A Novel Quantification Method for N-Nitrosodimethylamine for Laboratory-Scale Research Applications

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Background/Objectives. N-Nitrosodimethylamine (NDMA) is a probable human carcinogen contaminating groundwater and drinking water. Some states in the US limit the concentration of NDMA in water to the low part per trillion (ng/L) range. Analytical techniques to quantify NDMA typically start with large samples (1 L) and concentrate the NDMA, either by liquid/liquid extraction or solid phase extraction, and then analyze the concentrate via methods such as gas chromatography mass spectroscopy (GC/MS). This analytical method severely limits researchers' ability to conduct laboratory-scale experiments at treatment-relevant concentrations with the necessary replications for statistical analysis.

Approach/Activities. A new quantification method applicable for laboratory testing has been developed using ^{14}C-labeled NDMA and liquid scintillation counting (LSC). LSC enables the use of 10 mL samples to measure activities corresponding to single-digit ng/L concentrations. The activity to NDMA mass ratio for application of LSC was calibrated using 1 L samples and high resolution GC/MS that can individually quantify unsubstituted and substituted NDMA.

Results/Lessons Learned. Use of the ^{14}C-NDMA LSC method has reduced the experiment container size for adsorption equilibrium studies from 1 L (without replicates) to 50 mL container, enabling 4 replicates for each measurement to reduce analytical uncertainty. The ability to analyze dozens of samples per day on-site compared to sending a few samples to an external lab once a week has greatly increased sample throughput. Overall, the enhanced quantification capability at treatment-relevant concentrations will enable lab-scale equilibrium, kinetic and column adsorption studies to screen new adsorption materials.