A93 Prediction and Standardization of Fire Debris Evaporation Patterns With the Advanced Distillation Curve

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After attending this presentation, attendees will have an understanding of the importance of evaporation patterns, the capabilities of the Advanced Distillation Curve (ADC) technique, the huge variation in accelerants, and the use of equations of state to predict such variations.

This presentation will impact the forensic science community because it is impossible on a practical level to know a priori the evaporation patterns of all potential accelerants, but the ADC and its link to fluid theory can provide such information in a validated database (i.e., math is cheaper than chemistry).

As pointed out by the recent National Academy of Sciences report on forensic sciences, the study of fire patterns and debris in arson fires is in need of additional study and standardization. Part of the difficulty is in determining the appropriate suite of analytes for which to focus fire debris analyses. This has been done with time consuming accelerant weathering or evaporation studies.

In this presentation, a recently introduced method will be discussed that has the potential of providing predicted evaporation patterns for accelerants. The method is complex fluid analysis protocol called the advanced distillation curve (ADC) approach, which features: (1) a composition explicit data channel for each distillate fraction (for both qualitative and quantitative analysis); (2) temperature measurements that are true thermodynamic state points that can be modeled with an equation of state; (3) temperature, volume and pressure measurements of low uncertainty suitable for equation of state development; (4) consistency with a century of historical data; (5) an assessment of the energy content of each distillate fraction; (6) trace chemical analysis of each distillate fraction, and, (7) a corrosivity and stability assessment of each distillate fraction.

As applied to accelerants, the method allows the rapid prediction of the evaporation or weathering pattern as a function of temperature. This is done by measuring the boiling curve and along with it a composition explicit data channel. It is this channel, provided by any analytical technique that one cares to apply, that furnished the predicted evaporation pattern. Access to the qualitative and quantitative composition data can also provide an enthalpic analysis of the accelerant, as well as trace analysis of constituents that can serve as taggents. The application will be discussed of the method to kerosenes and gasolines, and outline how expansion of the scope of fluids to other accelerants can benefit the criminalist in the analysis of fire debris for arson. We also describe the existing database of accelerants that has been measured, and the potential for additional measurement parameters that can be added to the protocol. **Accelerants, Evaporation Patterns, Fire Debris**

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