A145 Evaluation of Fast Gas Chromatography Coupled With Hydrogen Mobile Phases in Drug Identification

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The goal of this presentation is to disseminate an assessment of both fast gas chromatography technology and the use of hydrogen as a replacement for helium mobile phase in drug identification.

This presentation will impact the forensic science community by presenting research which demonstrates a significant impact on the analysis time in drug identification. Fast gas chromatography significantly shortens the retention time of individual species and the replacement of helium mobile phase with hydrogen gas more than recoups lost resolution from the shorter columns while saving laboratories supply money.

The objective of this project is designed to assist crime laboratories' assessment of new separation techniques and gauge the feasibility of implementation. The first objective of this project is an assessment of the expected gain in resolution and sample throughput for a drug identification unit using a combination of Fast GC and hydrogen carrier gases. This area of application is prime ground for realizing the full potential of Fast GC – H_2. In 2008, a joint project funded by the Midwest Forensics Resource Center between the University of Wisconsin – Platteville (UWP) and the Wisconsin State Crime Laboratory – Madison demonstrated incredible reductions of over 50% in retention times of ignitable liquids from arson debris using the Fast GC. This study also found that the use of hydrogen as a carrier gas more than compensated for resolution losses related to Fast GC. In fact, the more compressible hydrogen carrier produced improvements in resolution for the Fast GC analysis compared to a conventional GC technique using helium carrier gas ($p < 0.01$). Fast GC-H_2 separation of drug identification samples could potentially decrease retention times of straightforward matrices to several tens to a few hundred seconds. This presentation addresses the limiting factors of this technique including the scanning rate of the quadrupole mass spectrometer and effects on detection limits of illicit drugs.

Experimental design involves the Fast GC and conventional analysis of one dozen Scheduled compounds including cocaine, tetrahydrocannabinol (THC), heroin, 3,4-Methylenedioxymethamphetamine (MDMA), trifluoromethylphenylpiperazine (TFMPP), lysergic acid diethylamide (LSD), buprenorphine, synthetic cannabinoids, alprazolam, clonazepam, boldenone, and nandrolone. The figures of merit selected for ANOVA ($p < 0.05$) comparisons center on retention times and chromatographic resolution of a master standard containing these twelve compounds. Given that many laboratories may hesitate to modify existing units for Fast GC, the first assessment examines the benefit in simply switching to the less expensive hydrogen mobile phases from the helium mobile phase. The control in this experiment is the conventional GC operating with a standard DB-5, 30 m column and helium mobile phase. The hydrogen is employed instead, and a data set is generated with resolutions compared to the helium gas. Subsequently, the heating ramp of the conventional GC is increased without altering other variables to assess just how aggressive of a heating ramp can be used to reproducibly equal the conventional use of helium. The second set of experiments uses solely helium while comparing Fast GC and conventional GC in the event that a laboratory is not ready or able to convert to hydrogen carrier but is interested in the Fast GC gains. In this particular case, the data demonstrate the resolution decrease for cost: benefit analysis. Finally, the two variables (Fast GC and hydrogen mobile phase) are combined to assess the maximum benefit.

Fast GC, Drug, Identification

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