# B15 A New Headspace-Mass Spectrometry Method for the Identification of Ignitable Liquids in Fire Debris Analysis

*Marta Ferreiro-Gonzalez*, Avenida Juan Ramon Jimenez, 38, Puerto Real, Cadiz 11510, SPAIN; Fernandez-Barbero, Unlisted; Jose Angel Alvarez, PhD, University of Cadiz, Dept of Analytical Chemistry, Faculty of Sciences, Apartado 40, Puerto Real 11510, SPAIN; Jesus Ayuso, PhD, University of Cadiz, Dept of Physical Chemistry, Faculty of Sciences, Apartado 40, Puerto Real 11510, SPAIN; Miguel Palma, PhD, University of Cadiz, Dept of Analytical Chemistry, Faculty of Sciences, Apartado 40, Puerto Real 11510, SPAIN; and Carmelo G. Barroso, PhD, University of Cadiz, Dept of Analytical Chemistry, Faculty of Sciences, Apartado 40, Puerto Real 11510, SPAIN*

After attending this presentation, attendees will understand the importance of developing new analytical techniques for the identification of accelerants in arsons. They will realize how Headspace/Mass Spectrometry (HS/MS) technique can help in fire debris investigation which does not require sample preparation.

This presentation will impact the forensic science community by providing a green analytical technique for the identification of Ignitable Liquid Residues (ILRs) in fire debris. Apart from the speed of the analysis and the fact that the sample does not require sample pre-concentration, this technique also has good accuracy, is low cost, is easy to handle for routine analysis, and does not produce any residues as solvents are not used.

In arsons, accelerants such as ignitable liquids are commonly used to initiate or accelerate a fire. Therefore, the detection of ILRs at fire scenes is a key step in the investigation.[1] The most commonly used ignitable liquids are petroleum-based products like gasoline, diesel fuel, or kerosene as they are easy to obtain and easy to ignite.[2] In some cases, traces of ignitable liquids may remain at the fire scene and these could be matched to samples that are associated with the suspect. The identification of the type of ignitable liquid is very useful information for investigators when there is a suspected arsonist.

Gas Chromatography/Mass Spectrometry (GC/MS) is the most used analytical technique for the analysis of ILRs in fire debris. Indeed, American Society for Testing and Materials (ASTM) International provides guidelines for the identification and classification of ILRs from fire debris by using GC/MS.[3] Before chromatographic analysis, it is necessary that the ILR be in a vapor or volatile form, thus a prior suitable sample preparation step of the ILR from fire debris samples is required. Different sample preparation standard practices have been approved by ASTM International for isolating the ILR. Passive headspace concentration with adsorption on Activated Carbon Strips (ACS) is currently the most commonly used method for isolating ILRs from fire debris because of its sensitivity, ease of handling, and because it is not non-destructive.[4-6] The drawback of this method is the need of a solvent such as Carbon Disulfide (CS2) for the desorption of the compounds from the ACS, which is extremely hazardous.

In this study, a new analytical method based on a Headspace/Mass Spectrometry (HS/MS), also known as electronic nose, for the analysis of ILRs is presented. The working conditions for the HS/MS analytical procedure were optimized using different fire debris (wood burned with gasoline, diesel, and citronella oil). The variables optimized included incubation temperature and incubation time. The optimal conditions were as follows: 115°C and 15 minutes. The optimized method was applied to a set of fire debris. To simulate a post burn, samples of several ILs (gasoline, diesel, citronella oil, kerosene, and paraffin oil) were used to ignite different substrate (wood, cotton, cork, paper, and paperboard). Chemometric methods (Hierarchical Cluster Analysis (HCA) and Linear Discriminant Analysis (LDA)) were applied to the MS data (45-100m/z). At first instance, HCA was enough to perform a correct classification of different ILRs.

Compared to the current methods, HS/MS does have specific advantages. Apart from the speed of the analysis and the fact that the sample does not require sample pre-concentration, this technique also has good accuracy, low cost, is easy to handle for routine analysis, and does not produce any residues because solvents are not used. This technique can be considered as a green technique for fire debris analyses.

**References:**

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**Fire Debris, Ignitable Liquids, Headspace-Mass Spectrometry**