PAINT

COLLECTION:

Any disruption to the crime scene area could potentially contaminate the paint evidence. Investigators can then proceed to collect the paint sample, typically by carefully scraping or peeling the paint from the surface area where it was located. Tools such as tweezers might be used during the collection process.

In order to collect and preserve paint evidence, it is important to start with securing the scene of the crime. Prior to the collection of a paint sample, the area containing the sample should be photographed without disrupting the evidence. Any disruption to the crime scene area could potentially contaminate the paint evidence. Investigators can then proceed to collect the paint sample, typically by carefully scraping or peeling the paint from the surface area where it was located. Tools such as tweezers might be used during the collection process.

Until the paint evidence can be forensically examined, it should be carefully preserved so that it remains unaltered while it is transferred from the crime scene to the laboratory. All paint samples should be kept in separate containers. If paint evidence is found on clothing, it should not be removed. Rather, the clothing should be rolled up in paper and sent to the lab.

Once in the lab, the examination will begin. Investigators will look for several things, such as the edges of the paint sample, and whether or not there are multiple layers of paint present beyond the surface layer. In our example story, this could help police determine if the culprit's car is newer or older, as a paint chip from a car that has been painted several times over the years is likely to have multiple paint layers.

Packaging:

There's a simple rule of thumb for deciding which type of evidence packaging—wet evidence goes in paper containers (wet evidence can degrade if placed inside plastic containers) and dry evidence goes in plastic.

Examination:

Analysis of Paint

In Forensic Science, the aim of paint analysis is to find its

source of origin by comparing the questioned sample with

the standard. The paint can be found from any sources present on scene of crime such as tools, walls, glass and glass

fragments, fingers, nails, roads, motor vehicles etc. for the

better analysis and good results the proper sample should

be available. For the collection of samples proper equipments should be used such as sharp edge knife for scraping, white paper funnels for the chip collection, sealing of

paint chip in container etc. The samples can be obtained

from the areas like wall, ceiling, door, window, automobile

door etc. The known samples collected should have all layers of undamaged paint film. The known samples should

be packaged carefully. Sometimes paint flakes are also

collected for the purpose of analysis. Paint flakes are also

removed by several methods or by using instruments like

blade, knife etc. or by gently impacting on opposite side of

the painted surface.

Microscopic Techniques

Initial examination of paint is carried out by stereomicroscope. The stereomicroscope is used to determine the number, sequence, colour, thickness and texture of each layer in

paint. The cross section of paint is revealed by cutting the

paint chip perpendicular to the surface by using the microtone. Polarized Light Microscope is used to study the optical properties of transparent sample such as pigments using

the transmitted polarized light. Polarized Light Microscopy

can be used for both identification and comparison purpose.

Plane polarized light is used to observe colour, pleochroism,

opacity and to determine refractive index.

Fluorescence microscope is used to observe the visible fluorescence of opaque and transparent samples. Fluorescence

occurs when light absorb the material is re-emitted with longer wavelength. In this microscope, light reaching the sample

and light reaching the eyepiece is regulated by many filters.

Many pigments, binders, coatings are fluorescent. Fluorescence microscopy is used to distinguish layers and particles that appear similar in visible light.

Spectroscopic Techniques Spectroscopy is the interaction of light with the matter. The most powerful and popular technique for the examination of paint is Fourier Transform Infrared Spectroscopy. Even small samples can be easily examined by the IR spectroscopy. The technique is useful for the identification of polymer binder, pigments and fillers present in each layer of the paint. Both organic and inorganic components can be detected using the IR spectroscopy. The pigments and fillers will give small speaks in spectra. However identification of organic pigments is difficult due to their low concentration in the paint. The X-ray Fluorescence technique is also a good technique for the paint examination. It is based on the emission of characteristics X-ray by the sample on excitation by X-ray source. The XRF gives the information of elemental data of single or multiple layers. The variation in thickness of layers may cause the variations in the X-rays ratios of element present; this technique is used for both for the purpose of comparison and qualitation. The XRF is also very useful for the elemental analysis of lead in paint. Raman spectroscopy can also be used for the identification of binders, pigments, additive and coatings. Raman spectroscopy is useful for the analysis of inorganic pigments and additives because like Far-IR spectroscopy, it can provide information about low frequency Vibrational transition. Raman spectroscopy has advantage over IR spectroscopy. The organic and inorganic pigments are infrared active but they are very difficult to distinguish as their absorptions are low. The pigments have strong absorption in Raman Spectroscopy. Raman peaks are sharp and they do not overlap unlike IR peaks. The Raman Spectroscopy is very useful in the identification of car paints. Micro-chemical Test The test is also known as solvent test. It is based on reactions of pigments and binder with the oxidizing and reducing agents. The test is destructive in nature. The test is applied to both known and questioned sample. Reactions such as layer dissolution, swelling, softening, filler effervescence, and flocculation and colour changes are noted. Pyrolysis Gas Chromatography-Mass Spectroscopy Py-GC/MS is a destructive technique that uses the pyrolytic breakdown of products to differentiate the types of binders and plasticizers in paints .The total ion chromatogram also gives the information regarding the additives, pigments and impurities. The automobile paints are high complex polymer mixtures having the multiple layers of polymers. With the high complex polymers, certain substances such as oxides of metals are added to introduce the property of opacity, this make the paint samples difficult to analyse using normal techniques. The Pyrolysis of the sample decreases the polymeric content leaving behind inorganic constituents. The presence or absence of monomers helps in distinguishing the paint sample from others. The technique is also useful in determination of approximate age of paints.

Soil

Collection :

Soil samples can be collected in different ways depending on where the sample is being collected from. If samples are being collected indoors or from a vehicle vacuuming is generally used. If the sample is outdoors it’s collected by placing a teaspoon of soil into a plastic vial. When found on a tool, it is wrapped in plastic and then sent to the lab for testing. Collecting soil samples off of a body isn’t any harder than collecting a sample from anywhere else but it takes more work and care so that the evidence doesn’t get contaminated. When collecting samples from a body, samples should be taken at regular intervals and a different spoon should be used each time.

Packaging :

**Each evidentiary item bearing soil should be photographed and its location should be duly indicated**. Wherever relevant, the depth of the location should also be recorded. The impression evidence should be documented before and after casting.

The samples should be packed in **screw-top plastic containers or screw-top centrifuge tubes** 45 (Fig. 4). Glass containers may also be used, but only after proper padding so as to avoid breakage during transportation.

Examination:

UNUSUAL MATTER

Macroscopic observation and low-power stereomicroscopic observation is important

at the initial step of forensic soil examination. It will be lucky for examiners if

unique particles such as paint chips, fibers with distinctive color, glass fragments

can be found both in a questioned soil sample and a control one. The examination

can be focused on these unusual matter in soil, and at this step soil is only

background of evidence.In some articles described interesting cases in which unusual matter could be the key to identify soil evidence and related materials. In a murder case in California, victimís body was dropped at a oil well apron where gravel which was transported from 300 mile south was used. Soil material found in the suspectís car was compared with those around the oil well apron. The questioned sample from the car contained rock fragments which were the same with the imported gravel (1, 4). Blue thread gave key information in a rape case in Upper Michigan. Three flower pots had been tipped over and spilled on the floor in the struggle. Potting soil on the suspectís shoe was compared with one of those flower pot spillings. Small clipping of blue thread existed both in that flower pot sample and on the shoe of the suspect (1). In another rape case in New Jersey, that happened at a vacant lot in back of a bar, coal fragments was important. The suspect had soil samples in the cuffs of his pants that were typical glacial sand of northern New Jersey. In addition, the soil contained fragments of clean Pennsylvania anthracite coal. In this sample there was too much coal when compared with samples in the surrounding area. Further investigation showed that some 60 years ago, the vacant lot was the coal pile of a coal burning laundry (1, 2). A police officer happened to look at a man arrested on a minor crime. He observed ìthatís the worst case of dandruff I have ever seen.î It was not dandruff but diatomaceous earth that compared species-to-species with the insulation materials of a safe that had been ripped the previous day (1, 4). There was a murder case in Hiroshima, Japan, in which the body of victim, who was a professor of the university, was found in his office with sand on his body. The reason why sand was put on the body was not clear, but the sample collected from sand storage for a sand bath in a laboratory where the suspect was working was compared with that on the body. Cell fragments with unique shape existed both in the sand on the body and that in the sand storage (11). A woman who lived in Yokohama in Japan killed her husband. She and her daughter carried the body 100 km to the west, and abandoned the body in forest where lava from volcano Mt. Fuji distributed. This lava has distinctive characteristics that are black porous baslt with strong magnetic force and white phenocrysts of bytownite (calcium rich plagioclase). Soil material was collected from floor mat and trunk of suspectís vehicle. In these samples black rock fragments were found. But the area of Yokohama, where the suspect was living, is widely covered with loamy soil developed from thick sediment of fine volcanic ash, and rock does not originally exist. The rock fragments were identified as the lava originated from Mt. Fuji on the basis of the distinctive characteristics (12).

SCREENING METHOD

The forensic soil comparison stands on considerable variation among soil. The

significance of match between questioned samples and control ones must be

interpreted in consideration of the intra-sample variation within questioned samples

and control samples. As it is needed to demonstrate the range of local difference of

soil for interpretation, the number of soil samples collected for comparison

inevitably increase. Simple and rapid screening methods, therefore, are required for

successful identification from a large number of soil samples. Color comparison and

determination of particle size distribution for soil samples can be carried out quite

easily, and the combined data can be quite useful for discriminating among similar

samples. Junger (14) has examined discriminating power of air-dried soil color and

particle size distribution on soil samples, which had been collected systematically.

Color comparison on air-dried soil alone is insufficient for discrimination of

samples. In order to increase discriminating power Sugita and Marumo (15) studied

multiple color observation on soil samples. This method composed of color

observation on air-dried soil, moistened soil, the soil after decomposition of organic

matter using hydrogen peroxide, the soil after removal of iron oxides using sodium

dithionite, and the soil ignited at 850 °C in an electric furnace. For the soil after

decomposition of organic matter and after removal of iron oxides, finer particle

fraction will be preferable color observation. Namely, the surface of dried deposit by

centrifuging after these treatments, because it is more homogeneous than the bulk

sample.

Fibre

Collection

Identifying rare or unusual fibers at a crime scene has increased in significance, as it may place a suspect at the scene of the crime. Fibers are gathered from a crime scene using tweezers, tape, or a vacuum. The most common sources of transferred fibers are clothing, drapes, rugs, furniture, and blankets.

Packaging

Typical packaging for fiber evidence includes, but is not limited to, pill boxes, paper bags, and cardboard boxes. An appropriately sized container shall be used for the item of evidence being packaged. Keep all items separated before packaging to prevent cross-contamination.

Examination

### Scanning electron microscopy**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Fiber_analysis&action=edit&section=2)**]**

*Main article:*[*Scanning electron microscope*](https://en.wikipedia.org/wiki/Scanning_electron_microscope)

SEM opened sample chamber

Scanning electron microscopy (SEM) is method of photography which requires an instrument called the [scanning electron microscope](https://en.wikipedia.org/wiki/Scanning_electron_microscope), which uses electrons rather than light to form an image. There are many advantages to using the SEM instead of a light microscope. Using SEM requires a large [depth of field](https://en.wikipedia.org/wiki/Depth_of_field), which allows a large amount of the sample to be in focus at one time.[[4]](https://en.wikipedia.org/wiki/Fiber_analysis#cite_note-IAStateref-4)

### Atomic force microscopy**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Fiber_analysis&action=edit&section=3)**]**

*Main article:*[*Atomic force microscopy*](https://en.wikipedia.org/wiki/Atomic_force_microscopy)

A commercial AFM setup

Atomic force microscopy is a method which is carried out using an atomic force microscope, which is an instrument that can analyze and characterize samples at the microscopic level. The instrument allows the analyst to look at surface characteristics with very accurate resolution ranging from 100 μm to less than 1 μm.[[5]](https://en.wikipedia.org/wiki/Fiber_analysis#cite_note-TXstateref-5)

### Comparison Microscopy**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Fiber_analysis&action=edit&section=4)**]**

Comparison microscopes are often used by analysts to look at the general characteristics of the fibers. This technique is generally only useful when comparing a known sample from a scene to a possible source. The analysts will look at a cross section of the fibers under a comparison microscope and look at characteristics such as frays, cuts, striations, crimps, colour, thickness, and general shapes within the fiber. The comparison microscope allows for two samples to be observed simultaneously. [[3]](https://en.wikipedia.org/wiki/Fiber_analysis#cite_note-:0-3)

Glass

Collection

All glass found at hit-and-run scenes should be recovered. The search should not be limited to the point of impact, since headlight glass may be dropped off at some distance away as the car leaves the crime scene. Glass from different locations should be kept in different containers. All glass should be collected because more than one type may be present

Packaging

Place small glass fragments in paper bindles, then in coin envelopes, pill boxes, or film cans which can be marked and completely sealed.

Place large glass fragments in boxes. Separate individual pieces with cotton or tissue to prevent breakage and damaged edges during shipment. Seal and mark the box containing them.

Examination

The forensic examination of glass could also be undertaken in two steps. One is that the physical comparison of suspected and control glass fragments and their source and secondly, the examination of glass fractures on fragments and their reconstruction for determining the direction and sequence of impact of projectile.

PHYSICAL COMPARISON FOR EXAMINATION OF GLASS

APPEARANCE- transparent/ milky/ ground/ colored.

Type of glass- ordinary/ borosilicate/ laminated/ pyrex/ automobile glass etc.

The physical examination of glass includes two mainly parameters namely, the thickness and curvature of glass pieces under examination of glass evidence. The thickness of glass sheet varies significantly from one place to another place and do not uniform throughout.

1. EDGE THICKNESS: a micrometer is employ to measure accurately the edge thickness of the glass fragments. Reading should be taken all around the broken edged to find out at which point, the crime exhibits matches with any portion of the broken glass.
2. CURVATURE: a spherometer is used to measure the radius of curvature of the glass fragments having curved surfaces. The radius of curvature of the fragments is calculated using the formulae.

**R= (l2/6h)+(h/2)**

**FLUORESCENCE UNDER UV RADIATION**

Some types of glass fluorescence under ultraviolet radiation with different colors such as brown, violet, purple, blue or green etc. it is considered to be one of the rapid, non-destructive and reliable method for examination of glass.  This examination of glass has to e conducted in a dark room and the glass pieces to be exposed to UV radiation should be of similar size and thickness and they are to be thoroughly washed with acetone or any other solvent to remove grease or dirt.

When there is a clear difference in fluorescence of the two glasses, it indicates different sources of their origin. On the other hand, the similarity in fluorescence by itself cannot be proof of similar source and further tests are to be conducted to arrive at the possible commonness of origin.

**PHYSICAL MATCHING OF FRAGMENTS**

The most conclusive evidence of the source of a piece of broken glass is an exact fit with a broken edge of the original glass. It is done in much the same way in which a jigsaw puzzle is put together. The sizes of fragments, their shapes, and therefore the fractured edges are moved around until the edges of the given pieces are found to correspond.