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Forensic Methods of Detection and Removing Fiber Microparticles from Objects in Detecting Crimes

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Abstract: It is known that at the scene of a crime, traces of various objects, materials and particles of substances that are in contact with it always remain. In the article, the determination of the nature of fiber microparticles, their group affiliation and source of origin provides the investigator and researcher with important informative information to clarify the circumstances of the crime. Also, the exceptional importance of fiber microparticles in determining the time and place of the crime was investigated and explained with examples. In addition to studying the most widespread methods of removing textile fiber particles from movable objects in world practice, a number of necessary shortcomings of the method were also studied, and research conducted in this field was studied and examples were shown.

Keywords: *crime, forensic, film, tape, woven fibres, robbery, theft, microparticles, objects*

INTRODUCTION

It is known that at the place of a crime, traces of various objects, materials and particles of substances

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that are in contact with it always remain. The role and importance of fiber microparticles as information carriers of forensic importance in the detection and investigation of serious crimes of greed, greed-violent and violent nature, such as murder, rape, theft, robbery, etc. The determination of the nature of fiber microparticles, their group affiliation and source of origin provides the investigator with important information to clarify the circumstances of the crime (Алиев, 2016). Fiber microparticles are also of exceptional importance in determining the time and place of the crime. In world practice, the most common method of removing woven fiber particles from movable objects is by applying adhesive film. Along with this possible method, a number of necessary shortcomings of this method are noted below:

The complexity of localization of the location of woven fiber particles, contamination of small-area films, the impossibility of processing due to the shape and properties of the object, the small size of the required area, spinning of the film, the lack of sufficient technical durability of the film, etc. As a new method free from all these shortcomings, forensic researchers propose the use of adhesive boards. According to the structure of the mentioned board, it consists of a 100x130-mm polyester film, on the surface of which a 100x100-mm "grid" is previously drawn, which are divided into 10x10-mm squares and marked. The film is attached to the glass plate with a "scotch" type tape. Depending on the size of the plate, four or more tapes can be attached side by side. The film is then covered with a "Double Coated" type tape to form a single area (Гросс, 1908, p. 92).

The adhesive plate is carefully torn off the glass piece and transferred to clean plastic tracing sheets measuring 23x28 cm. Such plates can be used for several contacts with the treated area. Before each new contact, the plate is examined under a laser microscope, if luminescent fibers were used in the study of the fibers, they are examined by laser illumination. The locations of their placement are marked with a felt-tip pen, and the fibers are transferred to the surface of the comparison glass with thin tweezers. This method is universally free from a number of disadvantages of previously used methods. The advantages of the "adhesive plate" method are: The size of the processing area, the possibility of precise localization of the found fibers, the low sorption of ambient fibers to the surface of the board, the main features of the "Double Coated" adhesive tape, etc. Forensic investigation and expert experience show that the formation of textile fiber particles can be found in almost all crimes within the framework of the use of fibrous materials. These inclusions are found in various objects, and the results of the conducted examinations give grounds to state the following opinions (Аверьянова et al, 2017, p. 24).

Woven fiber particles are most often detected when they come into contact with the active movements of the criminal and his clothing. In the series of crimes commited where fibred particles are detected are: murder, rape, harm to health, etc (Huseynov et al, 2025). In this case, the mutual passage of individual particles of woven fibers, even threads, loops, and fabric particles from clothing is observed. Fibers can also remain on the criminal instruments used in the commission of the crime (Aliyev, 2024). A significant amount of fiber inclusions are formed at the crime scene, especially on objects, objects of the material environment, and on the criminal himself during movement. The search and detection of woven fiber particles in any other micro-object has a number of tactical features compared to other traces, the most important of which is their selection by the naked eye (Mahmudov, 2006, pp. 207-214).

The practice of working with microobjects requires compliance with the following general rules: During the inspection of the crime scene, it is not allowed for many people to be present or move in places where fibers are likely to be present. Because when objects are moved or touched, the fibers change their location and can be replaced by someone else. In addition, when outsiders move around the crime scene, fibers from their outer clothing may be left behind. If the presence of outsiders is inevitable or necessary, their places of movement should be specified. Persons searching for particles of woven fibers should be careful not to contaminate the objects being examined and not to erase traces that may remain on the objects (Khalilov & Mirzezade, 2024). For this purpose, it is necessary to use clothes made of white synthetic materials made of smooth fabrics. It is considered advisable to work with medical gloves at the crime scene. If there is no special clothing, you can wear a white cotton robe, because even if white cotton fibers fall on things, it is not difficult to recognize them. This is because white cotton fibers are often encountered in everyday life, in the air and other places. The sleeves of the clothing or robe should be cleaned with a white cotton wet cloth or with the foam part of a sponge. This action is done in order to remove extraneous fiber particles (Крылов, 1980, p. 41-44).

It is necessary to search for particles of woven fibers purposefully. Initially, it is necessary to specify the places where the fibers may be, taking into account the characteristics of the crime and the probable actions of the participants. It is important to distinguish these parts when the integrity of the dust on the objects is broken, when there are damages. In this case, the focus is not on understanding the traces, but on determining the inevitable changes in the conditions of the objects (Karimli & Ozturk, 2025). In this sense, the statements of the victims and witnesses about the conditions before the crime can be of significant help. After all the probable hypotheses are ready, the sequence of their verification should be organized in such a way that there are no obstacles to the verification of the following ones. When searching for particles of textile fibers, it is necessary to determine in a timely manner what types of fibers can be carried by products made of fibrous material from the crime scene and on clothing, and to take samples from these products. To search for particles of textile fibers, it is advisable to start first of all from the place where the criminal enters and exits the apartment. However, special attention should be paid to those items with which the criminal is most likely to come into contact. Also, searching for fibers in the clothing and body of a corpse requires special experience and care, since turning and transporting the corpse inevitably leads to the replacement, loss, and displacement of fibers. Therefore, their search should be carried out directly from the moment of confirmation of death, together with a forensic expert, until the external examination (Aliyev et al, 2025). The search for woven fiber particles is carried out sequentially, starting from the exposed parts of the body and moving to the upper clothing. All found fibers must be protected from damage. Only then can the body be turned over and the clothing removed. When searching for woven fiber particles in open areas, special attention should be paid to the places where the criminal sat, lay, or knelt, as well as not only the bark of trees and plants at the scene of the crime, but also those located along the path of movement. Specially trained service dogs provide the necessary assistance in finding them. Because the direction of the criminal's movement is the objects that are in contact with him. Investigative practice shows that there is a certain dependence between the location of woven fiber particles and the type of crime. Usually, fibers are found on objects that have been in mechanical contact with the objects that formed the trace (Лебедев, 1999, pp. 5-14).

LITERATURE REVIEW

Experience shows that more woven fiber particles are found on objects that the perpetrator comes into contact with while at the scene and when leaving it. There are several specific places that are more "suitable" for the placement of woven fiber particles: such inclusions can be found practically in all areas of the victim's clothing and body. These fibrous materials depend on the mechanism of contact with the products: During the criminal's struggle with the victim, the fibers of clothing items are more likely to be found on the buttons; during an attack from behind, they are found in the neck, back, and shoulders: If the perpetrator has entered the victim's pockets, the fibers of his clothing can be found in the lining of the victim's coat, jacket, pockets, bag, and briefcase. If the victim's mouth is tied with a bandage, etc., textile fiber particles can be found in the mouth area and between the teeth. The fibers can remain there when the hands are tied (Аверьянова et al, 2017, p. 76). Woven fiber particles are located throughout the surface of the victim's clothing, the body, in which the victim is wrapped in any material. During rape, woven fiber particles from the offender's clothing remain on both the victim's outerwear and underwear, and are often found on the inside of the clothing. On the victim's body, they usually remain on the hands, shoulders, breasts, thighs, and groin. It is characteristic that at this time, fibers from pieces of these items are found in the listed areas of the human body when the victim is lying on these objects (Tofig, 2024). In practice, it is possible to encounter cases when the victim's clothing was either removed by the offender or lost for some reason. In such cases, the victim's place of residence should be thoroughly examined. Here, it is possible to find woven fiber particles from clothing items that are not there, as well as fiber samples from other products. For example, which can remain as dirt on these items and, therefore, can be on the subject of the crime. Fibers are located on the clothes and body of the criminal in the same way as on the victim. During the struggle with the victim, the criminal, as a rule, remains with the fibers of the victim's clothing (Майлис, 2001, pp. 13-15). During the investigation of crimes involving harm to health, it is necessary to examine the suspect's shoes, in addition to his hands and clothes. If the criminal has carried the victim from one place to another, the fibers of the victim's clothing may remain on the criminal's shoulders, arms, armpits, thighs and knees. When stolen items are transported, fibrous materials form fibrous inclusions in the criminal's clothing. In practice, it has been found that such fibers have been found on the clothing of the suspect in the theft several years later (Behbudov et al, 2024).

During the investigation of a rape incident, it is necessary to first look for woven fiber particles of the victim's clothing on the front and inner sides, folds, buttons, and sleeves. Woven fiber particles of the furniture and bedding of the apartment where the crime was committed are often found in the knee and elbow areas. At the scene of the crime, criminals often sit, stand on furniture, etc. Therefore, woven fiber particles can be found on the back, trousers, shoe uppers, carpet, etc. In addition, fibers from the clothing of people who were in the room can get on the criminal's clothing. Including the owners of the apartment where the theft was committed. In this way, fibers also remain on the clothing and sometimes on the arms of the criminal who used the vehicle in cases of theft or hijacking of a vehicle (Азаренко, 2000, p. 86). It is known from many criminal cases that after the victim is attacked, the criminal wraps the weapon he inflicted the injury with in paper or other fibrous material and leaves it wrapped at the crime scene (Белкин, 2001 p. 25). Often, it is possible to find woven fiber particles from

the criminal's clothing on the surface of the packaging. As mentioned above, woven fiber particles from the criminal's clothing remain at the crime scene. During the search, it is important to pay attention to areas with natural obstacles, such as fences, bushes, trees, and narrow passages. Basically, all obstacles encountered by the criminal while moving, especially their sharp protruding parts, edges, and corners, should be considered as possible carriers of woven fibers and other microobjects. Often around the crime scene, products made of separate fibrous materials or fibrous objects, such as buttons, knives, etc., are found, which the criminal either lost or threw away (Khalilov & Mirzazade, 2025). The use of trained service search dogs can help in searching for these objects. Therefore, fibers from the criminal's clothing and gloves may remain on mechanisms that have been subjected to mechanical damage. In all these cases, sharp, jagged edges, fingernails, parts of locking devices, and rough areas of other damage can be traces. Fibers can remain on broken barriers not only when they are destroyed, but also when they are passed through (Белкин, 1969, pp. 33-37). Fibers from the subject of the crime are more likely to be present at the scene of the crime: In objects that the criminal has touched, lay on, sat on, etc. It is also important to pay special attention to narrow passages between objects of the object environment, destructive, breakable objects, objects on which the criminal was forced to apply physical force. There may be fiber-bearing objects left by the criminal at the scene of the crime. In order to search for them, the statements of witnesses and victims who are well acquainted with the conditions of the place or apartment before the crime are of great importance. In road traffic accidents, fiber-bearing vehicles act as a trace-forming object, and the victim's clothing is an object. The fibers from the victim's clothing or on it found in a vehicle are sometimes important not only in solving the crime, but also in its assessment. For this purpose, when examining vehicles, it is necessary to examine the areas where the fibers of the victim's objects may remain (Sarijanlinskaya,1999, p. 87). However, it should be taken into account that when cleaning vehicles, cloth, scrap and other materials are used. Therefore, in any specific case, it is necessary to specify the location of the fibers left on the clothing, taking into account the circumstances of this case, the injuries on the vehicle, the body and clothing of the victim. In some cases, during the investigation of traffic accidents, it is considered important to clarify who was behind the wheel based on the incident. This can be determined by the specific location of the fibers. At the time of impact, the largest part of the fibers from the clothing of the person driving the vehicle remains on the steering wheel and other control mechanisms, but fibers may also remain from the clothing of the people in the car. All of the above factors, the analysis of the ways and methods of detecting fibrous materials during the examination of the scene of the accident, and other investigative actions should also be considered important and necessary (Mahmudov, 2003, pp. 25-26). For the detection and removal of woven fibers, simple devices and apparatuses adapted to work with small amounts of substances and materials are used by investigators, experts and forensic technicians. In addition, and especially in cases where fibers are suspected, special adhesive films and tapes are used. When searching for individual fibers and fibers in general, powerful illuminators and magnifiers, optical devices are used. If the color of the fibers is the same or similar to the object on which they are located, colored light filters are used to facilitate the study, which enhance the contrast of the fibers with the carrier objects. The fixation of fibers has procedural and scientific-technical aspects. In the procedural sense, the registration of fibers is the confirmation of the fact of their discovery and removal. This ensures that they are given the status of material evidence (Cəfərquliev,2002, pp. 4-7]. Procedural

registration is the compilation of a protocol of the investigative action, during which the woven fibers are found and removed. The protocol should reflect the sequence of actions for finding and removing the fibers, the means and methods of storing and packaging the places of their discovery. In addition to fibers and objects, photographs, hand-drawn drawings, and diagrams are attached to the protocol.

METHODOLOGY

In scientific and technical terms, these are specific manipulations with fixed fibers that accurately reflect their appearance, signs of the place of their discovery, and also ensure the long-term preservation of their important qualities for the confirmation of important signs in the case. The removal of textile fiber particles as a technical method means their separation from the carrier object and removal to a protected environment (Белкин, 2001, pp. 61-63). "Adhesive" film materials are suitable for removing sparsely located fibers. To remove the accumulation of fibers from the carrier objects, it is necessary to use tweezers, needles or other tools. In some works, the authors recommend using vacuum cleaners to remove fiber particles. Experience shows that the use of such devices should be considered unsatisfactory and inefficient. When they are used, a large amount of foreign particles are sucked in, which makes it much more difficult to find woven fibers for subsequent examination. The use of vacuum cleaners should be considered appropriate for removing fibers from large areas of products, from deep, cracks, narrow and inaccessible places. For finding and removing individual fibers, the use of the following technical means should be considered more appropriate and efficient (Аверьянова et al, 2017, p. 87).

All illuminating devices that emit strong light can be used as light sources. The use of portable mobile "Svet-1000" or similar illuminators used during film and photography gives good results when examining individual objects and their fragments (Garibli, 2025). The use of collagen lamp illuminators for this purpose is very effective. In some cases, in order to find fibers, it is necessary to examine the carrier objects in strong light directed at an angle or in colored light. For this purpose, specialized illuminators used in microscopy with special slots for light filters are useful: OI-19 (lamp 8W, 20W); OI-9m (this illuminator allows you to illuminate a 2.5 times larger area); OI-24 (lamp 12W, 100W). If the search for fibers is carried out in an open area, in a dark room or in a dark house, illuminators with an autonomous source of electrical energy are used (if there is no direct electricity supply) (Белкин, 2001, pp. 59-69). Fire extinguishers, household flashlights, magnifying optical devices: Loupes and microscopes are used to work with microobjects outside the laboratory. Loupes with a large linear field of view can be used to find textile fibers in the human body and other parts. The use of loupes with an illuminator and a tripod can also be considered effective. Loupes with an illuminator allow working in low light: the use of tripod loupes allows the expert or forensic scientist examining the scene to keep his hands free while searching for or removing fibers (Ozturk et al. 2024). The interchangeable loupe produced by the medical industry is very convenient for finding and removing textile fibers in adverse conditions. It is worn on the head. Its power supply is provided by a battery or a direct line through a step-down transformer. The magnifying power of the magnifier in the illuminator is 2 times, but it can be easily replaced with a more powerful one. When searching for woven fibers on large surfaces, the use of binocular stereoscopic microscopes of the MBS-1, MBS-2, "Technika" type is convenient. However,

they are used only for stationary studies. A simple device has been developed at the Institute of Forensic Science of the Ministry of Internal Affairs of the Republic of Poland, with the help of which it is possible to use these microscopes in conditions outside the laboratory for working with microobjects. The device consists of three moving supports, a chrome-plated head for fixing the microscope, and a support for holding the microscope with a tripod. The supports on the tripod are raised at their focal length during work with the microscope (Белкин, 1969, pp. 10-12).

RESULTS

It is necessary to approach the issues related to the preliminary examination of fiber particles and carrier objects with caution. It is especially important to note that the preliminary examination can never replace procedural actions, work with fiber particles is carried out only within the framework of procedural actions. The results of procedural actions have both evidentiary and operational-tactical significance. The preliminary investigation is not reflected in procedural documents, its results have no evidentiary force, information obtained in a non-procedural form is used only for operational-tactical purposes (Abbasov et al, 2024).

Therefore, when there is a basis for conducting investigative actions, a procedural examination with fiber microparticles is carried out. Since the preliminary examination is distinguished from procedural actions by its legal nature, their combination by law is not intended and is unacceptable. Failure to explain the essence of any operation with fiber particles during investigative actions to witnesses and not to record it in this protocol means a violation of the legislation. If the investigator opens the package and conducts an investigation of objects in a non-procedural manner, this not only nullifies the confirmatory measures, but also means that the fact of finding specific particles on the objects is not assessed. The reasons mentioned above mean a direct violation of procedural rules, such as the failure to pack material evidence in the presence of witnesses (Бразоль, 1997, p. 97). The detection and removal of woven fiber particles is considered an important issue not only for the investigator, but also for the expert. In the event that the investigator cannot detect woven fiber particles separately, all possible carriers are submitted for examination. Therefore, often the clothing of the person suspected of committing the crime and the victim is submitted for examination (Garibli, 2024).

DISCUSSION

The effectiveness of the expert examination of carrier objects containing fiber particles is largely determined by the correct choice of the methodology for finding and removing microtraces. Currently, porous foam materials, brushes, vacuum cleaners and other means are widely used in expert practice to remove fiber-origin microparticles. In order to promptly remove fiber-origin objects and particles from the crime scene and other areas, a new methodology for conducting examinations is being applied in the Expert Examination. After visual inspection of the material evidence, the fibrous particles on it are removed with the help of transparent, adhesive tape. Then, the adhesive side of the tape is glued together with the microfibers to a transparent polyethylene base or silicate glass slide. In this way, an optically transparent binary layer is obtained. Then, the fibers in these layers are marked in a certain way in reflected light using a microscope "Leica M205C" or MBS type microscopes, which

can magnify the fibers by 12-74 times (Аверьянова et al, 2017, p. 37). The fibrous particles, remaining in the binary layer, are examined in the transmitted light of the microscope in order to determine their origin. The results of the conducted research should be summarized and presented in a table. Experience shows that adhesion agents and solvent liquids do not affect the structure of the fibers. Experts mainly use a transparent polymer base, on which two types of lavsan and triacetate films are glued. The width of these films is 1075 mm, and the thickness is 100, 80 or 12 mm, according to TU 6-18-481-78. By the way, it should be noted that triacetate bases have higher optical properties.

CONCLUSION

The forensic study of fiber particles is one of the less studied areas compared to other forensic research areas. In this sense, there are enough scientific, theoretical, methodological problems waiting to be solved here. Scientific and technical progress, in turn, creates conditions for the creation and application of new methods, techniques and tools that allow each field of science to be improved and the level of efficiency to be increased. Fiber particles are important carriers of evidentiary and guiding information. They help to clarify a wide variety of facts, including the mutual contact of the clothes of the victim and the suspect, the presence of the person in a certain place, the path taken by the criminal to the place of the crime, and what objects he touched, what he was wearing, his profession, the possible displacement of the corpse, in short, many other issues that are important for the investigation and solving of the crime. Also, the provision of modern technical and forensic tools, the impact of scientific and technical progress on expert methods, allows us to successfully detect, record, capture and study a wide variety of micro-objects, and ultimately, to obtain information that was previously impossible and is important for solving and investigating crimes.

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