K29 Development of a New Gas Chromatographic Column Set for the Analysis of Blood Alcohol Concentration

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After attending this presentation, attendees will understand the importance of GC column chemistry in the resulting separation, and how this may be optimized.

The presentation will impact the forensic science community by making attendees aware of improved methodology available for BAC analysis.

Blood alcohol concentration (BAC) analysis may be the most common analytical test performed by laboratories involved in forensic and medical testing. This analysis typically uses static headspace sampling, followed by dual-column gas chromatography (GC) separation followed by flame ionization detection (FID). Chromatographic separation of the target analytes, as well as the possible interfering compounds, is critical for this analysis, especially given that the FID is not selective. Incomplete chromatographic separation will cause a quantification bias, and possibly invalidate the results of the test. This condition makes a number of demands on laboratories performing this work. Laboratories are also under time pressure, and must continually balance the need for separation with fast sample turnaround and short analysis times.

The most important chromatographic variable in this separation is the selectivity of the GC stationary phase; however, most GC column stationary phases were not designed with a particular separation in mind. This may lead to compromises in either the separation, or the analytical run-time of the analysis. By using a GC stationary phase and column dimensions which are specifically tuned for a separation will result in analytical improvements relative to the use of columns and dimensions that are not optimized.

The methodology of how this optimization is performed will be covered in this presentation. In brief, the use of thermodynamic modeling has been demonstrated as successful for both the development of new stationary phase materials and also for the optimization of GC conditions using commercial software without the need for lengthy experimental work in the laboratory. While these technologies have been proven successful, most laboratory personnel do not consider them in their method development work, and therefore most GC methods are actually operated far from optimal conditions.

This presentation will address the theory and development of two GC columns that are specifically optimized for the BAC separation using current analytical instrumentation. Through the use of thermodynamic modeling two new GC columns have been developed which allow for improved separation of the target analytes. Known interfering compounds have also been addressed in this approach, so as to maintain complete separation between the blood alcohols and possible coeluting compounds which may also be present in these samples. Finally, total analysis time has been minimized so that the complete separation occurs in less than three minutes, allowing for greater laboratory throughput as compared to most laboratories current operating conditions. Modeling accuracy will be demonstrated by comparison of theoretical results to those obtained in the laboratory. Also, comparison to existing column chemistries used for these separations will be shown to demonstrate the improvements possible using this approach.

The impact of this work to the forensic community is improvement in data quality for this very common analysis. Through the use of optimized GC column dimensions and stationary phase chemistry this analysis will have improved chromatographic resolution in shorter analysis times than what is common in current laboratories. This will enable laboratories to have greater sample throughput without sacrificing analytical quality, and will likely improve analytical quality for most testing laboratories performing BAC analysis.

Blood Alcohols, GC-FID, Ethanol

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