B83 Practical Aspects of Analyzing Vegetable Oils in Fire Debris

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The goal of this presentation is to provide valuable tools to forensic scientists and crime scene investigators and technicians alike, as findings will indicate proper storage conditions and illustrate the data that can be obtained through this analytical scheme.

This research will impact the forensic science community by providing a valuable tools for vegetable oil analysis in fire debris furthering the possibilities for data that can be obtained.

Vegetable oils can be found in fire debris as a result of burning, self-heating, or spontaneous ignition. For this reason, it is important that this debris be properly collected, stored and analyzed to obtain the most informative data. Passive and dynamic headspace concentration methods are not appropriate means of analysis for fire debris samples containing vegetable oils as those methods are only useful for volatile compounds.

Vegetable oils are primarily composed of triglycerides of three fatty acids on a glycerol backbone. Each oil type differs, depending on which fatty acids are present and the amount of each. Unsaturated fatty acids are typically found as liquids at room temperature, as with vegetable oils, while saturated fatty acids are mainly solid fats such as butter. It has been reported that different processes of burning, self-heating or spontaneous ignition can affect the fatty acid content of vegetable oils.[1] Knowledge of these changes can be used to identify the vegetable oil present and account for any variations in the data.

In this research, fatty acids in vegetable oils were esterified to fatty acid methyl esters through a base-catalyzed reaction and analyzed by gas chromatography-mass spectrometry (GC-MS). This analytical technique was used to monitor any changes in the fatty acid content produced from burning and spontaneous ignition or from environmental variables while being stored prior to analysis.

Wood spiked with vegetable oils and subsequently burned via piloted ignition were stored under conditions ranging from desirable (refrigeration) to nonideal (outdoors in the summer). The anticipation was that refrigerated and completely sealed cans would result in little to no change in fatty acid content, while cans with broken seals exposed to changing weather conditions would exhibit changes in the type and amount of fatty acids present. It has been shown through previous research in this laboratory that piloted ignition does not affect the presence or peak ratios of the fatty acids.

The vegetable oils that have the greatest propensity to self-heat and spontaneously ignite are those that are most unsaturated, such as linseed oil. The unsaturated double bonds undergo auto-oxidation which is an exothermic reaction that in turn, will catalyze the process. As this heating and catalysis cycle continues, the temperature will rise to the point of ignition providing the oil is present in an environment where the generated heat will not be dispersed to its surroundings, and there is sufficient oxygen for the oxidation reaction to progress. This characteristic was utilized to study the effects of spontaneous ignition of vegetable oils with the expectation that changes will be seen in the fatty acid peak ratios. Rags spiked with vegetable oils were introduced to circumstances to promote the occurrence of spontaneous ignition. The resulting debris was analyzed for the fatty acid content.

This research will present valuable tools to forensic scientists and crime scene investigators and technicians alike, as findings will indicate proper storage conditions and illustrate the data that can be obtained through this analytical scheme.

Reference:

1 Coulombe R, Gélin K. Spontaneous ignition of vegetable oils: chemical composition. Laboratoire de sciences judiciaries et de medicine légale, 2001.

Vegetable Oils, Fire Debris, Spontaneous Ignition

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