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Abstract Title: N-Nitrosodimethylamine Formation and Mitigation in Potable Reuse Treatment Trains Employing Ozone and Biofiltration

Abstract: Potable water reuse has been increasing throughout the world as a strategy to augment drinking water supplies. To ensure public health protection against pathogens and contaminants of emerging concern, potable reuse systems generally employ conventional disinfection and/or advanced oxidations processes. In particular, the use of ozonation has increased considerably in recent years to facilitate compliance with potable reuse guidelines and regulations. However, ozone can react with inorganic and organic disinfection byproduct (DBP) precursors present in the wastewater, thereby leading to the formation of unregulated and regulated DBPs. One critical DBP is N-nitrosodimethylamine (NDMA), which is a probable human carcinogen included on the U.S. EPA's Contaminant Candidate List. NDMA is not yet regulated at the federal level, but several states have implemented state notification levels at the low ng/L level (e.g., 10 ng/L in California). In potable reuse systems employing ozone-biofiltration, NDMA may form during ozonation, but the biofiltration process is expected to achieve some degree of attenuation, although the required operational conditions are not yet known. The combination of ozone and biofiltration also allows for the removal of bulk organic matter and other trace organics in a more cost effective manner than when using full advanced treatment consisting of reverse osmosis and an advanced oxidation process. In this study, a pilot-scale ozone-biofiltration system was operated at a water reclamation facility to identify the most important operational conditions impacting NDMA removal [e.g., ozone dose, assimilable organic carbon (AOC), dissolved oxygen (DO), and empty bed contact time (EBCT)]. Columns containing biological activated carbon (BAC) or anthracite were fed with ozonated membrane bioreactor (MBR) filtrate, and a separate control BAC column was fed with non-ozonated MBR filtrate. Results showed greater NDMA removal by the ozonated columns (>90%) compared to the control column (<50%), and higher AOC levels seemed to be more relevant to biodegradation than DO alone. It is hypothesized that ozonation also caused changes in microbial community structure and selected for taxa that were better adapted to NDMA biodegradation. This research leaves room for further investigation of specific NDMA-degrading taxa and optimization of biofiltration in water reuse applications.