

# Prospecting analysis of soot for post-fire investigation

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Keywords: post-fire investigation, soot, analysis.  
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## Motivation

The aim of post-fire investigation is to extract information from a fire scene to determine the origin and cause of the fire. Most traces and clues are, however, partially or completely destroyed by fire and intervention of fire-fighters. The problem is to find a source of information. The soot is particularly interesting because it is a record of the history of the fire. How to decode this information? How link the soot to his original material?

The objective of this study is to explore different analysis devices and to evaluate the information that each one can provide for the investigation.

Few studies have been found earlier, the most interesting seems to be Pinorini *et al* (1994).

## Protocol

Based on a reference soot, obtained in laboratory from a methane / ethylene flame (M / E soot; 5.0 mg), various analytical devices are used to determine an analysis protocol.

The following analytical devices were used: liquid chromatography coupled with a fluorescence detector (HPLC), gas chromatography coupled to a mass spectrometer (GC-MS) and thermogravimetric analysis (TGA).

## Soot analysis

This protocol is then applied to two soot obtained in the laboratory: acetylene soot (A soot, 5.0 mg) and polystyrene soot (2 samples: PS1 and PS2 soot; both 5.1 mg).

The results of HPLC allows to quantify PAHs masses. And phenanthrene, fluoranthene, pyrene, benzo (a) pyrene and indeno (1,2,3-cd) pyrene seems to differentiate materials (Figure 1). The total mass of PAH for each samples is highly variable: 16,14 µg for M/E soot; 0.580 µg for A soot; 94.53 µg for PS1 and 106.11 µg for PS2.

The results of GC-MS allows to find qualitatively other PAHs such as naphthalene, acenaphthylene or phenylanthracene. The presence of phenanthrene and pyrene, quantified by HPLC, were confirmed by GC-MS.

The results of the ATG are operated according to the method of Jiang *et al* (2011). The results are presented in Table 1. We distinguish significant

differences between the different samples. The two polystyrene soot are in the same range.

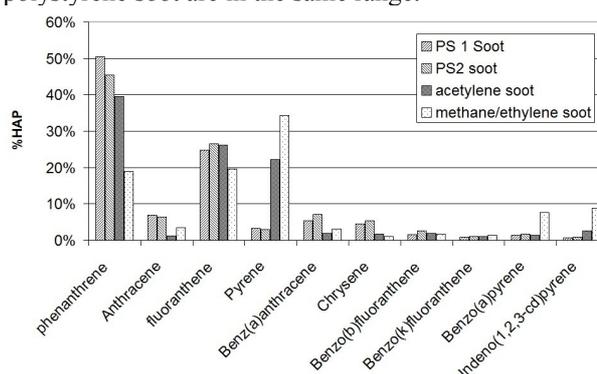


Figure 1. Percentage Distribution of PAHs after HPLC analysis.

Table 1. Organic carbon (OC) and elemental (EC) obtained by TGA analysis.

	M/E soot	A soot	PS1 soot	PS2 soot
EC	79.12	93.76	68.29	70.68
OC	20.46	02.42	30.43	28.05
Other	00.42	03.83	01.28	01.28

## Conclusion

Devices used have provided lots of information to differentiate soot. The TGA is a technique particularly attractive since it provides information on the composition of soot (percentage of elemental carbon and organic carbon). GC-MS can see all the compounds unlike HPLC. However, it should be interesting with a quantitative GC-MS. It has also been observed that these results were linked to each other, especially OC rate with HAP mass.

In terms of the investigation, soot seem to offer many different features. We now come to relate them to their original material. This will rebuild the progress of the fire.

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Pinorini, M. T., Lennard, C. J., Margot, E, Dustin, I., and Furrer, E, *Soot As an Indicator in Fire Investigations: Physical and Chemical Analyses*, Journal of Forensic Sciences, JFSCA, Vol. 39, No. 4, July 1994, pp. 933-973.