B19 Portable Trace Vapor Sampling With Field-Capable Porous Layer Open Tubular (PLOT) -Cryoadsorption

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After attending this presentation, attendees will be able to apply a portable (briefcase-mounted) vapor sampling instrument based on PLOT-cryoadsorption to trace vapors of explosives, fuels, drugs, fuels, pollutants, and so forth.

This presentation will impact the forensic science community by enabling the use of a very rapid, yet very sensitive, dynamic trace vapor sampling method that facilitates comprehensive rapid vapor collection for qualitative identification and quantitative determinations of low uncertainty.

Building on the successful application in the laboratory of PLOT-cryoadsorption for collecting trace vapor samples, a robust portable instrument suitable for field conditions is presented.[1-4] The unit mounts in an aluminum briefcase, easily transported by vehicle or by air. The instrument functions entirely on compressed air, making it suitable for use in locations lacking electrical power, and for use in flammable and explosive environments. The three major functional aspects of the instrument will be discussed: (1) the field-capable PLOT-capillary platform; (2) the supporting equipment platform; and, (3) the interface with the necessary peripherals. The PLOT-capillary platform used in the portable unit differs from the lab unit in that it uses a high-flow multipath module that is highly robust. Vapor sampling can be conducted with either a wand-like hand piece (containing the PLOT module) for close sampling or with a special standoff module for more remote sampling. In both cases, the PLOT module can be heated and cooled to facilitate vapor collection and subsequent vapor sample removal. The interface (between the support platform and the sampling units) features a unique countercurrent approach to minimize thermal loss. Several types of PLOT-capillary elements and sampling probes are described, and applications to a variety of samples relevant to forensic analysis will be discussed.[5]

To demonstrate the capabilities of the portable unit, trace vapors were sampled from coumarin (a drug), the explosive 2,4,6-trinitrotoluene (solutes used in initial development of PLOT-cryo technology), naphthalene, aviation fuel, and diesel fuel on a variety of matrices and test beds. It was demonstrated that trace vapors from these analytes can be easily detected and reliably identified using the portable unit. By leveraging efficiency-boosting temperature control and the high-flow-rate multiple capillary wafer, very short collection times (three seconds) yielded accurate detection. For diesel fuel spiked on glass beads, a method detection limit below 1ppm was determined.

Current work in which vapor sampling inside of a large volume, closed chamber shows that quantitative performance is somewhat more uncertain than the lab version of PLOT-cryo (approximately 1%, mass/mass), but the portable unit nevertheless provides lower uncertainty than conventional purge and trap methods.

Reference(s):

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3. Bruno T.J. Field Portable Low Temperature Porous Layer Open Tubular Cryoadsorption Headspace Sampling and Analysis Part I: Instrumentation. *J. Chromatogr.* A, 2016. 1429: p. 63 – 71.
4. Bruno T.J. *Sampling system and process for sampling.* Patent Applied For, Patent Application No 15-014,0673. 2015, Secretary, United States Department of Commerce.
5. Harries M.E., Bukovsky-Reyes S., Bruno T.J. Field portable low temperature porous layer open tubular cryoadsorption headspace sampling and analysis Part II: applications. *J. Chromatog.* A, 2016. 1429: p. 72 – 78.

Headspace Analysis, PLOT-Cryoadsorption, Trace Vapor Sampling