

Forensic science and bushfires: part 1 – discrimination of matches

As recent issues of the Bulletin have suggested, investigating the causes of bushfires is a challenging exercise. It is often difficult to make definitive assessments when so many volatile variables, such as climatic conditions, come into play.

Police services also face a difficult task when investigating arson fires. It can be an uphill battle to identify suspects and gather enough physical and circumstantial evidence to mount a case. This Bulletin looks at the first of two recently published studies that show how developments in forensic science are providing tools to assist arson investigators meet these challenges.

Matches are one of the most common means of igniting fires. First-responding fire crews or investigators may locate burned or unburned matches near a point of ignition, but it may not always be clear whether the matches found were the source of ignition. In cases where serial arson is occurring, burned or unburned matches may be found at multiple fire scenes. Suspects are sometimes found with matches in their possession. Being able to link matches from a fire scene with matches from other fire scenes, or matches found on a suspect, can provide police with valuable corroborative evidence.

Researchers from the National Research Institute of Police Science in Chiba, Japan have shown that it is possible to forensically discriminate matches by combining observations such as the shape of the matchstick and the colour of the match head with analysis of the chemical elements of the matches (Kazamatsu, Suzuki, Sugita and Suzuki 2005). Kazamatsu et al. used a technique called inductively coupled plasma-atomic emission spectrometry (ICP-AES) to conduct simultaneous multi-elemental analysis on burned and unburned wood and paper matches. This allowed them to compare the levels of magnesium, aluminium, calcium, iron, zinc and barium in a sample of matches. Using all of these elements, all 28 pairs could be clearly discriminated from one another in both burned and unburned samples.

Kazamatsu et al. also used X-ray diffraction analysis (XRD) to investigate differences in the crystal structures of burned and unburned matches. They burned matches for one second, two seconds and until they burned out, finding that all crystals were destroyed in the first second and longer burning times did not affect the crystal structure. They concluded these results show that “match heads from a single source should show similar elemental compositions even after combustion” (Kazamatsu et al.: 3).

Kazamatsu et al. note that matches found at fire scenes are usually combusted, while those found with suspects are usually unused. They advise that a sample of the unburned matches should be combusted to allow comparison. Their work demonstrates the scientific validity of this comparison, without a need to control the burning conditions of the matches.

The work of Kazamatsu et al. has shown that it is possible to scientifically link matches found at one fire scene with those found at another fire scene or in the possession of a suspect. By showing that burned matches from a given matchbox or matchbook retain chemical elements that discriminate them from matches in other samples, they have provided arson investigators with a potentially vital evidentiary tool. The question then becomes whether arson investigators have access to the scientific techniques necessary to make use of it.

For more information:
Kazamatsu M, Suzuki Y, Sugita R & Suzuki S 2005. Forensic discrimination of match heads by elemental analysis with inductively coupled plasma-atomic emission spectrometry. *Journal of forensic science* 50(4): 1-4.