

Fiber Analysis

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Fiber evidence can be found at crime scenes in a number of different ways. In personal contact between the clothing of a suspect and a victim, cross-transfers may occur. In a break-in, fibers can become fixed to window screens, or broken glass. If a fight occurs, fibers can become fixed to a number of object. In an auto accident, fibers, threads, or even pieces of clothing may adhere to parts of a vehicle.

Fiber analysis does not follow any set procedure. Microscopic examination of both longitudinal and cross sectional samples is generally used. Additional tests such as burning tests and solubility test can also determine the identity of a fiber. Solubility tests are generally beyond the capabilities of most classroom procedures due to solvents required.

Color tests for fibers are also applied using special stains. Since most fibers are colored, dyes must be stripped from the fibers before using the dyeing test. Reagents and procedures required for stripping colors from fibers are generally beyond most classroom procedures and requires a laboratory.

Materials

- Clear tape (Scotch tape or equivalent)
- Microscope, 30x or 40x comparison microscope
- Microscope, compound, 100x, and greater magnification
- Paper, white (or dark colored paper if you are wearing white clothing.)
- Known fiber samples such as wool, cotton, nylon, etc.
- Forceps
- Microscope slides (plastic preferred)
- Cover slips
- Water
- Dropper

Safety Precautions

There are no safety hazards in this procedure.

Procedure

Comparing fibers from your clothing

Pick up fibers from your clothing with a piece of clear tape. Place the tape on a piece of white paper. (Note: If you are wearing white clothing, place the tape on a sheet of dark colored paper) Examine under a microscope. 30x or 40x binocular comparison microscopes are adequate for this activity. 100x or higher power microscopes are preferred for detailed examination..

Natural fibers tend to look like hair and will often have rough external surfaces. Plant fibers, such as cotton, may be more ribbon shaped and may contain twists at irregular

intervals. Synthetic fibers tend to be smooth and uniform, and some may have long extrusion lines on the outer layer.

You always leave trace fibers when you are in contact with another object. Take a piece of clear tape and use it to pick up fibers from several places on your chair. Place the tape on the piece of white paper near the tape with fibers from your clothing. Use the microscope to see if you can identify fibers from your clothing that were on the chair.

Examining known fibers

Place a sample of a known fiber on a microscope slide. Examine it at 30x or 40x under a comparison microscope. Use forceps to handle the fibers. Record the name, appearance, and general properties of the fiber. Draw a sketch of the fiber structure.

For higher magnification studies, place a drop of water on the fiber and cover with a cover slip. Examine the fiber under a compound microscope with magnifications of 100X and 400x. Record the name, appearance, and general properties of the fiber. Draw a sketch of the fiber.

Better identification of fibers is obtained by microscopic examination of fiber cross sections. (See Figure F-1) In this procedure, a bundle of fibers or a piece of yarn is threaded through a cork with needle. Then a very thin slice of the cork is cut using a razor blade. The fibers held in the slice of cork are then viewed under a microscope. This procedure requires advanced techniques.

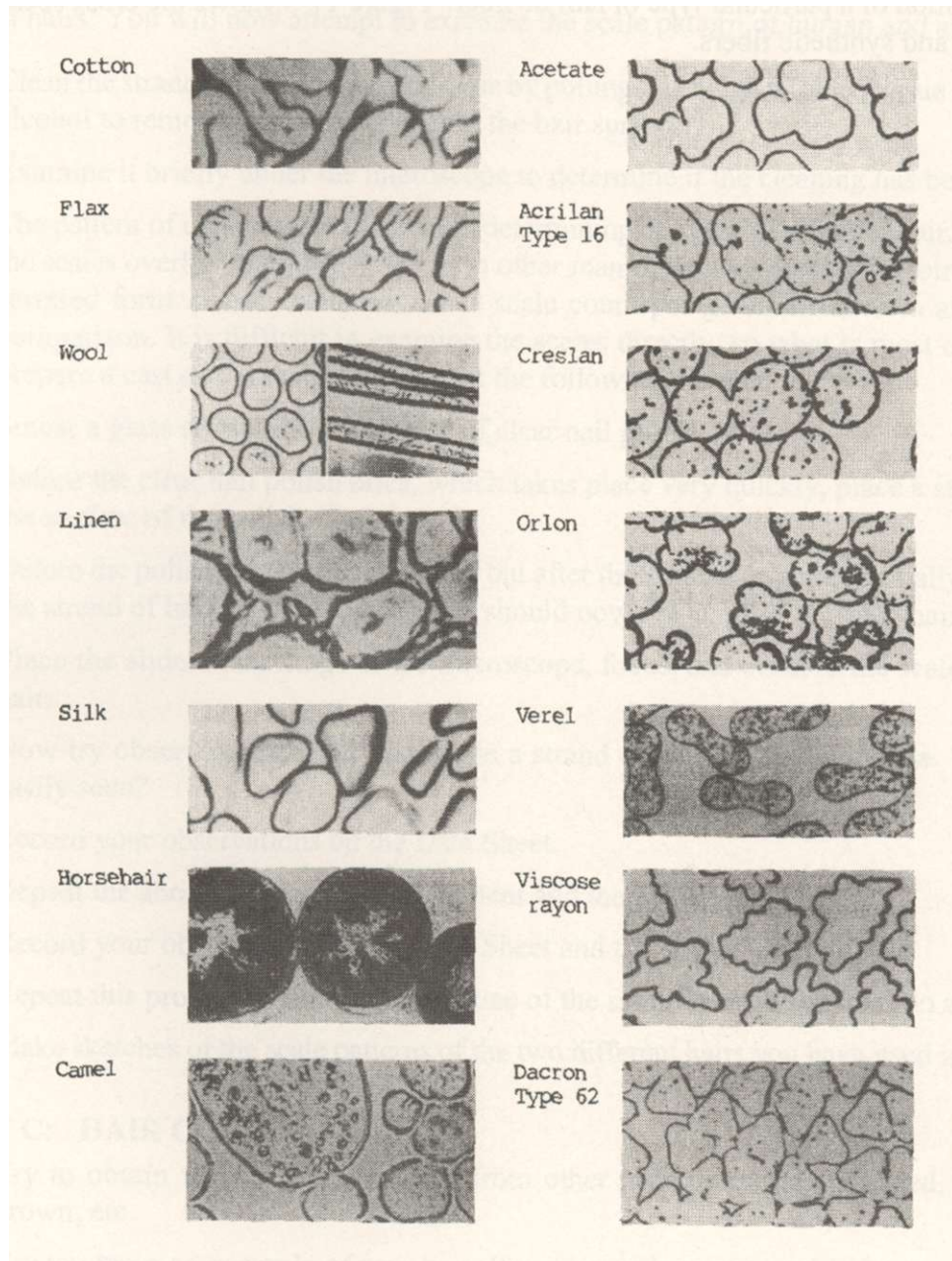


Figure F-1. Cross sections of several natural and synthetic fibers. Reproduced from Melone, et. al., Lab Manual for Crimminalistics, 6th ed, Prentice Hall.

Burning Tests for Fibers

A flame is applied to the end of the fibers, yarn, or cloth.

Materials

Fiber samples: wool, cotton, silk, rayon, and polyester

Forceps

Candle or Bunsen burner

Safety Precautions

The forceps used will get hot. Allow the forceps to cool before handling the tips that were in the fire.

Place any hot or smoldering fibers on a flame proof surface. Allow them to cool before discarding.

Procedure

Light a candle or a Bunsen burner

Holding a fiber, bring it close, but not in direct contact, to the flame. Does the fiber melt, ignite, or curl? Record your observations.

Touch the fiber to the edge of the flame. Does the fiber ignite quickly or slowly? Does it sputter, melt, or drip? Record your observations.

Remove the fiber from the flame. Does it continue to burn? Does it glow and smolder? Does it self-extinguish? Record your observations.

If you note the odor of burning hair: fiber is probably silk or wool

If you note the odor of burning paper: fiber is probably cotton, cupra rayon, viscose rayon, or linen

If the fiber melts and forms beads: fiber is probably acetate, polyester, Dacron, Dynel, nylon or Orlon

If the fiber does not burn: fiber is probably asbestos or a glass fiber

Dyeing Tests for Fibers

Dyeing tests involve the use of T.I.S. Identification stains (available from Testfabrics, Inc., www.testfabrics.com). These are special mixtures of dyes that color different fibers different colors. Since most fibers obtained from a crime scene are colored, they must be stripped of dyes before applying the dyeing tests. The stripping procedures are beyond those of most classrooms.

Materials

- Fiber samples: wool, cotton, silk, rayon, polyester, etc.
- Multifiber fabric #43, (available from Testfabrics, Inc.)
- Forceps or crucible tongs
- Beaker tongs
- Hot plate
- T.I.S. Stain No.1
- T.I.S. Stain No. 3A
- 5% acetic acid, $\text{HC}_2\text{H}_3\text{O}_2$, (vinegar)
- 2 beakers, 400 mL or 600 mL
- disposable gloves

Safety Precautions

Wear safety goggles at all times in the laboratory.

The TIS stains will stain your skin and clothing. Wear disposable gloves and handle all cloth samples with forceps or tongs.

The TIS stains are used at boiling water temperature. Handle the beakers with beaker tongs.

Procedure

T.I.S. Stain no. 1 is recommended for use with natural fibers. T.I.S. Stain no. 3A is recommended for synthetic fibers. Using both stain solutions provides a better match as you will have two colors to use for fiber identification.

T.I.S. Stain no. 1:

To identify fibers or cloth samples, prepare a 1% solution (w/v) of T.I.S. Identification Stain No. 1. Heat the solution to boiling. Maintain a hot, but not actively boiling solution.

Wet the fiber or cloth, along with a strip of multifiber fabric, with distilled or deionized water. Squeeze out the excess liquid and place the samples in the hot dye bath for 3 to 5 minutes.

Remove the samples and wash out any excess dye.

Compare the color of the fiber or cloth samples with the multifiber fabric.

T.I.S. Stain no. 3A:

To identify fibers known to be synthetic, prepare a 0.05% solution of T.I.S. Identification Stain No. 3A. (0.05 g for each 100 mL water) Heat the solution to boiling and add 2 mL 5% acetic acid solution for each 100 mL of solution. Maintain a hot, but not actively boiling solution.

Wet the fiber or cloth, along with a strip of multifiber fabric, with distilled or deionied water. Squeeze out the excess liquid and place the samples in the hot dye bath for 5 minutes.

Remove the samples and wash out any excess dye.

Compare the color of the fiber or cloth samples with the multifiber fabric. (See Figure F-2)



Figure F-2: T.I.S. Identification stains and fiber colors.

FORENSICS

Data and Results

Name _____ Course and Section _____

Partner(s) _____ Date _____

Fiber analysis

Were you able to identify fibers from your clothing that were on the chair? Explain.

Identification of known fibers – microscopic identification.

Name of fiber
fiber

Characteristics of the fiber

Sketch of the

Dyeing Tests for Fibers

Were you able to identify the fibers or fabric using the T.I.S. stains? Explain. (Tell how the colors of the dyed fibers compared with those of the reference colors (multifiber fabric)?)