THE TRANSFER AND PERSISTENCE OF SMALL FRAGMENTS OF POLYURETHANE FOAM ONTO CLOTHING

Kenneth G. WIGGINS, A. EMES, L. H. BRACKLEY
Forensic Science Service, London, United Kingdom

ABSTRACT: The transfer and persistence of microscopic size pieces of polyurethane foam onto clothing has been studied. Although only a limited amount of work has been carried out, it has been shown that whilst relatively high numbers of foam fragments are initially transferred many fall off quickly. Most of the experiments were performed using cotton material as the recipient. The results obtained are remarkably similar to some of the work carried out by Pounds and Smalldon in 1975 on the transfer and persistence of fibres in relation to clothing.

KEY WORDS: Transfer; Persistence; Polyurethane foam; Cotton.

Problems of Forensic Sciences, vol. XLVI, 2001, 255–259
Received 15 May 2001; accepted 15 September 2001

CASE STUDY

The case of interest was a murder, which took place in a forest in the South of England in October 1979. The victim has never been identified and the suspect only appeared in court charged with this murder in May of this year.

The suspect was first interviewed around the time of the murder but was released for lack of evidence. When the case was re-opened in 1999, it was shown that blood found in the cab of the suspect's lorry gave the same DNA result as that of the victim. It was at this point that the suspect admitted that the victim had been in his lorry but he did not admit murder. There was certainly no evidence of an attack taking place in the lorry. The blood was far more likely to have come from vaginal bleeding as a result of the victim having an ectopic pregnancy. The only other forensic evidence was 15 fragments of polyurethane foam found on the victim's dress, which were microscopically similar to those in a small foam mattress found in the lorry.

The last independent siting of the victim was when she was seen with the suspect in the North of England at 3.00 p.m. on Friday 19th October 1979. The victim's body was discovered in a forest in the South of England at ap-

proximately 2.15 p.m. on Tuesday 23rd October 1979. The weather conditions round about this time were dry and sunny.

The pathologist stated that the victim died any time from Saturday 20th October 1979 to early on Monday 22nd October 1979.

The suspect stated that he left the victim approximately 40 miles from the forest between 10.00 a.m. and 1l.00 a.m. on Saturday 20th October 1979. As I said earlier there was a small foam mattress found in the cab of the suspect's lorry.

Additionally, 15 fragments of polyurethane foam microscopically similar to that mattress were found on the back of the victim's dress. We have to assume that these fragments originated from the mattress in the lorry and that they were transferred from fragments that existed on the passenger seat.

The suspect says that the victim would not have come into direct contact with the mattress because of where he stored it behind the passenger seat. However he quantified this by saying unless she sat on it and he didn't see her doing this. We therefore believe that the fragments adhered to her dress after she sat in the passenger seat, which was heavily contaminated with foam fragments.

Tapings from the seat after the murder showed there to be somewhere in the region of 700 foam fragments present on the tape.

Blood distribution evidence showed that the victim was murdered at or near the spot she was found in the forest. It is uncertain how many foam fragments were originally transferred to the victim's dress or how quickly the fragments would be lost. Individual foam fragments are generally in the region of 200–300 microns in length. In order to assess the finding of the 15 foam fragments two scenarios were considered.

The victim was murdered in the forest less than 4 hours after leaving the lorry or the victim left the lorry in London, as the suspect said, and was murdered more than 4 hours later.

We felt that we needed more information so we conducted a very limited number of experiments. Unfortunately in the perfect world many more experiments would have been performed but due to time and particularly costing restraints imposed by the police only limited experimental work was possible.

EXPERIMENTAL

Three pieces of material each approximately 100 cm^2 in size were selected. One was a woollen material, one denim and the third black and white cotton fabric removed from the victim's dress.

Limited experimentation showed that the woollen material was unsuitable because it trapped foam fragments and made recovery and subsequent counting inaccurate. For most of the experiments the denim and black and white cotton were seeded with 20 or 50 foam fragments. However to assess how many fragments would shed on average from the mattress the cotton material was rubbed against the mattress and then taped. The number of foam fragments counted on average was 185.

Once the denim and or cotton material had been seeded with 20 or 50 foam fragments the material was pinned to the laboratory coat of a volunteer who would wear it for a set time period. This was then removed, taped and foam fragments on the tapes counted. Results of the experiments can be seen in the following tables.

Clearly most of the foam fragments are lost in the first two hours.

We have already said that we are going to assume that the 15 foam fragments found on the victim's dress were transferred from the lorry seat. Earlier we mentioned two possible scenarios: either the victim was murdered in the forest less than 4 hours after leaving the lorry or the victim left the lorry in London and was murdered more than 4 hours later. If the first scenario is correct the suspect is lying and we assume that he drove the victim, in his lorry, to the edge or near the forest where she was murdered at the spot where her body was found.

RESULTS

TABLE I. SUMMARY OF REMAINING FOAM FRAGMENTS – AVERAGE

Time [hours]	Blue denim	Black and white cotton
1	20 seeded – 12.8 remained	20 seeded – 9.4 remained
2	20 seeded – 7.5 remained	20 seeded – 1 remained
4	20 seeded – 4 remained	20 seeded – 0.5 remained
4	–	50 seeded – 0 remained
4	–	185 seeded – 15 remained
7	–	185 seeded – 2 remained

TABLE II. BLUE DENIM MATERIAL – EXTRAPOLATED

Time [hours]	No. retained average	Retention average [%]	No. retained range	Retention range [%]
0	185	100	185	100
1	118	64	74–166.5	40–90
2	70	38	37–102	20–55
4	37	20	18.5–55.5	10–30

TABLE III. BLACK AND WHITE MATERIAL – EXTRAPOLATED AND ORIGINAL RESULTS

Time [hours]	No. retained average	Retention average [%]	No. retained range	Retention range [%]
0	185	100	185	100
1	87	47	18.5–139	10–75
2	9	5	0–18.5	0–10
4	6.7	3.6	0–15	0–8.1
7	2	1.1	0–2	0–1.1

She is likely to have a lot of foam fragments on her clothing but probably far less than the 700 fragments removed from the passenger seat, with sellotape, after the offence. Immediately she jumped or was lifted from the lorry, foam fragments would begin to fall off. If lifted some fragments would have transferred to the suspect.

From our experiments some fragments would fall off quickly. If the victim walked or was dragged fragments would be lost. If she put up a fight many could be lost in a short time (this was not experimentally tested but seems logical). Furthermore if this happened on October 20th 1979 she would have spent three days laying in the open before being discovered. Although there would be no movement it is fair to assume that some fragments would be lost to the elements and the ground on which she lay. Finally, the body would have been disturbed when being placed in the body bag. Fragments would have been "lost" in the bag and when the clothing was removed and packaged. The experimentation and these assumptions mean that this scenario cannot be discounted.

The second scenario favours the suspect. We assume that 700 foam fragments are transferred to the victim's clothing when she leaves the lorry in London.

From our experiments where we can see that 15 fragments could remain after 4 hours from an original figure of 185. If 700 were transferred then approximately 50 could be present after 4 hours. This is a loose estimate based on a volunteer carrying out normal tasks in a laboratory. The degree of activity of someone hitchhiking or walking in the open air would be much greater. Loss of foam would continue as the victim got into any second vehicle and some would be deposited into the vehicle. Finally fragments would be lost between the second vehicle and the place where the body was dumped, during any struggle, to the elements, on the surrounding ground and during body bagging and removal/packaging of clothing.

If we presume that the time taken from leaving the lorry in London to the victim meeting her death is two hours laboratory experiments show that between 35 and 196 fragments from a transfer of 700 could be present. We have

already discussed the levels and types of activity involved in this case which would have resulted in loss of foam although the exact amount is unknown.

In our opinion this scenario would be just about possible with a two-hour time interval if the sequence of events were as follows.

Hundreds of foam fragments would have to have been transferred to the victim's clothing whilst in the lorry. Having left the lorry in London she would have needed to get another lift very quickly. Her body would probably have to have been dumped in the forest (40 miles away) within two hours of her leaving the lorry.

If the time interval is four hours, which is more feasible, the scenario becomes very much less likely. This means we feel the experimental results and the probable activity levels as discussed are supportive of the first scenario but the second cannot be absolutely discounted. It is our belief that the findings provide moderate support for the proposition that the victim was murdered in the forest less than 4 hours after leaving the lorry.

This conclusion is based on the following scale of support for a given proposition scenario: no support; weak; moderate; moderately strong; strong; very strong.

Without going into detail the experimental results are very similar to those obtained by Pounds and Smalldon [1, 2] in their fibres experiments published in 1975. Incidentally the jury decided that although scientific tests suggested the victim had at some stage been in the suspect's lorry there was nothing to link him directly to the murder, or the murder scene. After a four-week trial the jury took just 75 minutes to clear the suspect of murder.

References:

1. Pounds C. A., Smalldon K. W., The Transfer of Fibres between Clothing Materials during Simulated Contacts and their Persistence during Wear – Part 1: Fibre Transference, *Journal of the Forensic Science Society* 1975, vol. 15, pp. 17–27.
2. Pounds C. A., Smalldon K. W., The Transfer of Fibres between Clothing Materials during Simulated Contacts and their Persistence during Wear – Part 2: Fibre Transference, *Journal of the Forensic Science Society* 1975; vol. 15, pp. 29–37.