

# Examination of chemical micro-traces - the last resort?

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## Summary

Chemical micro-traces belong to the group of forensic traces. In the case of this type of traces, we are dealing with group identification. Nonetheless, they are a very valuable and often the only procedural source of information about a crime that has taken place, and their evidential significance increases, in particular, in situations where it has not been possible to secure forensic traces in the course of the conducted activities, which would allow for individual identification of a perpetrator. The purpose of this article is to show the importance of chemical micro-traces in clarifying the circumstances of an incident and identifying a perpetrator on the basis of an opinion made in 2020 at Forensic Laboratory of the Voivodeship Police Headquarters in Kraków concerning a road accident which resulted in the death of a young woman.

**Key words:** chemical micro-traces, road traffic accident, fibres, plastics

## Introduction

Chemical micro-traces, despite their group identification, are often one of the few or the only 'clue' in an ongoing investigation and at the same time a trace which, after physical and chemical tests, has a significant evidential value. Many times, only the analysis of this type of forensic traces was able to provide answers to questions that arose throughout the pre-trial and court proceedings, which were of vital importance for solving the case and clarifying the circumstances of an incident and reconstructing its course. Tests of chemical micro-traces often removed doubts, the clarification of which was of vital importance in shaping the substantive content of a decision to be issued in a given criminal trial.

The analysis of chemical micro-traces plays an important role, among others, in the framework of investigations such as road accidents and collisions. Practice shows that in these types of incidents micro-traces are the only traces that are revealed and subsequently subjected to identification and comparison tests, unlike other types of forensic traces. These tests have been helpful in identifying a vehicle that knocked down a person, sometimes fatally, as well as a driver who committed an offence.

## Case study

A road accident occurred on 25 June 2018, on a road near Nowy Sącz. There were three people travelling in an AUDI A6 car - two twin brothers Karol F., Kamil F. and their acquaintance Angelika P. At some point the car fell off the road and hit an embankment (Fig. 1). As a result of this incident, Angelika P. - as the subsequent

post-mortem showed - died on the spot, due to extensive head injuries. Only the two twin brothers survived.



**Fig. 1.** The AUDI A6 vehicle involved in the incident in question, a few hours after the road accident

The first on the scene of the accident was the brothers' uncle, who lived nearby. In the damaged car he saw Karol F. and Kamil F. in the front seats, Angelika P. was sitting in the back. Due to the need to call an ambulance, he had to return home, where he had left his phone. At this time, Kamil F. moved to the back seat, right next to the young woman, while Karol F. moved away from the scene of the accident. After some time, he was found by police officers in nearby bushes.

Both brothers, after being taken to hospital, were tested for blood alcohol content, and the result of this test clearly indicated that they were in a state of intoxication at the time of the accident. Toxicological tests

carried out later showed that both of them were also under the influence of amphetamine.

From the very beginning, Karol F. and Kamil F. falsely stated which of them had been driving the car at the time of the accident. They unanimously claimed that neither of them had driven the vehicle and that Angelika P. had been the driver. The testimony of the first witness present at the scene - the twins' uncle - was also of no help at this stage of the proceedings. The problem was that the two brothers are 'identical' and the witness was unable to distinguish between them.

The prosecutor in charge of the investigation decided to appoint experts in genetic testing. However, Karol F. and Kamil F., as monozygotic twins, have virtually identical DNA. The analysis of the biological traces revealed in the car therefore did not provide an answer to the question of which of them had been sitting in the driver seat and driving the vehicle at the time of the incident.

The appointed dactyloscopy expert concluded in his opinion that the fingerprints on the steering wheel secured by the forensic technician came from both Karol F. and Kamil F. As the car belonged to the brothers' family, it was known that they both often used it interchangeably. The expert report therefore did not provide an answer to the key question.

The next step was to appoint a traceology expert. The secured driver floor mat, clutch and accelerator pedals, as well as the shoes of all accident participants were provided for testing. Unfortunately, the tests showed that there were no footwear marks on the pedals. According to the experts, the driver had most likely, as a defensive gesture, taken his feet off them moments before hitting the embankment.

Another hope of the investigators was to examine the odour traces secured from inside the vehicle. However, as a result of actions undertaken, odour analyses failed to determine samples and match the smell of one of the three people with the traces secured on the driver seat.

A lot of hope was also placed in the analysis of injuries of the accident participants. Investigators expected that the injuries of the accident participants would match the damage secured in the car and, on this basis, it would be possible to determine where someone had been sitting. And this is where another problem arose. All those riding in the car were not wearing seatbelts, and were even being 'flung' over the interior of the car as it was rolling over. Only on the young woman's body no injuries were found which could indicate that she had been behind the wheel at the time of the accident. However, it was not possible to establish who had been driving the vehicle and who was responsible for the death of Angelika P.

Due to the lack of any key evidence, the pre-trial proceedings were discontinued. After about two years from the moment of the accident, the prosecutor issued a decision to resume the proceedings and

appointed the chemical analysis laboratory at the Forensic Laboratory of the Voivodeship Police Headquarters in Kraków to issue an opinion in this case.

### Handling of evidence and comparison material

The aim of tests was to answer the following questions (original spelling):

- “1. Does the evidence secured during the visual inspection of the Audi A 6 vehicle plate no..... of 25.06.2018 in the form of micro-traces from the driver seat backrest trace no. 2, contain fibres which may come from clothing belonging to Karol F...., Kamil F....., Angelika P..... sent for testing as comparison material?
2. Does the evidence secured during the visual inspection of the Audi A 6 vehicle, plate no..... of 25.06.2018 in the form of evidence: deployed driver seat airbag no. 5, deployed airbag from the driver seat backrest on the left side of the driver seat no. 6, contain fibres which may come from clothing belonging to Karol F....., Kamil F....., Angelika P..... sent for testing as comparison material?
3. Does the evidence secured in the form of clothing of Karol F...., Kamil F....., Angelika P..... contain own fibres from airbags from the Audi A 6 vehicle plate number..... sent for testing?
4. Does the evidence secured in the form of clothing of Karol F....., Kamil F....., Angelika P..... contain traces coming from the Audi A 6 vehicle plate no..... and the left front driver seat door of the Audi A 6 vehicle plate no..... marked as trace no. 10?
5. Does the evidence secured in the form of clothing of Karol F....., Kamil F....., Angelika P..... contain own fibres from the front passenger airbag from the vehicle Audi A 6 vehicle plate number..... sent for testing?
6. Does the evidence secured in the form of the front passenger airbag from the Audi A 6 vehicle plate no..... contain micro-traces from the clothing of Karol F....., Kamil F....., Angelika P.....?”

The following were provided for testing:

- forensic traces in the form of micro-traces collected from the surface of the driver seat backrest during visual inspection of the AUDI A6 vehicle, secured on a sheet of transparent micro-trace film,
- three deployed airbags (driver front airbag, driver side airbag and passenger front airbag) secured from inside the AUDI A6 vehicle,
- clothing item secured during the autopsy of Angelika P.'s body,
- clothing items secured from Karol F., Kamil F.

#### 1. Fibre testing

The micro-traces taken from the driver seat backrest during the visual inspection of the wreckage of the AUDI A6 were examined in detail using the Leica MZ75

stereo microscope (white reflected light, magnification from 6.3 to 50x). They were found to be multi-coloured and diverse textile fibres (Fig. 2). In view of the above, they were qualified for further comparative instrumental testing.

Next, the clothing items provided for testing, belonging to Kamil F., Karol F. and Angelika P., were subjected to detailed macroscopic examination, during which the contact fibres were collected by transferring them onto sheets of transparent film for collecting micro-traces, and the own fibres from clothing items were sampled. The own fibres from clothing items were further subjected to microscopic examination using a stereo microscope and the ZEISS Axiostar 1122-100 biological microscope (white-light reflectance technique - BF, magnification 100 and 200x), in order to determine the grade of the individual textile fibres included in the threads from which the examined clothing items were made.

The next step was to carry out a comparative microscopic examination of textile fibres secured from the backrest of the driver seat with the own fibres from clothing items of the three participants in the road

accident in question. The purpose of such tests, which are regularly carried out in micro-trace examination laboratories, is first and foremost to establish whether an individual fibre, which constitutes evidence, can come from a particular textile product, which is the comparative material in a given case.

Thus, on the basis of the comparative tests carried out, it was found that among the diverse and differently coloured textile fibres secured from the backrest of the driver seat of the AUDI A6 vehicle, there were five red cotton fibres that did not differ in structure and shade of colour from the red cotton fibres coming from the sweatshirt fabric secured from Karol F. (Fig. 3), and one silvery-grey cotton fibre that did not differ in structure and colour shade from the silvery-grey cotton fibres coming from the trousers fabric, also secured from Karol F. However, no equivalents of these fibres were found among the own fibres from Angelika P.'s and Kamil F.'s clothing items.

Knowing the answer to the first question included in the Decision to appoint an expert, the focus was then on testing the three deployed airbags.

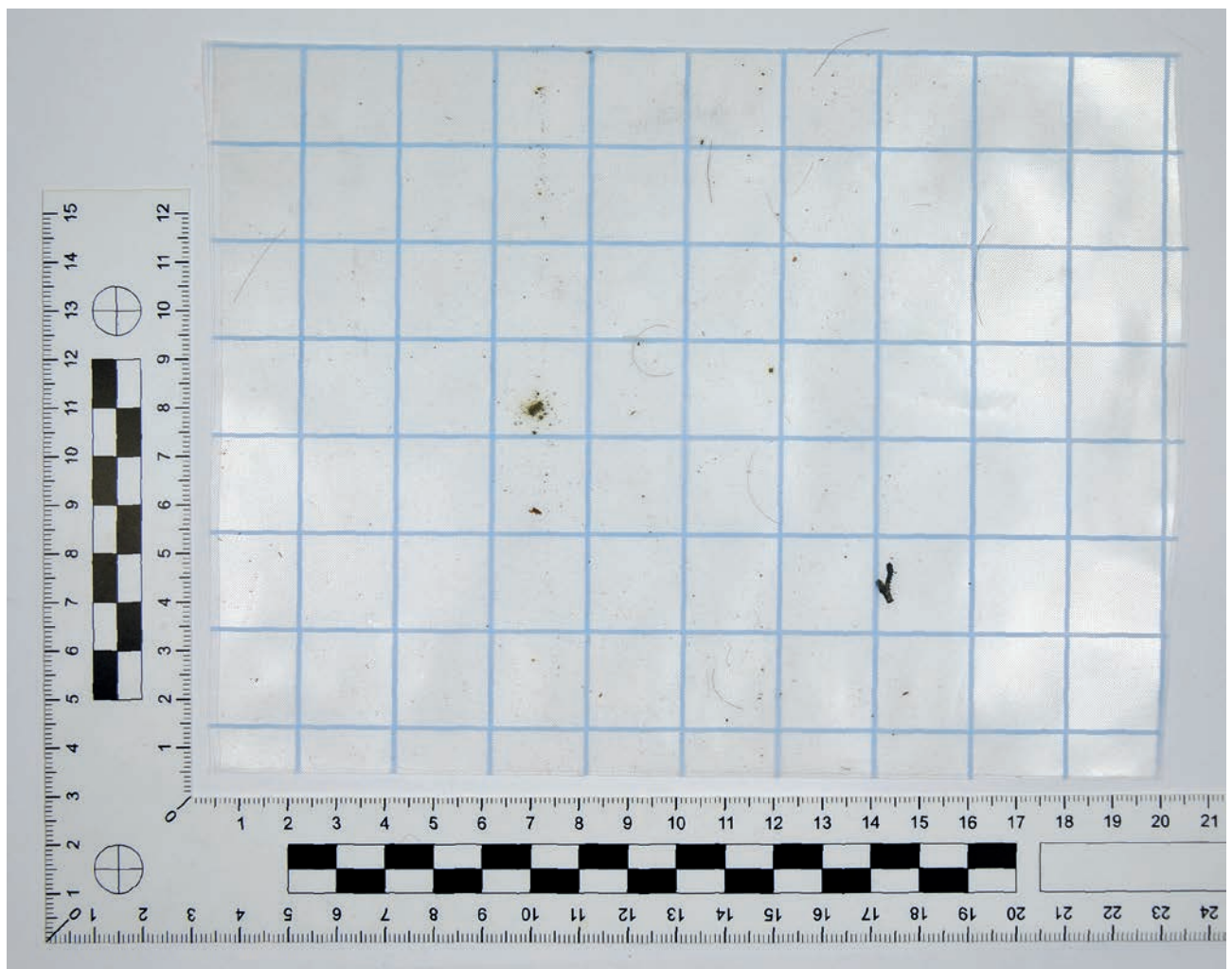


Fig. 2. Textile fibres collected on the surface of a sheet of transparent film for collecting micro-traces



Fig. 3. Karol F.'s sweatshirt

The airbags supplied for testing were therefore subjected to macroscopic examinations, during which the fibres on their surfaces were collected by transferring them onto sheets of transparent film for collecting micro-traces, and samples of the own fibres coming from the airbag fabrics were taken. The own fibres were then subjected to a detailed microscopic examination in order to determine the grade of individual textile fibres included in the threads from which the airbags under examination were made. Subsequently, in order to answer the question of whether the individual items of clothing, secured from the three road accident participants, came into contact with the airbags deployed during the incident, a comparative microscopic examination of the own fibres from the clothing items and the airbags in question was carried out.

As a result of these tests, it was found that among the contact fibres collected from the surface of the driver front airbag, there were six red cotton fibres, which did not differ in terms of structure and shade of colour from the red cotton fibres from the Karol F.'s sweatshirt fabric. On the other hand, no equivalents of these fibres were found among the own fibres from Angelika P.'s and Kamil F.'s clothing items and the other clothing items of Karol F.

In addition, on the front surface of the deployed driver front airbag, a print was visible that looked like a textile print (Fig. 4). This print was accompanied by a very slight red staining of the airbag's own fibres. Due to the fact that, at the time of testing to issue an opinion, the Forensic Laboratory of the Voivodeship Police Headquarters in Kraków did not have the equipment to carry out further group tests of such a print, it was indicated in the final conclusions of the opinion that such tests could be carried out by the Central Forensic Laboratory in Warsaw or the Institute of Forensic

Research in Kraków. Information already obtained later by the author of the publication shows that the prosecutor who supervised the proceedings decided to send the aforementioned airbag to the Institute of Forensic Research in Kraków, and the comparative tests carried out indicated that the print could come from Karol F.'s sweatshirt.

During the next stage of testing carried out at the Forensic Laboratory of the Voivodeship Police Headquarters in Kraków, it was found that among the contact fibres collected from the surface of the passenger front airbag (Fig. 5), eleven navy blue cotton fibres were present, which did not differ in terms of structure and shade of colour from the navy blue cotton fibres coming from Kamil F.'s sweatshirt fabric. However, no equivalents of these fibres were found among the own fibres from the clothing items of Angelika P., Karol F. and the remaining clothing items of Kamil F.

However, the macro- and microscopic examination of the driver side airbag was the most relevant in this case (Fig. 6). On its surface, seven red cotton fibres were found, which did not differ in structure and colour shade from the red cotton fibres coming from Kamil F.'s sweatshirt fabric. Significantly, microscopic examination of the aforementioned airbag revealed the presence of a blue plastic-looking substance on its surface. Subsequent tests showed that the marks corresponded in colour shade and chemical composition to the plastic material used as interior trim in the AUDI A6 car. It is likely that when the airbag was deployed, part of the fabric from which the airbag was made rubbed against the interior of the car with great force. The red cotton fibres revealed were actually clung to these marks, undoubtedly demonstrating the dynamic nature of the interaction between the airbag and the textile product, made of the aforementioned



**Fig. 4.** Deployed driver airbag and close-up of a fragment of this airbag containing a delicate print that looks like a print of some textile

red textile fibres. Also important at this point seems to be the fact that among the contact fibres collected from the surface of this airbag, no equivalents of these fibres were found among the own fibres from Angelika P.'s and Kamil F.'s clothing items qualified for testing.

It should be mentioned here that the comparative microscopic examination carried out did not reveal, among the textile fibres secured from the surface of the three deployed airbags, the presence of fibres that would have equivalents among the own fibres from the clothing items of Angelika P. Karol F. and Kamil F.



**Fig. 5.** Deployed front passenger airbag

## 2. Plastics testing

During examination of Kamil F.'s clothing items, it was found that the front surface of the right leg of his grey trousers was covered with a blue plastic-like substance (Fig. 7). As these marks indicated the dynamic nature of their formation - probably due to heavy friction as a result of a road incident - it was decided to carry out a detailed examination of the AUDI A6 vehicle.

Already at the beginning of these examinations, it was established that the damage to the body of the car was characteristic of that caused by a road incident. During the examination of the vehicle interior, it was also found that the dashboard and the plastic parts of the inner door surface were made of blue plastic. In addition, a very detailed and thorough examination established that the surface of the door of the glove compartment in the dashboard, on the passenger side, showed scratches on the blue plastic covering the glove compartment (Fig. 8). These scratches could indicate the dynamic nature of the formation of this damage.

A sample of blue plastic was taken from the area of the scratch for further comparative laboratory testing. Subsequent instrumental laboratory tests carried out using a stereo microscope and the Perkin Elmer Spectrum Two FTIR spectrometer with ATR (reflection technique) showed that the marks on the surface of Kamil F.'s grey trouser leg corresponded in terms of colour shade and chemical composition to the plastic material covering the passenger-side glove compartment door of the AUDI A6 (Fig. 9). In addition, analysis of the recorded FTIR-ATR spectra revealed that the evidence (MD\_P and MD\_S) and comparison (MP) plastics were made of polypropylene.



Fig. 6. Deployed driver side airbag with visible marks of a blue substance

**Conclusions**

The examination of the evidence provided for testing in the case in question showed that:

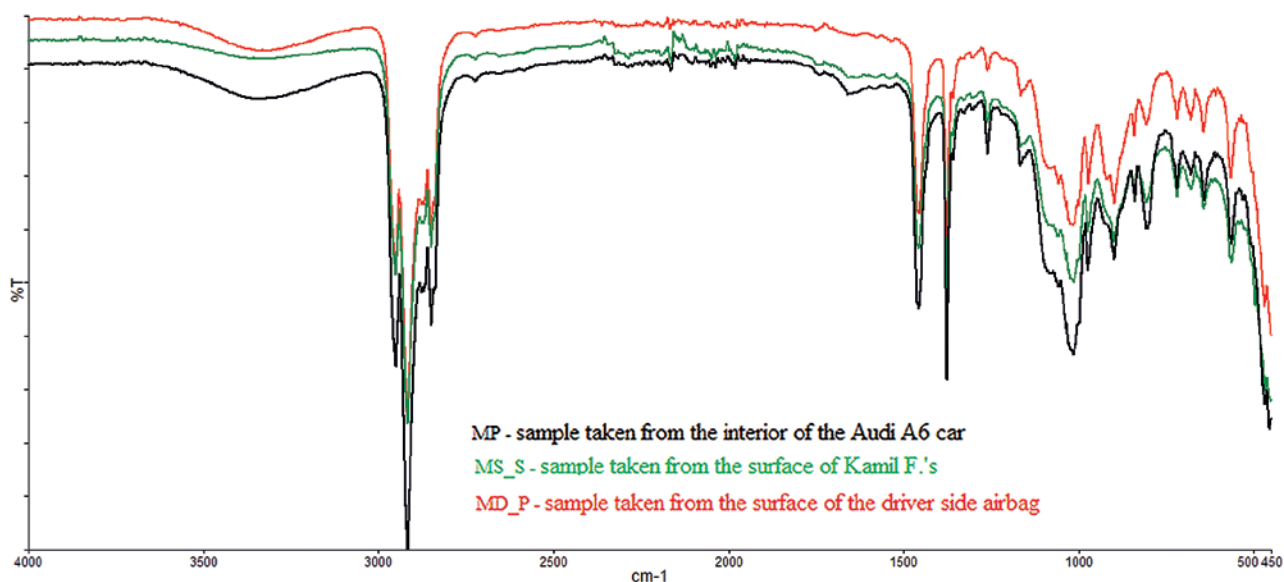
- 1) Among the evidential fibres secured from the backrest of the driver seat of the AUDI A6 vehicle, five red cotton fibres were found, which could have come from the red sweatshirt of Karol F., and one silver-grey cotton fibre, which could have come from the grey tracksuit bottoms of Karol F. However, no equivalents of these fibres were found among the own fibres from Angelika P. and Kamil F.'s clothing items.
- 2) On the deployed driver front airbag provided for testing, six red cotton fibres were found, which may have come from Karol F.'s red sweatshirt, while on the deployed driver side airbag, seven red cotton fibres were found, which may have come from Karol F.'s red sweatshirt. The fibres revealed on the surface of the driver side airbag were embedded in the blue plastic marks on the surface of the airbag, which undoubtedly demonstrates the dynamic nature of the interaction between the airbag and the textile product made of the aforementioned red textile fibres. Significantly, no fibres were found on the aforementioned two airbags which would have equivalents among the own fibres from Angelika P.'s and Kamil F.'s clothing items qualified for comparative examination.
- 3) Eleven navy blue cotton fibres were found on the deployed passenger airbag provided for testing, which may have come from the navy blue sweatshirt of Kamil F. On the other hand, no such fibres



Fig. 7. Trousers of Kamil F. with visible marks of a blue substance on the front surface of the right leg



**Fig. 8.** Interior of the AUDI A6 vehicle tested and a close-up of the scratches found on the surface of the glove compartment door.



**Fig. 9.** Recorded FTIR-ATR spectra of the evidence (MD\_P and MD\_S) and comparison (MP) material

were found on this airbag, which would have counterparts among the own fibres from Angelika P.'s and Karol F.'s clothing items qualified for comparative testing.

- 4) During the examination of the AUDI A6 vehicle, the outer surface of the plastic covering the glove compartment door, on the front passenger side, was found to be scratch. These scratches may indicate the dynamic nature of the formation of this damage. On the front surface of the right leg of Kamil F.'s grey trousers, on the other hand, blue plastic marks were found. These marks correspond in colour shade and chemical composition to the plastic (polypropylene) covering glove compartment door on the passenger side of the AUDI A6 car involved in the road accident.

#### Postscript

This opinion provided circumstances allowing identification of the accident perpetrator and, as a result, was the only one to contribute to charging Karol F. with causing a fatal accident and driving under the influence of an intoxicant (in the form of amphetamine) and alcohol. In May this year, the District Court in Gorlice sentenced Karol F. to six years' imprisonment for the above acts.

#### Sources of figures:

**Fig. 1:** [https://static.halogorlice.info/data/articles/s4\\_jeden\\_z\\_blizniakow\\_skazany\\_nieprawomocnym\\_wyrokiem\\_1651664283\\_27456.jpg](https://static.halogorlice.info/data/articles/s4_jeden_z_blizniakow_skazany_nieprawomocnym_wyrokiem_1651664283_27456.jpg)

**Fig. 2-9:** authors

*Translation GTC AMG sp. z o.o.*