B14 Additional Criteria for Identification of Gasoline in Fire Debris Samples

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After attending this presentation, attendees will understand new characteristics of gasoline which may support the identification of residues of gasoline in fire debris casework.

This presentation will impact the forensic science community by adding criteria, to the minimum criteria described in literature, for the identification of gasoline in fire debris casework.

Gasoline is a complex refinery blend product of crude oil. Due to its low flash point, it is extremely flammable and therefore a favorite liquid for arsonists.

The identification of residues of gasoline in fire debris samples can be challenging. The composition of gasoline is defined and is controlled by physical properties, while its presence in fire debris is based on the identification of its chemical composition. External factors may add to the complexity. Part of the gasoline may be lost due to evaporation, the release of background components from the burnt/pyrolyzed debris materials may interfere and either alter the composition of the gasoline residues present or may show resemblances in composition with gasoline, and the presence of bacteria and fungi may partially decompose the composition of the gasoline residues present.

Fire debris experts must have a broad knowledge on both the (variation in) the chemical composition of gasoline and on the factors that may affect this composition or may show resemblances with this composition. The latter is extremely important as a way to avoid false positive identifications.

Different guidelines can be found in literature on the identification of gasoline in fire debris samples. These include minimum criteria that should be met for a positive identification and warnings in order to avoid a false positive conclusion. These minimum criteria focus on the main compounds in gasoline including the aromatics and the more volatile alkanes with the necessity of both being present with aromatics usually more abundant than alkanes. It is important to note that their Gas Chromatographic (GC) patterns may vary from batch to batch. Due to this variation, a comparison to reference gasoline(s) is recommended for a positive identification. These minimum criteria are still somewhat general. Additional criteria that may support a positive identification without having to compare to the compositions of reference gasoline(s) on a case-to-case basis would therefore be most welcome and can — by opinion — be found by looking carefully at the way gasoline is produced.

Some gasoline blends are primarily added or produced as blend-product for gasoline: these blends are the octane enhancers. These can be oxygenates and/or the alkylate product from the alkylation refinery process. Typical oxygenates that may be encountered in gasoline are ethanol, Methyl Tert-Butyl Ether (MTBE), Ethyl Tert-Butyl Ether (ETBE), Tertiary Amyl Methyl Ether (TAME), and/or Tertiary Amyl Ethyl Ether (TAEE). The combination of oxygenate(s) in gasoline may vary from blend to blend and their use may be restricted by country legislations. The alkylate product usually consists of branched C_8-alkanes from the 4/4-alkylation (including iso-octane, 2,2,4-trimethylpentane) and/or branched C_7-alkanes from the 3/4-alkylation, and is different in composition from the C_7- and C_8-alkanes in crude oil and found in "straight-run" light petroleum distillates. The alkylate alkanes (in particular the C_8-alkanes) can therefore be considered characteristic for gasoline, despite some variation in their pattern from gasoline blend to blend.

Based on the national reference collection of gasoline, the impression is that most, if not all, gasolines today contain either one or more oxygenates or an alkylate fraction as octane enhancer. To test whether this also applies to gasolines in other countries, a total of 48 gasolines from 11 different European countries (Netherlands not included) were collected with help from European forensic colleagues and analyzed. Overall, 47 out of the 48 were observed to contain an octane enhancer. One gasoline from Scotland did not; this gasoline contained a naptha fraction instead.

In the identification of gasoline in fire debris samples, adding the presence of an octane enhancer as minimum criteria for a positive identification is recommended: either 4/4-alkylate (C_8-isomers, including iso-octane) and/or oxygenates (e.g., MTBE, ETBE, TAEE), whereas the C_8-pattern and oxygenate combination may vary from batch to batch. Depending on the laboratory method(s) employed, they can still be recovered from fire debris samples, even when the gasoline residues show significant weathering.

Gasoline, Identification Criteria, Fire Debris Analysis