

Collection and Recovery Efficiency for VOCs: Evaluation of the LESS[™] Sampler

Background

Challenge samples were collected with the LESS[™] air sampler and a traditional air sampling pump on thermal desorption tubes to assess the collection and recovery efficiency for 109 target analytes with a volatility range from n-C₂ to n-C₁₂. Markes C2-AAXX-5270 stainless steel thermal desorption tubes containing two sorbent beds (Carbograph 1TD – a graphitized carbon black sorbent and Carboxen 1003 – a very strong molecular sieve) were used to collect the analytes of interest under controlled laboratory conditions to determine the overall true-positive detection rate.



Testing

All 109 target analytes were introduced to the LESS[™] air sampler and the traditional air sampling pump from two individual non-humidified SUMMA[®] canisters at nominal concentrations of 5 ppb-v and 1 ppb-v. Both SUMMA[®] canisters were prepared by dynamically diluting a certified gas standard to the desired concentration, with confirmatory analysis, at a NELAC accredited third-party lab. Safe sampling volumes were employed to capture the analytes of interest above the analytical detection and reporting limit and within recommended breakthrough volumes for all collected samples.

Challenge samples for the LESS[™] air sampler and the traditional air sampling pump were collected for 45 minutes at a flow rate of 50 mL/min for individual samples, blank samples and conventional duplicates and at flow rates of 50 mL/min and 200 mL/min for distributive volume pair samples as specified in U.S. EPA's Compendium Method for the Determination of Toxic Organic Compounds in Ambient Air (Method TO-17).

Collections for LESS[™] were varied across the 28 available positions to determine accuracy, precision and false-negative rates. Additionally, blank samples were taken to assess the cleanliness of the system and false-positive rates. For each LESS[™] collection, the automated system controlled and recorded the duration and flow rates for each sampling event. For the traditional air sampling pump, collections were randomized in the testing scenario, the manual collection device allowing only a single collection at a time by the user.

Analytical

Samples were quantified as mass on tube for 54 of the 109 target analytes at a second NELAC accredited third-party analytical lab using gas chromatography-mass spectrometry (GC/MS) analysis per Method TO-17, with the remaining 55 analytes semi-quantitatively reported as tentatively identified compounds (TICs). Standard quality assurance and quality controls were implemented during the analysis of the samples per the TO-17 method.

Results

For the 109 target analytes sampled, 103 were detected with the most volatile (acetylene, ethylene, ethane, propane), 1-butanol and methanol (analytical spiking solvent) not being recovered. Average analytical recoveries were within 70 – 180% for most analytes and exhibited similar trends for both collection systems with correlations at or above 0.90. False-negatives were observed for 3 compounds at the 1 ppb-v test concentration with low rates of occurrence. Standard deviations for both collection systems were less than 30% with the exception of 7 compounds. Blank samples reported a few false-positives for acetone, hexachlorobutadiene, 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene for each collection system, with mass levels at the analytical reporting limit. Figure 1 presents average recovery results for the LESS[™] air sampler and the traditional air sampling pump for all 54 quantified analytes at each test concentration and flow rate.

Conclusions

At both test concentrations and associated collection volumes, the LESS[™] air sampler consistently collected and recovered all target analytes at similar precision and accuracy when compared to the traditional air sampling pump. Most average recoveries were above 100%, with little variation and strong correlation between the two collection systems.

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LESS and SKC Samples

