A2 Kinetics of Ion Mobility Spectrometer Sampling With Gunpowder and Methamphetamine

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After attending this presentation, attendees will understand that, across multiple forms of IMS sampling, whether positive or negative, results in an adjustment of the area of a spike following a set pattern of kinetics.

This presentation will impact the forensic science community by presenting groundwork, such as on a spectrum when it no longer becomes possible to extract the sample from the IMS swab and identify it in a GC/MS.

Ion Mobility Spectroscopy (IMS) is a commonly used instrument for field detection of drugs and explosives. A major disadvantage of IMS testing is its need to vaporize and therefore destroy part of the sample applied to the swab, limiting repetitive testing that may be required in a criminal case by both the defense and the prosecution. This research was undertaken to study the diminution of sample over repeated IMS samplings. A search of the literature revealed no previous studies of this kind.

The testing regime examined detection after continuous repetition using diphenylamine, methamphetamine, GSS, nitroglycerin, and ephedrine, starting with 1µl amounts to minimize the sample needed, and also to prevent overloading the device. A swab was inserted into the machine repeatedly with a spectrum taken of each run, until the sample could no longer be detected by the IMS due to the sample's peak blending into the small amount of background noise. The chemicals varied in length of retention from as short as three runs, to as long as 89 consecutive runs with clean cycles every 20 runs to assure that the signal being observed was not the result of carry-over. After data collection was complete, a Gaussian fit was taken of the average peak spectrum and cataloged in an excel spreadsheet, wherein it was found that every chemical tested seemed to follow a similar pattern. All chemicals decayed rapidly at first being diminished by half within the first two runs and then quickly declining until a nearly flat line is achieved. Upon further analysis, a distinct pattern was observed when plotting the natural log (ln) and inverse area of the peaks. The plot revealed a pattern pertaining to second order kinetics. This was confirmed by applying the form $1/kt+1/[A_0]$ to all peaks and running the numbers through the formula, with the same areas being concluded once k and A_0 were computed.

This study indicates that in both negative and positive mode of the particle analysis sampling in an IMS instrument, the major components of both gunpowder and methamphetamine follow a pattern of second order kinetics when repeatedly submitted to the spectrometer. It is hoped that continued research will determine at which point samples tested in the field are still suitable for subsequent testing in the laboratory by GC/MS.

Kinetics, IMS, Analysis

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