B148 Crude Oil Characteristics for Identifying Petroleum Distillates in Fire Debris

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After attending this presentation, attendees will understand which crude oil characteristics are necessary to distinguish petroleum distillates from non-conventional "petroleum-like" products in fire debris analysis results.

This presentation will impact the forensic science community by providing more detailed guidance in identifying and differentiating certain ignitable liquids products than can currently be found in scientific literature.

Petroleum distillates are crude oil refining fractions from the first refining process, the atmospheric distillation. These so called "straight-run" or "conventional" distillates are characterized by dominating alkanes and a relatively low content of aromatics. The composition of distillates generally mirrors the composition of the crude oil(s) from which it was distilled. The crude oil characteristics can therefore be used by fire debris experts for identifying petroleum distillates in fire debris and to distinguish them from: (1) distillates that have been further refined; and, (2) "petroleum-like" products that have been produced synthetically.

Straight-run distillates can be further refined for specific applications. Examples of processes are de-aromatization and de-waxing. De-aromatization is employed to remove or reduce the aromatic content; the alkane composition in this process remains unaffected. De-waxing is used to meet the low temperature properties required for its application. The end product of this process has no (or a reduced level of) n-alkanes and a branched alkane fingerprint pattern that no longer resembles that of crude oil. An alternative classification for these products, when encountered in fire debris analysis results, must therefore be considered.

Due to the imminent depletion of oil and the effect its usage has on the environment, more and more "petroleum-like" products are currently produced synthetically. Examples of such products are Gas-To-Liquid (GTL) diesel, some lamp oils, and some lighter fluids. GTL diesel is (and the other examples can be) the end product of the so called Fisher-Tropsch (FT) process. Some products, like lamp oils, are also currently known to be the blend result of a normal alkane product and an isoparaffinic product, the latter of which is obtained, for example, through an alkylation process.

Compared to petroleum distillates, these synthetic "petroleum-like" products do not contain a characteristic crude oil fingerprint pattern: branched alkanes are present but their pattern is different from that of crude oil, and both cycloalkanes, isoprenoïds, and aromatics (all present in crude oil) are absent. These synthetic "petroleum-like" products fall into the American Society for Testing and Materials (ASTM) E1618 class "Others-Miscellaneous."

The alkane pattern that is considered characteristic for straight-run petroleum distillates is discussed and illustrated in this presentation. Crude oil examples are illustrated to show that these characteristics originate from crude oil. Examples of more refined distillates and of synthetic "petroleum-like" products are illustrated to show that the alkane fingerprint pattern of these products does not resemble/no longer resembles that of crude oil.

Crude Oil, Characteristic, Petroleum Distillate