

## SELECTED CASES OF PAINT COATING EXAMINATION

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**ABSTRACT:** Criminalistic examination of paint fragments is often useful in determination of a run of an event. Three real cases will be discussed. Two of them concern the hit-and-run accidents and the third one refers to identification of lacquer used for parquet painting in connection with poisoning caused by volatile paint components. In all cases comparative analysis was conducted.

**KEY WORDS:** Paint comparison; Infrared microspectrometry; Optical microscopy.

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### INTRODUCTION

Criminalistic examination of paint fragments may be useful to determine a run of an event. In practice, the investigation most frequently includes a comparison of an “evidence” sample taken from the scene of a crime with the “control” sample in order to establish whether they came from the same source. Sometimes it is necessary to determine the composition of the paint in question. Optical microscopy, infrared spectrometry and elemental analysis are routinely applied in paint examinations [1, 2, 4, 5]. These methods provide information about both layer structure and chemical composition of the examined samples [3, 6].

Paint samples may come from various surfaces i.e. wooden, metallic or plastic. However, fragments of automobile paints are mostly subjects of examination. In Poland car paint examinations have three characteristic features. They concern very often paint chips coming from repainted and repaired cars. The examinations aim at sample comparison mostly. In hit-and-run cases always they lead to conclusions that are formulated in category of probability.

In the presented paper three real cases will be discussed. Two of them concern the hit-and-run accidents and the third one refers to identification of lacquer used for parquet painting in connection with poisoning caused by volatile paint components.

## METHODS

The paint samples were examined by the use of optical microscopy, infrared microspectrometry and X-ray microspectrometry. Observation of the morphology of the sample was carried out using a Nikon SMZ-U stereoscopic microscope, a PZO Biolar polarising microscope and a Nikon Labophot 2 fluorescence microscope. The infrared measurements were carried out using an FTS 40A Fourier spectrometer with a UMA 500 microscope (BioRad/Digilab) by transmission technique. An elemental analysis was performed on a Jeol JSM-5800 scanning electron microscope, equipped with an Oxford Instruments Link ISIS 300 X-ray spectrometer.

## CASE 1

The body of a young woman was found on the road. The perpetrator had run away. The investigation resulted in the identification of the suspect driver. The vehicle was not recovered, as it has been sold. In front of the suspect's house, where he usually parked his car, bits of car paint were found.

The subject of examination were paint samples:

- taken from the scene of road accident,
- isolated from the clothing of a car accident victim,
- found at the place where the suspect used to park his car.

The aim was to find out whether the paint chips found on the victims clothing and the paint bits recovered at the scene of the accident are similar to those found at the usual parking place of the suspect's vehicle.

As a result of the laboratory examinations it was found that all samples consisted of multi-layer car paints: the outer layer – deep-red, then the yellow one, deep-red one, white one and the red one. The thickness of the corresponding layers in the examined bits revealed approximate conformity (Table I). So did the chemical composition of the three consecutive layers (Figure 1).

TABLE I. THICKNESS OF CORRESPONDING LAYERS IN EXAMINED PAINT SAMPLES

Layer	Colour	Thickness [ $\mu$ ]		
		Road	Parking place	Clothing
1	Deep red	70-130	90-95	–
2	Yellow	10-15	10-15	10-15
3	Deep red	20-30	20-25	20-25
4	White	580-620	–	–
5	Deep red	45-70	–	–

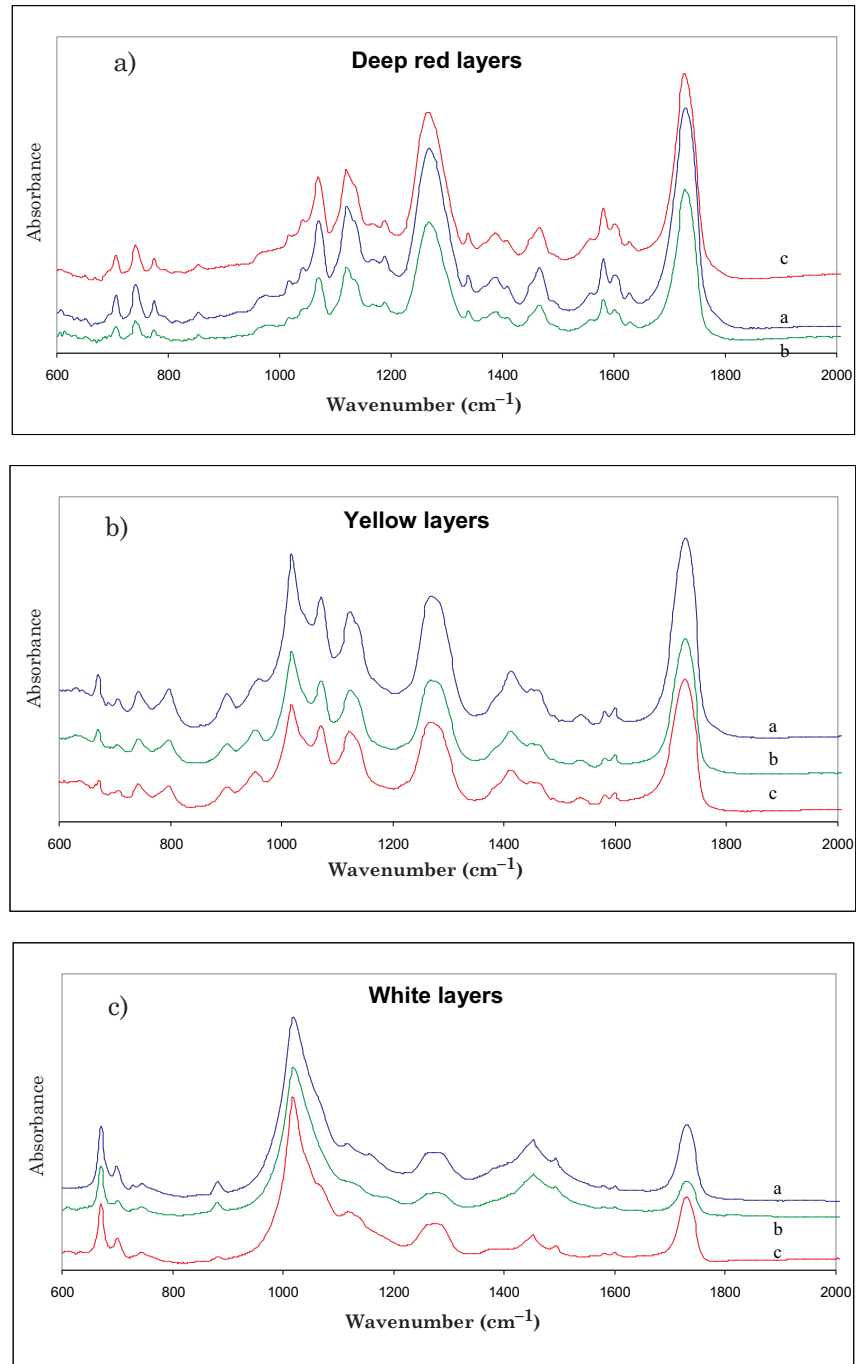


Fig. 1. Infrared spectra of corresponding layers (deep red, yellow, white) in paint chips coming from: parking place (a), road (b) and clothing (c).

The top layer consisted of the modified alkyd paint, containing compounds of iron and lead chromate. The chemical composition of the remaining layers was the following:

- yellow layer – alkyd resin, talc, ferrite yellow, titanium dioxide, zinc compounds;
- deep-red layer – modified alkyd resin, lead chromate, iron compounds;
- white layer – ground coat paint, carbonates, talc;
- red layer – alkyd-nitro-cellulose paint.

So, the compared paint samples reveal similar layer structure and thickness of the corresponding layers as well as the chemical composition of 3 consecutive layers. In addition, plastic elements found on the crime scene were recognised as being typical for the same car model as that of the suspect.

Conclusions: among the examined multi-layer bits from the scene of incident, it was possible to find such fragments that showed conformity in the layer structure and the chemical composition to the bits recovered from the clothing of a victim and the parking place of the vehicle which suggests their common origin. In addition, the positive identification of plastic elements of the vehicle also revealed at the scene of the crime, allowed the participation of the suspect in the traffic accident to be confirmed.

## CASE 2

During a traffic accident a man was hit. The perpetrator had run away from the scene of the incident. After some time, as a result of the investigation, a vehicle was identified which might have taken part in the incident.

The subject of the examination were fragments of paint coating, taken from different parts of the suspect's vehicle as well as the victim's clothing and fragments of plastic with traces of paint, revealed at the scene of the incident.

The aim was to find out whether the paint on the plastic elements is identical with the paint from the suspect's vehicle. Another question was whether there are traces of the vehicle's paint on the victim's clothing.

It was found from the examinations that the fragments of the paint coating from the vehicle had a multi-layer structure with the red colour of the top layer. Similarly, the colour of most of the layers seen in cross-section, was red, with a slightly different shade. The chemical composition of red layers, both top and deeper ones, was different. Seven types of red paint were found (Table II).

The fragments of plastic, found at the scene of the accident, showed on their surface the presence of urethane modified acrylic paint containing sty-

rene. Its IR spectrum, however, was different from that found on the body and plastic elements of the car.

The left side of the denim vest of a victim revealed a paint abrasion of the red colour. The bits of the red paint recovered from the abrasion do not have the identical chemical composition. Three types of paint can be differentiated (Table III); with one showing conformity with the paint found on the plastic elements recovered from the road, and none with the paint recovered from the vehicle.

TABLE II. COMPOSITION OF RED PAINTS VISIBLE ON CROSS-SECTION OF CAR PAINT CHIPS

Number	Main components of paint
1	Acrylic-alkyd resin
2	Urethane modified alkyd resin, sulphate
3	Urethane modified acrylic resin, styrene
4	Alkyd resin
5	Alkyd resin, carbonate
6	Acrylic-melamine resin, styrene
7	Alkyd-nitro-cellulose resin, styrene

TABLE III. COMPOSITION OF RED PAINTS FOUND IN THE ABRASION ON CLOTHING

Number	Main components of paint
1	Urethane modified acrylic resin, styrene
2	Urethane modified alkyd resin
3	Urethane modified acrylic resin, styrene, talcum

Conclusions: it was stated that the red paint, visible on the fragments of plastic recovered from the scene of accident does not conform to any types of red paint taken from the suspects' vehicle. The paint taken from the abrasion on the clothing does not conform to the paint coming from the suspect's vehicle. It was not established whether the plastic fragments recovered from the road are parts of plastic protective sheets from a car belonging to the suspect.

So, it was concluded that despite the fact that the body of the car was covered with different paints of the same colour and a similar shade, no bit could be found whose chemical composition would conform to the victim's clothing. The participation of the suspect in this accident was excluded.

## CASE 3

After the painting of parquet floor in a school gym, the janitor exhibited the symptoms of poisoning. The firm that painted the parquet floor argues that the applied lacquer is non-toxic.

A fragment of lacquered parquet floor bit was examined in order to find out what kind of substance was the parquet floor lacquered with.

It was found that the parquet floor bit was varnished with a colourless lacquer. Two types of lacquers: polyurethane and nitro-cellulose were found on the floor bit (Figure 2). At the distance of 1.5 cm from its edge there is a clearly discernible borderline between superimposed lacquer layers (fragments of the surface painted once or twice). Some fragments are varnished by the use of both lacks, some only by nitro-cellulose lacquer. Infrared spectrum of the lacquer of the outer layer in the double-layer coating conforms to the spectrum of polyurethane lacquer "Harzłak" which, together with polyurethane resin and diisocyanamides contains aromatic hydrocarbons, toluene and xylol.

IR spectrum of lacquer found on the wood in single-layer coating conforms to the spectrum of the nitro-cellulose lacquer (Kapon), containing methyl ketone, ethyl acetate, butyl acetate, amyl acetate, isobutyle ketone, anaesthesia ether, ethylene glycol, cyclohexanone, and as diluents, alcohols and aromatic hydrocarbons. Nitro-cellulose lacquer was placed directly on wood.

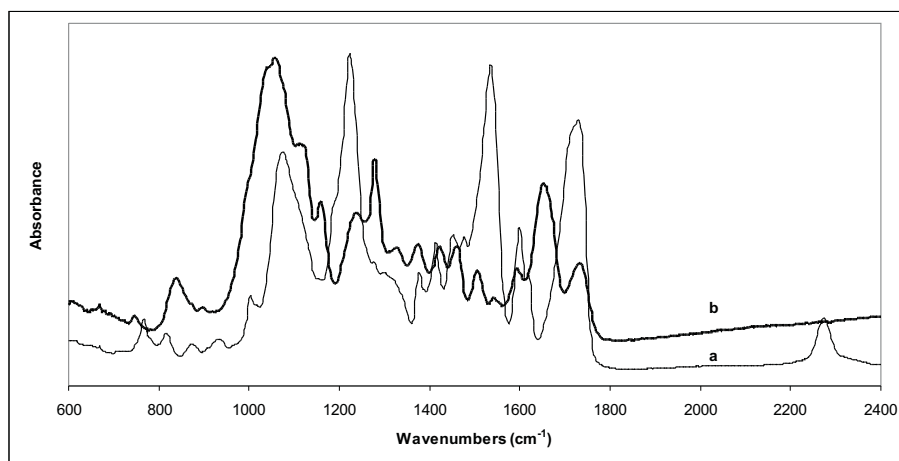


Fig. 2. Infrared spectra of polyurethane (a) and nitro-cellulose (b) lacquers.

Conclusions: it was stated that both types of lacquer nitro-cellulose and polyurethane, which are non-toxic after drying up, are produced on the basis

of organic solvents. It was not possible to establish whether the nitro-cellulose lacquer remained after the preceding painting, or, was the ground coat layer under the top lacquer (polyurethane).

#### FINAL REMARKS

The determination of morphology and chemical composition of examined paint samples has proved particularly valuable in all presented cases. It enabled to compare paint samples and to decide whether they may have common origin. But the successful identification of paint as well as hit and run vehicles from evidential paint fragment can be greatly facilitated with a comprehensive laboratory collection of reference paint samples and the accompanying chromatic and molecular information. Information about the make, model and year, whether developed initially for the purposes of vehicle identification or a statement of uniqueness, will add to the weight and credibility of comparison evidence.

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