*for*Water Research Snapshot

TO: *for*Water Members

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SUBJECT: **Coagulant addition for managing sediment-associated phosphorus bioavailability to prevent cyanobacterial blooms in drinking water reservoirs**

Research Summary

Algae, especially cyanobacteria, blooms are one of the biggest threats to water quality and the provision of safe drinking water globally. Phosphorus (P), the limiting nutrient for primary productivity in freshwater, is transported by fine sediment, thus fine sediment management is a potential climate change adaptation strategy. Drinking water reservoirs are not typically designed to manage internal loading of P from fine sediment; while this has been well studied in lakes, investigations of management strategies such as coagulant addition to prevent P release from bottom sediments (i.e., P inactivation) to mitigate the proliferation of cyanobacteria in raw water storage reservoirs are scant.

This study was conducted to:

(i) describe P release from fine sediment in a raw water reservoir,

(ii) characterize its availability for biological uptake,

(iii) evaluate P inactivation by application of common coagulants ($FeCl_3$, Alum, PACl), and

(iv) evaluate the combination of strategically-timed reservoir dredging and coagulant application on P inactivation and turbidity reduction.

Results

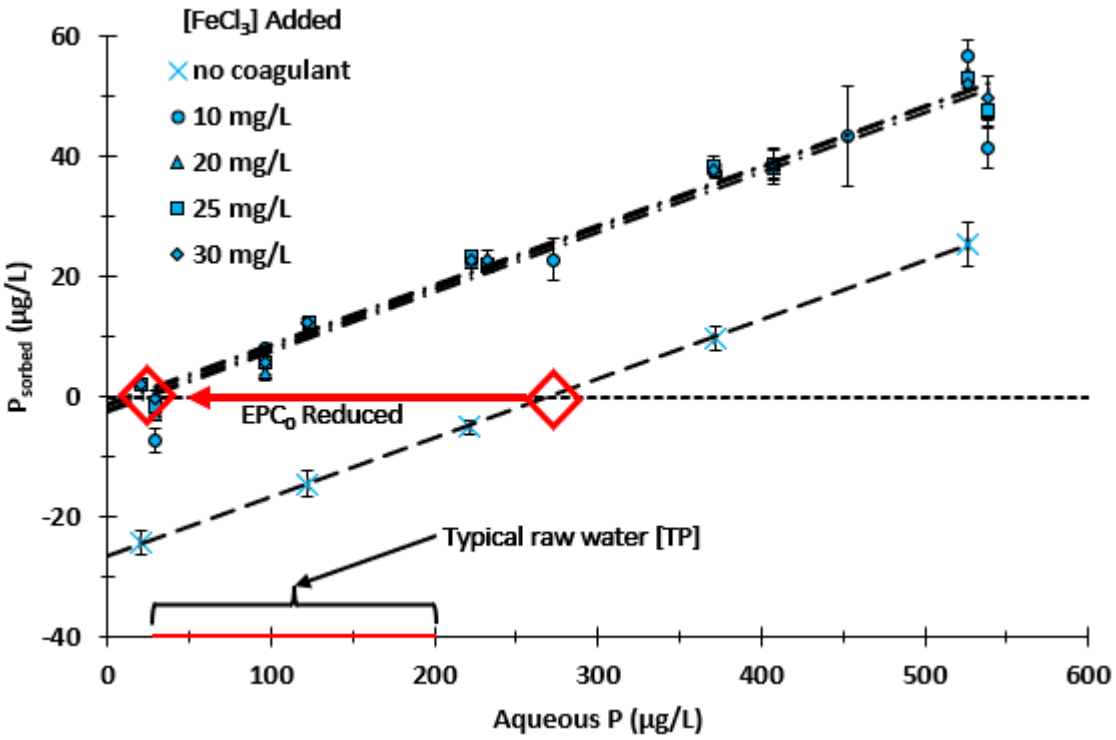
- Small amounts of fine sediment deposited in the reservoir can release significant amounts of PO_4 (i.e., phosphate) to the water column, as would be expected.
- Application of relatively low doses of common chemical coagulants, especially $FeCl_3$, effectively inactivated P to below target thresholds in the presence of fine sediment.
- The combination of reservoir dredging and coagulant application not only inactivated P, but also eliminated the potential for its re-release to the reservoir water column.
- Seasonal coagulant application coupled with strategically-timed dredging may be an effective P inactivation approach for risk management and climate change adaptation, especially for systems that use offline raw water storage reservoirs.

Key Messages

- Systems that treat high quality source water originating in forested landscapes are at most risk in the event of a natural disturbance such as wildfire. With the rapid deterioration of source water quality, utilities can use strategically-timed reservoir dredging and seasonal dosing of common chemical coagulants for P inactivation.

- Chemical coagulant dosing to reservoirs can also be effective in absence of regular dredging. In built reservoirs sludge accumulation requires consideration. In natural reservoirs, ecosystem impacts must be considered. Occasional chemical coagulant dosing to reservoirs that cannot be regularly dredged (e.g., natural reservoirs) is practiced in systems such as New York City's; however, it is practiced for turbidity reduction. The longevity of concurrent impacts of the occasional coagulant addition events on P inactivation has not been evaluated.
- Despite reductions in upstream external loading, water utilities must still account for the fine sediment and internal loading potential within source water reservoirs. Utilities can directly manage the risk of cyanobacteria proliferation by treating reservoirs with coagulant.
- For utilities yet to be impacted by cyanobacterial blooms, paying particular attention to elevated total P levels (near or above 30 µg L^{-1}), elevated total particulate P concentrations, and large concentrations of fine-grained sediment (< 64 µm) as precursors to cyanobacterial blooms.

Figure 1



P sorption to the reservoir water column from sediment, inactivated with a range of coagulant doses of $FeCl_3$ (mean ± 1 SD, n=3 at each aqueous phase concentration). Lower EPC0 values indicate that less P will be released from the sediment to the water column.

Contact Information

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