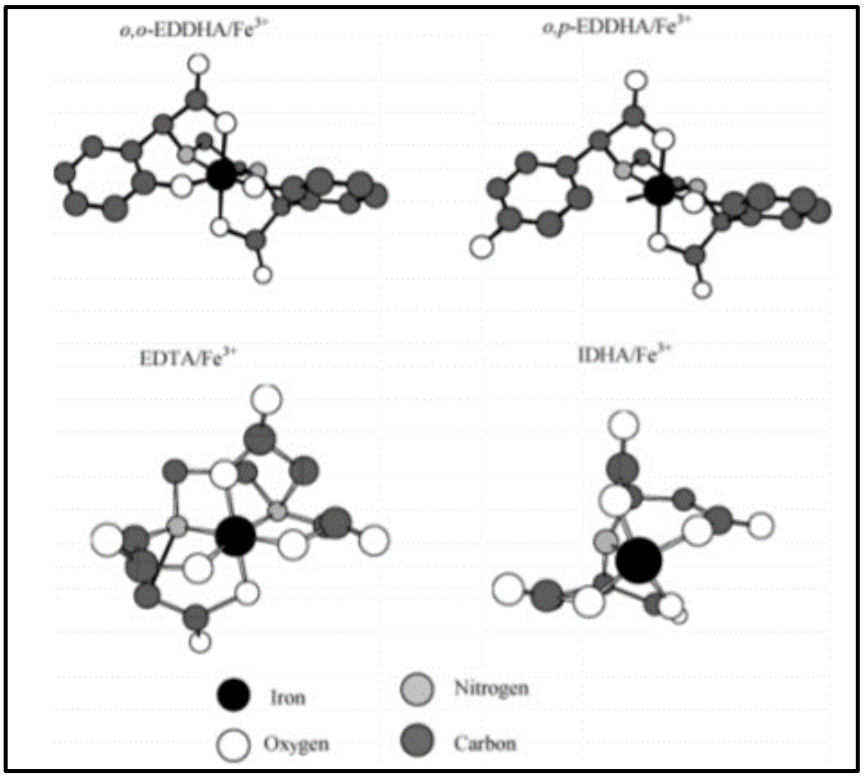

Figure 1: Ball and stick model of several common iron chelators.

Credit: https://scienceinhydroponics.com/2019/08/using-a-biodegradable-iron-chelate-idha-in-hydroponics.html

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