Performance of a biomineralization-associated peptide in struvite scale inhibition

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Struvite crystals tend to form hard scale on process equipment surfaces of wastewater treatment plants, such as sludge liquors pipes, pumps, centrifuges and aerators, leading to clogging and breakdowns of these equipment. To control the struvite scale, researchers have made many efforts to search for effective chemical inhibitors, but an efficient and environmentally-friendly inhibitor is still lacked so far. Meanwhile, it is found that several urinary proteins enriched in aspartic acid residues are intimately involved in the pathological biomineralization processes of urinary stones and inhibit the crystal growth of urinary stones including struvite stone. Therefore, the synthetic peptide polyaspartic acid (PASP), which is a structural and functional analogue of aspartic acid residues in urinary proteins, can potentially be used to control struvite scale. In the present study, we investigate the inhibitory capacity of PASP to struvite in a dynamic environment. The experimental results show that PASP is effective in growth inhibition of struvite and its inhibitory capacity is proportional to its concentration. The effect of several key parameters, including pH, mixing energy, reaction time, and calcium ions on PASP inhibition performance was examined for practical application. The results show that the inhibitory capacity of PASP is sustainable and efficient. Dissolution experiments show that PASP can promote the dissolution of preformed struvite and its effectiveness increases with concentration. As PASP is nontoxic, biocompatible, and highly biodegradable, it can potentially act as a feasible and environmentally-friendly inhibitor and cleaning agent for struvite scale.

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