COMPLEX ANALYSIS OF EVIDENCE FOR ESTABLISHING CIRCUMSTANCES OF DEATH – A CASE STUDY

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ABSTRACT: An example of performing complex investigations is presented in a case, when the clothes of a death N. N. was submitted for tool marks examinations in order to establish, the circumstances of his death. As the result of a visual inspection of the evidence it was found that on the surface of the jacket and the trousers multiple blood stains, frictional traces and damages such as tearing and disconnection's of seams were present. Examinations with the use of optical microscopy provided an information on the presence of greasy material rubbed in the textile, as well as microtraces of paint and glass. The traces were separated from the substrate and studied using infrared spectrometer (FTIR) and scanning electron microscope with an energy dispersive X-ray spectrometer (SEM-EDX). Physical and chemical examinations performed allowed to establish that on the surface of the clothes there were present stains of an anticorrosive material usually used for protection of chassis as well as car paint chips and glass microtraces possibly originating from a car window. All the performed complex investigations of the death's clothes allowed to establish with a great probability that he was a victim of a car accident. Moreover, the results of physico-chemical examination provided information that could be utilised in identification of the car that took part in the accident.

KEY WORDS: Forensic toolmark examination; Criminalistic identification of microtraces; FTIR; SEM-EDX.

Problems of Forensic Sciences, vol. XLVII, 2001, 300–307
Received 5 June 2001; accepted 15 September 2001

INTRODUCTION

With increasing frequency, toolmark examination is becoming an integral part of wide-scale, complex forensic studies. This complex type of examinations allow to increase the probability of the identification of tools or objects being in contact with the victim in the critical instant. It takes place mainly in the absence of traces and marks such as clear imprints of tools, objects and fragments of appliances on the surface of the evidence materials. The identification of objects remaining in contact with the victim at the event gives rise to an elaboration of a hypothetical version of the course of that event.

In the evidence material there are often present only traces in the form of abrasions, rips, tattering etc., that result from an action of various objects and tools. Their identification in such cases are very difficult. Angular tear of a textile may occur, for instance, when it gets either hooked by a sharp protruding object, or stricken by such an object. In such a case one should search for other material evidence that among a few probable versions would allow to choose the one of the highest probability.

CASE REPORT

An example of a complex forensic study being frequently performed in the Institute of Forensic Research, Cracow, is examination of the clothes of an individual, N. N., who had died an apparently violent death in some unknown circumstances. Clothes of N. N., i.e. velvet trousers and an artificial leather jacket (Figures 1, 2) secured at the autopsy were send to the Institute for suitable examinations.

In the prosecutor's resolution the question on the circumstances of N. N.'s death was included. In order to answer this question a complex multistage forensic examinations were performed.

Fig. 1. A photograph of the victim's jacket with various damages.

Fig. 2. A photograph of tattering and abrasion of the victim's jacket.

OPTICAL INVESTIGATIONS

At first, toolmark examiner carried out an optical inspection of the clothes in order to establish whether there are present clear imprints or such damages that would allow to identify the kind of an object or a tool that was in contact with the victim at the critical event.

It has been found that some damages on the surface of the clothes are present but no tool imprints. In the front upper part of trousers occurred a 10 cm long horizontal tear. Seam in the crouch was ripped up. The following damages were observed on the surface of the jacket:

- abrasion of the artificial leather in the vicinity of the left lower pocket and a tear off a small fragment of the leather in the vicinity of the first button,
- rip of the seam connecting the left sleeve with the back of the jacket (of a length about 19 cm) and the presence of a blood stain (confirmed later with a Kastle-Mayer serological test) in the vicinity of the left shoulder girdle and also a smear of a soil type material.
- traces of an intensive abrasion together with a folding of the surface of the leather present of the height of the left scapula, both arm pits, in upper part of the left sleeve, at the height of the right kidney as well as in the lower port of the jacket: in the vicinity of the left outer seam.

In the surface of both evidence items no traces of thermal changing and no car varnish smears were found.

So numerous damages of the external layer of the cloths suggests that the person wearing them could have taken part in a car accident, but also could have fallen out of a train, taken port in a fight or else in other unusual accident in that the victim was exposed to a violent action of various objects (tools). In addition, in the course of optical investigation the surface of the evidence cloths an observation in UV light was carried out. It was found that oily stains are present at the right sleeve.

PHYSICO-CHEMICAL EXAMINATIONS

In order to look for the most probable hypothesis of the accident the next stage of the examinations was performed, i. e. the chemical analysis of microtraces obtained by shaking the evidence clothes as well as the extraction of the oily stains. Among the microtraces shaken off one – and multilayer car paint chips of various colours (green, red, blue and black) as well as glass fragments of the linear size not exceeding 1 mm were found.

The chemical composition of each layer of the car paint chips revealed was established by means of a FTS 40A infrared spectrometer coupled with a UMA 500 microscope by Bio-Rad/Digilab. The obtained results are shown in Tables I and II. The paint chips included binders based upon the following resins: alkyd, alkyd modified with styrene, alkyd – polyurethane, acrylic modified with styrene and melamine. Thus, the chips could have been fragments of car paints and most probably they did not originate from one car. With the same technique it was established that the oily stains containing a mixture of esters and hydrocarbons (Figure 3) could have originated from a means used for car conservation. The results obtained at this stage of examinations allow do presume that the person wearing the examined clothes could have taken part in a car accident.

In order do strengthen the probability of this hypothesis the chemical analysis of the revealed glass fragments was performed using a JSM-5800, Jeol scanning electron microscope and a Link ISIS 300, Oxford Instruments energy dispersive X-ray spectrometer. The obtained results are given in Table 3. From the quantitative elemental analysis of the evidence glass fragments as well as a glass classification scheme (Figure 4) that worked out at the Institute earlier [1] it was possible to classify them as fragments of window panes or car windscreens. In this non-statistical approach the established values of the concentrations of iron (0.00 wt. %) and magnesium (1.95; 1.97 wt. %) both being lower then critical values in the scheme were utilised to perform the above-mentioned classification.

Fig. 3. IR spectrum of material extracted from the oily stain.

TABLE I. CHARACTERISTICS OF THE REVEALED SINGLE-LAYER PAINT FRAGMENTS

Colour	Amount	Composition	Notes
Green	4		Probably not lacquer
Green	1	Styrene-modified acrylic resins, melamine resin	
Green	3	Alkyd resins	1 particle – surface lacquer, 2 particles – undercoating lacquer (carbon-based filler)
Light blue	1	Alkyd resins	Surface lacquer
Blue	1	Kaolin, carbonates	Probably not lacquer
Red	1	Styrene-modified acrylic resins, melamine resin	Surface lacquer
Red	1	Alkyd resin	Surface lacquer
Red	1	Alkyd-polyurethane resin	Surface lacquer
Red	2	Alkyd resin, $BaSO_4$, talc	Undercoating lacquer
Red	1	Kaolin, carbonates	Probably not lacquer
Black	2	Alkyd resin, talc, carbonates	Undercoating lacquer

TABLE II. CHARACTERISTICS OF THE REVEALED MULTI-LAYER PAINT FRAGMENT

Layer nr	Colour	Composition
1	Dark blue	Styrene, polyurethanes, alkyd resin
2	Black	Polyurethanes, alkyd resin, talc
3	White	Alkyd resin, talc
4	Dark blue	Alkyd and acrylic resins, melamine
5	White	Polyurethanes, alkyd resins, TiO_2, $BaSO_4$
6	Grey	Epoxy resins, TiO_2

TABLE III. ELEMENTAL COMPOSITION OF GLASS FRAGMENTS 1 AND 2, EXPRESSED IN WEIGHT %

Element	Fragment 1		Fragment 2	
	Mean value	Standard deviation	Mean value	Standard deviation
O	47.36	0.25	45.31	0.24
Na	9.82	0.08	9.89	0.10
Mg	1.95	0.03	1.97	0.06
Al	0.07	0.06	0.00	0.00
Si	37.00	0.22	38.60	0.21
S	0.11	0.07	0.12	0.01
K	0.19	0.04	0.24	0.04
Ca	3.32	0.04	3.66	0.03

CONCLUSIONS

The results of the complex analysis of the clothes of a victim who had died in unknown circumstances made it possible to determine a high probability that he had been involved in an auto accident. Moreover, they provided indications facilitating the eventual identification of the vehicle involved in the collision.

The results obtained at every single stage of the performed examinations, treated separately, are not categorical. However, the sum of the physical and chemical examinations suggests that N. N. took part in a car accident and the results of toolmark examination do not contradict that hypothesis.

Thus, as a result of the performed complex examinations it has been established with a high probability that N. N. participated in a car accident. Moreover, the chemical examinations of microtraces provided an information that could be utilised in the identification of the vehicles taking part in the accident.

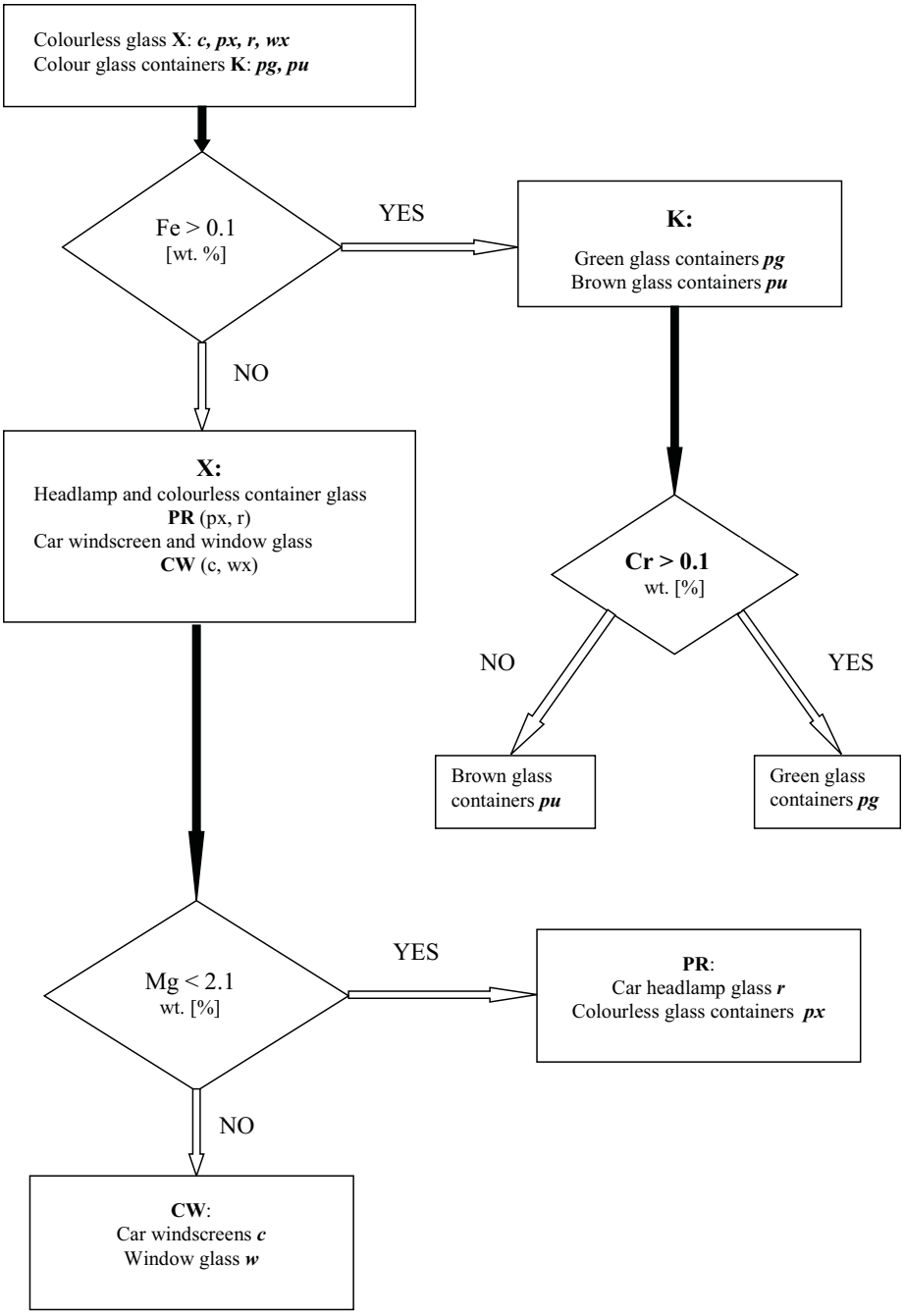

Fig. 4. A glass classification scheme – a non-statistical approach [1].

References:

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