Lanthanum modified bentonite as a ballast to sink Microcystis cyanobacteria and inactivate phosphorus in eutrophic lake water

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Objectives

High-frequency algal blooms in Taihu Lake(East China) poses significant challenges to water resource management in basin. Coagulation-based water processes have demonstrated great potential as in-lake measures to mitigate eutrophication and control algal blooms. However, the classical colloidal models and flocculation theories are not suitable for Microcystis Aeruginosa-dominated algae suspension. Therefore, the combination of a coagulant with a ballast to precipitate cyanobacteria from the water column was a new technology for surface scum blooms management in eutrophic lakes, which was known as “flock and sink”.

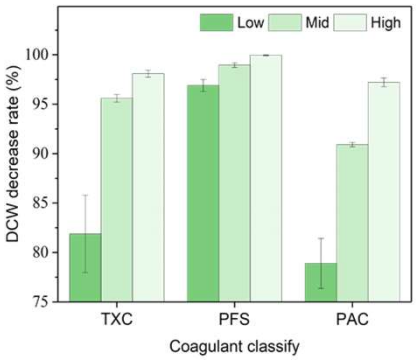

Figure 1 The variation of surface cyanobacteria biomass under different coagulants within 7 d

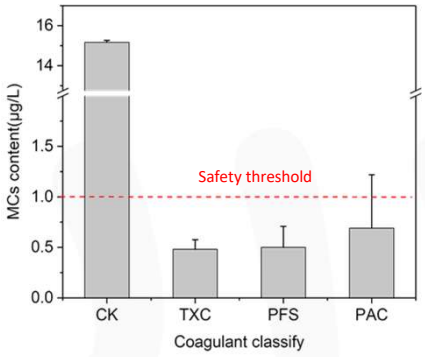

Figure 2 Release and Degradation of Algae Toxin under Different Coagulants within 7 d

Methods

We combined different coagulants (TXC,PFS,PAC) with lanthanum modified bentonite (LMB) that used to reduce algal biomass and remove phosphorus from water within 7 d. Algal water during the Taihu Lake was collected to simulate the effects of TXC, PFS, PAC alone and in combination with LMB on the Microcystis blooms. The efficiency of flock and sink technique was evaluated based on algae biomass, soluble reactive phosphorus (SRP), algae cell structure and morphology and algae toxin (MC-RR, MC-LR) release.

Conclusions

The combination of LMB and coagulant could achieve rapid sedimentation of M.Aeruginosa aggregation floc, and the surface algae biomass decreased with the increase of coagulant addition. The “flock and sink” technology of TXC in combination with LMB is more suitable for the treatment of water bloom outbreaks dominated by M.Aeruginosa, and this technology has a greater application prospect for lake ecological restoration in the Taihu Lake basin.

Results

At low addition levels, PFS can achieve significantly better removal effects on surface cyanobacteria than PAC and TXC(96.90%,78.89%,81.87%), while at high addition levels, both coagulants can achieve excellent removal effects on surface cyanobacteria(99.95%,97.22%,98.09%). Meanwhile, SRP in the water body was adsorbed by LMB, but the effect of SRP removal in the PAC treatment group was slightly lower than TXC and PFS, the SRP content decreased to 0.039 mg/L 0.019 mg/L and 0.018 mg/L respectively. And the high addition of PAC and PFS would lead to a increase of MC-RR content in the water body, which had high water ecological Risky.

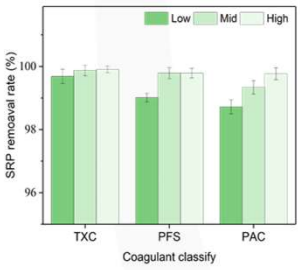

Figure 3 The variation of surface water SRP under different coagulants within 7 d

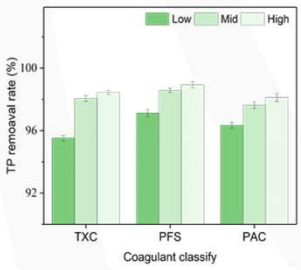

Figure 4 The variation of surface water TP under different coagulants within 7 d