

Development of Traceable Precision Dynamic Dilution Method to Generate Dimethyl Sulphide Gas Mixtures at Sub-nmol/mol for Ambient Measurement

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Dimethyl sulphide (DMS) is an important compound in global atmospheric chemistry and climate change. Traceable international standards are essential for measuring accurately the long-term global trend in ambient DMS. However, developing accurate gas standards for sub-nanomole per mole (nmol/mol) mole fractions of DMS in a cylinder is challenging, because DMS is reactive and unstable. In this study, a dynamic dilution method that is traceable and precise was developed to generate sub-nmol/mol DMS gas mixtures with a dynamic dilution system based on sonic nozzles and a long-term (> 5 years) stable 10 $\mu\text{mol/mol}$ parent DMS primary standard gas mixtures (PSMs). The dynamic dilution system was calibrated with traceable methane PSMs, and its estimated dilution factors were used to calculate the mole fractions of the dynamically generated DMS gas mixtures. A dynamically generated DMS gas mixture and a 6 nmol/mol DMS PSM were analysed against each other by gas chromatography with flame-ionisation detection (GC/FID) to evaluate the dilution system. The mole fractions of the dynamically generated DMS gas mixture determined against a DMS PSM and calculated with the dilution factor agreed within 1% at 6 nmol/mol. In addition, the dynamically generated DMS gas mixtures at various mole fractions between 0.4 and 11.7 nmol/mol were analysed by GC/FID and evaluated for their linearity. The analytically determined mole fractions showed good linearity with the mole fractions calculated with the dilution factors. Results showed that the dynamic dilution method generates DMS gas mixtures ranging between 0.4 nmol/mol and 12 nmol/mol with relative expanded uncertainties of less than 2%. Therefore, the newly developed dynamic dilution method is a promising reference method for generating sub-nmol/mol DMS gas standards for accurate ambient measurements.

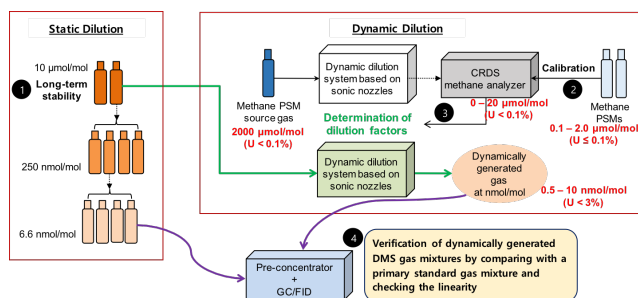


Figure 1. An overview of the research scheme.

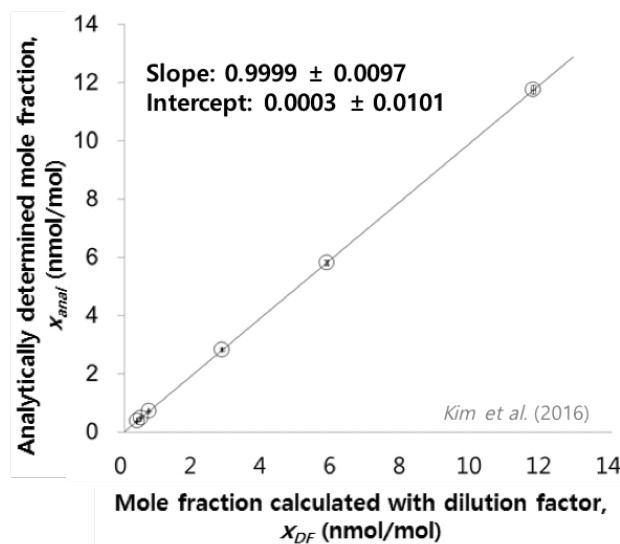


Figure 2. Mole fractions (amount-of-substance fraction) calculated by dilution factors vs. analytically determined mole fractions.