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ABSTRACT BOOK

INFORMATION

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The Forum on Microcolumn Separations

DEVELOPMENT AND CHARACTERIZATION OF A TOLUENE PERMEATION TUBE IN A DYNAMIC GAS GENERATION SYSTEM FOR CALIBRATION OF AN ONLINE GAS CHROMATOGRAPHY AT PPB LEVEL

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BTEX (benzene, toluene, ethylbenzene, and m-, o-, and p-xylene) compounds are major markers of urban air pollution due to their involvement in ozone and secondary organic aerosol formation [1]. In indoor environments, toluene can be considered a target among volatile organic compounds and BTEX compounds (e.g., newly-built or painted spaces, solvent use, petrol stations, etc.) [2]. Annual average ambient toluene concentrations can range from 0.01 to 4.39 parts per billion (ppb), whereas the concentrations are generally higher indoors (few to tens of ppb) [3].

To ensure quantification of trace toluene, reliable and well-characterized calibration sources are required. Calibration quality primarily influences the accuracy of the quantification by any analytical method. However, gaseous toluene in conventional pressurized cylinders may suffer from instability, wall effects, and degradation at trace concentrations. This limitation can be addressed by the development of a dynamic gas-generation device based on continuous and diluted emissions from a custom-built radial toluene permeation tube (PT).

The PT was integrated into a permeation oven with precise temperature control. The generation device was coupled with a transportable gas chromatograph equipped with a preconcentrator (TD-GC-FID) for the detection and quantification of gaseous toluene concentrations and emission rate (ER). The stability of the ER for toluene was assessed and was equal to 90.64±3.69 ng min^{-1} at 40°C. The ER was linearly correlated to the oven temperature between 40-70 °C ($R^2 > 0.99$), following both Arrhenius and Fickian-Antoine models for concentration range extrapolation [4]. Toluene concentrations in the range of tens to hundreds of ppb can be generated by the PT within the same temperature range and 62.3-1062.3 mL min^{-1} flow rate range of pure zero-air. To further extend permeation applications, other compounds that may not be available in gas cylinders could also be housed in PTs, increasing utility in field and industrial applications.

References

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