Removal of Algae from Impacted Water by Cell Rupture and Sand Filtration

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Seasonal harmful algal blooms (HAB) periodically disrupt water supplies for desalination processes across the globe, significantly impacting water quality and increasing operation and maintenance costs for consumers. Pretreatment of HAB-impacted waters must prevent disruption of membrane processes due to algae and their toxins from reaching the public. This study uses microbubbles of ozone and a novel Serial Venturi Reactor (SVR) to rupture algal cells to be followed by sand filtration for the purpose of pretreating water supply during HAB. An objective is to determine how microbubble ozonation and subsequent cell lysis impact the efficacy of sand filtration to remove algal cells (measured as TOC) and toxins (measured using a microcystin ELISA test). Our pilot treatment system creates ozone on-site with an ozone generator and an oxygen concentrator, which is injected into the algae-impacted water in the form of microbubbles using a microbubble generator. The water is continuously recirculated between the holding tank and the SVR, enhancing contact between ozone microbubbles and algal cells in the suspension. Concurrently, the water in the holding tank is recirculated to and from a sand filter during treatment. Parameters including turbidity, pH, TSS, and TOC of the water are monitored at frequent intervals throughout treatment. On-going results show turbidity, TSS, and TOC removals by 83%, 88%, and 40% after 60 min. Ozonation rupture increases turbidity and TSS removal over sand filtration alone by a factor of two, and it increases TOC removal by a factor of three. This is attributed to the release of cellular materials that coalesce and become amenable to filtration. Technology effectiveness along with effects in mitigating cyanotoxins are currently being evaluated, with data forthcoming. The cell disruption/sand filtration technique has the potential to provide an economical means of removal of cyanobacteria and toxins from water supplies during HAB events.

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