Electronic Supplementary Information (ESI)

Purification and removal of the low molecular weight fraction of PolyDADMAC reduces N-nitrosodimethylamine formation during water treatment

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Figure S1 demonstrates that the polymer choice affects NDMA formation with c308 forming less NDMA in jar tests. Figure S1 also shows that bromide (in this range) does not substantially affect NDMA formation.

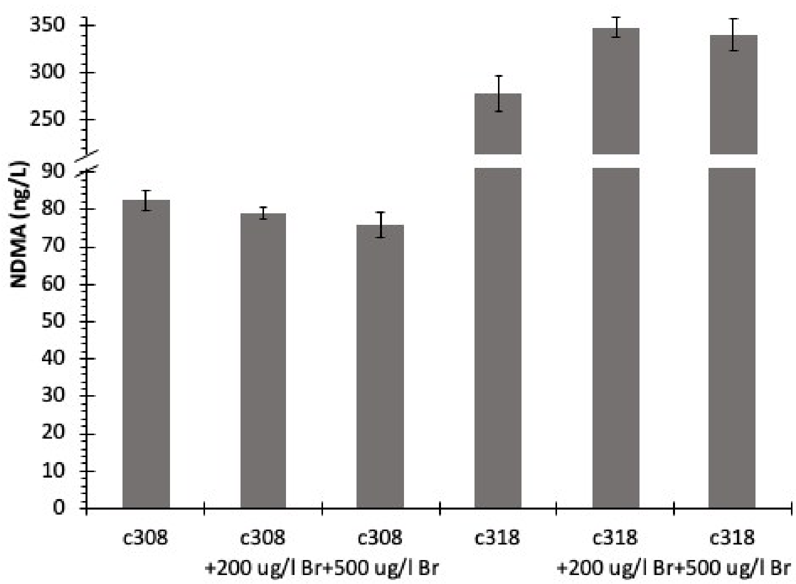

Figure S1 NDMA formed in Central Arizona Project water with addition of polyDADMAC (c308 or c318; 2 mg/L) and bromide (0, 200, 500 μgBr^-/L) after (jar tests) coagulation, flocculation, sedimentation, filtration, and chloramination with 18 mgCl_2/L.

Figure S2 demonstrates the NDMA formation potential of polyamines is significantly higher (5-7x) than polyDADMAC. Additionally, Figure S2 demonstrates that removing the low molecular weight fraction (<10 kDa) of polyamines (UF-Polyamine 2) lowers reactivity (48%) significantly. This reduction in NDMA formation is consistent with other studies in the literature.[10] These findings further emphasize that the low molecular weight constituents (e.g., <10 kDa) of cationic polymer coagulant aids significantly contribute to NDMA formation.

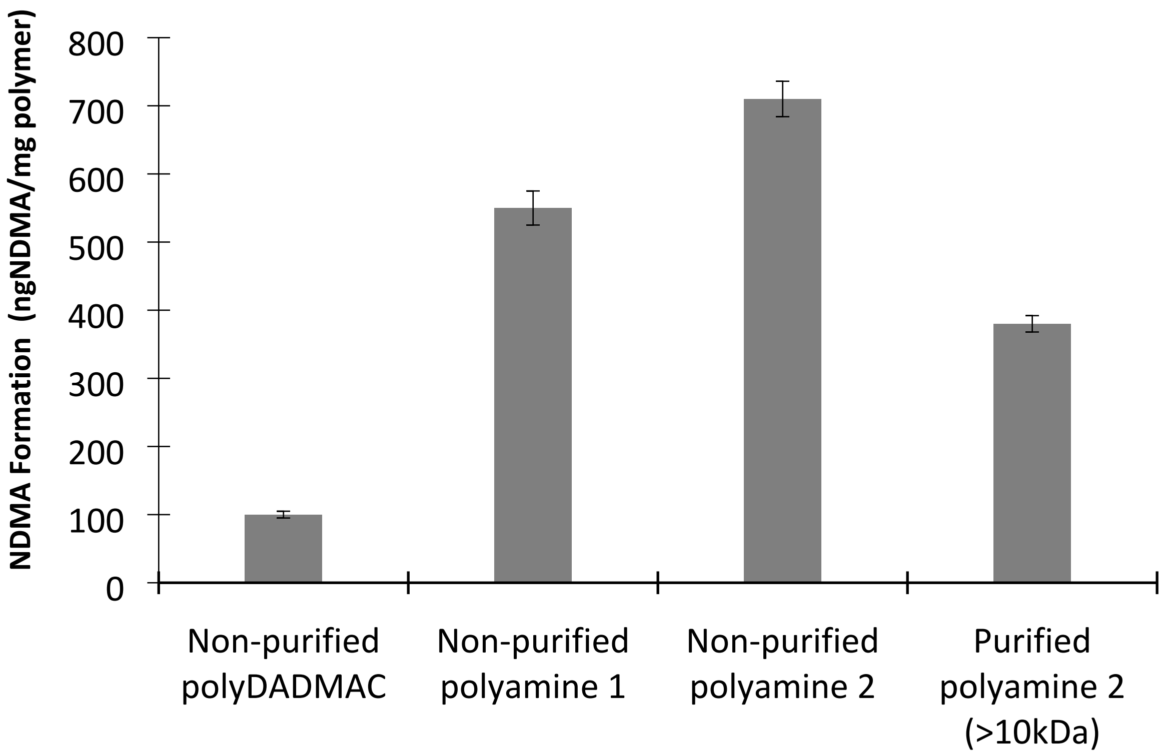

Figure S2 Reactivity of non-purified C308 polyDADMAC, two non-purified polyamine formulations, and diaultrafiltration purified polyamine formulation 2 (>10 kDa) purified (dead-end ultrafiltration).

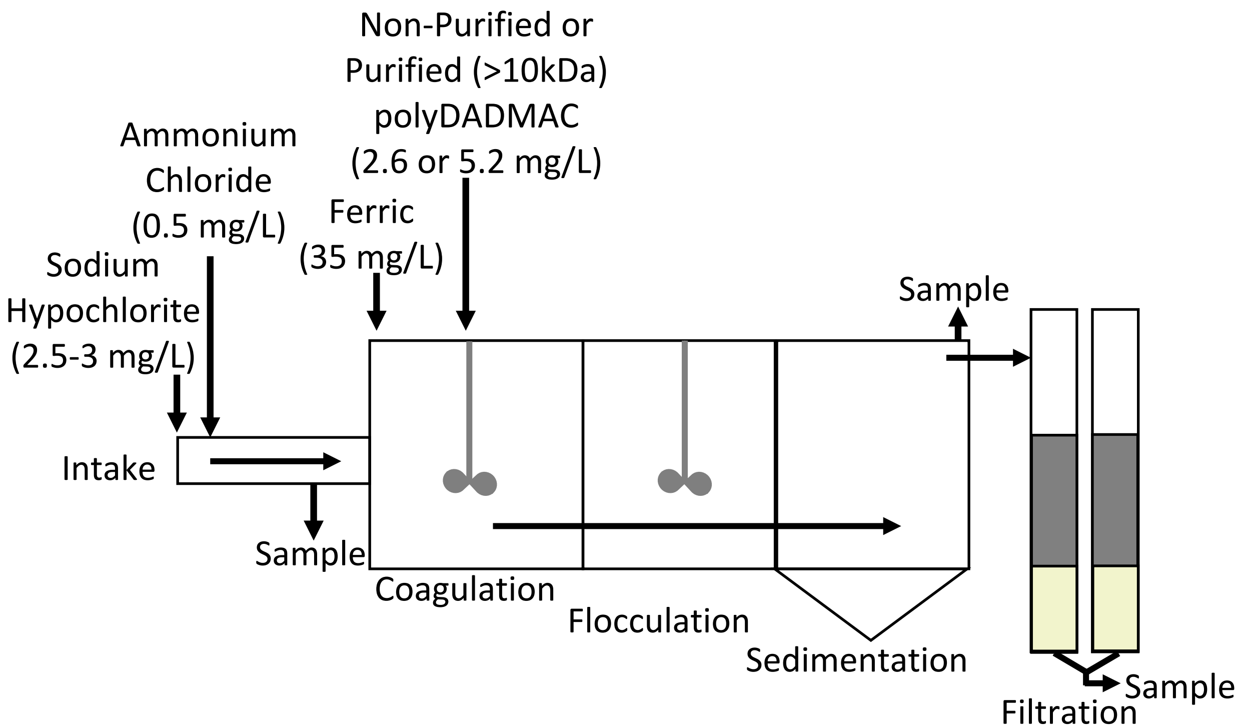

Figure S3 Pilot treatment train showing polymer and other chemical addition locations.

Complete details are available in a Water Research Foundation Report [1].

Figure S4 demonstrates that polyDADMAC aids in turbidity removal, and purification (removal of <10 kDa) does not affect efficacy of polyDADMAC.

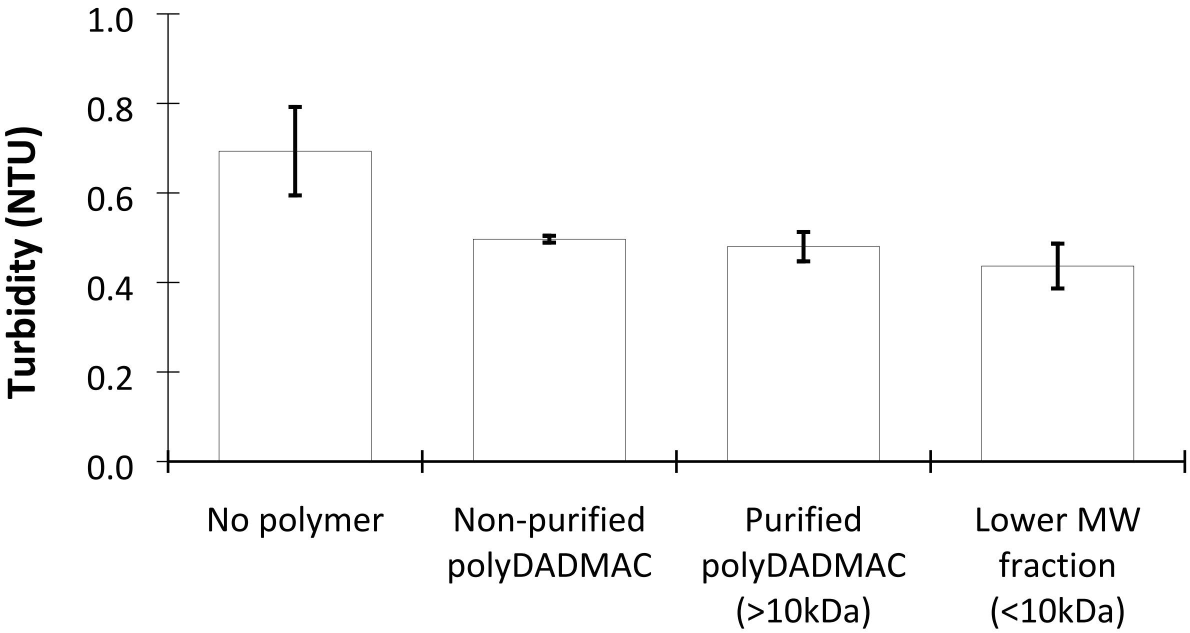

Figure S4 Turbidity of water after coagulation, flocculation, and sedimentation using non-purified C308 polyDADMAC, purified polyDADMAC, the lower molecular weight fraction (<10 kDa) polyDADMAC, and with no polymer. Jar tests were performed with Central Arizona Project water (surface water with low NDMA formation) with alum (20 mg/L) as the coagulant in all jars and treated/non-treated polymers as the coagulant aids at doses equivalent to 2 mg/L active polymer concentration based on DOC.

Figure S5 further demonstrates that under realistic operational conditions and natural water (in pilot tests), the removal of lower molecular weight constituents (<10 kDa) does not decrease the ability of polyDADMAC to remove DOC and potentially improves filtration efficacy.

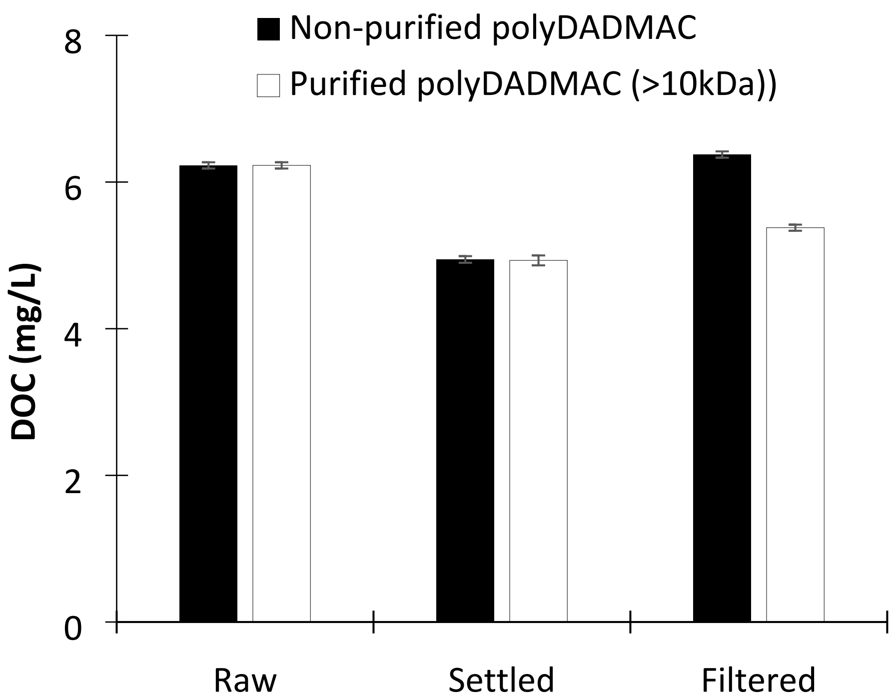

Figure S5 DOC in water throughout the pilot treatment train when non-purified polyDADMAC is added versus diaultrafiltration purified polyDADMAC (>10kDa).

References

1. Westerhoff, P.; herckes, P.; Fischer, N.; Donovan, S.; Atkinson, A.; Corwell, D.; Brown, R.; Croue, J.-P.; Linge, K. L.; Liew, D.; Lowe, A. *Understanding the source and fate of polymer-derived nitrosamine precursors*; Project No. 4622; Water Research Foundation: Denver, CO, 2019; p 174.