Identification of Fibers using Differential Staining

(Adapted from *Identification of Fibers and Fabrics by Differential Staining* by Professor Lawrence J. Kaplan, Williams College)

# Introduction:

The identification of fibers or fabrics from textiles is a common one in forensic science. The investigation of many crimes results in fibers or pieces of fabric as part of the physical evidence. Fibers/fabrics are common in crimes such as robbery, breaking and entering, homicide, rape, assault, and hit-and-run. In many of these cases, matching the fibers from the scene of the crime with those from the clothing of the suspect or a victim is part of the analysis. In other situations, the identification of the type of fiber/fabric is critical for the resolution of the case.

A polymer is a long-chain molecule formed when individual units, called monomers, are linked together. Fibers are polymers that can be categorized into two broad groups, natural and synthetic. Nylon and polyester are both examples of synthetic fibers. Wool and silk are natural fibers made from protein; and cotton is a natural fiber made of cellulose. Due to the range of chemical compositions, different fibers exhibit a range of chemical and physical behaviors. Most fibers are sufficiently different from one another in their chemical nature that when a stain solution consisting of a mixture of a few dyes is used, each fiber will be stained a different color.

Multifiber Fabric #43 consists of 13 commercial fibers woven together: acetate, SEF (modacrylic), arnel, bleached cotton, creslan 61 (acrylic), Dacron 54 (polyester), Dacron 64 (polyester), nylon 66 (polyamide), orlon 75 (acrylic), silk, polypropylene (polyolefin), viscose (rayon), and wool. When a piece of the Multifiber Fabric is dipped into a boiling solution of identification stains, each stain will selectively and differentially stain the different fibers different colors.

**Equipment:**

TIS Stain #1, prepared as a 1.0% solution of water

TIS Stain #3A, prepared as a 0.05% solution in water and then add 0.1 mL glacial acetic acid to 100 mL of solution

Testfabric Multifiber Fabric #43

Evidence Fiber from crime scene

Fiber from suspect clothing

**Procedure:**

1. Place 100 mL of stain #1 and #3A into separate 250mL beakers and place on a hotplate.
2. Heat the solutions but **do not** boil them. Reduce the setting to about 2.5; just high enough to keep the solution hot.
3. Cut 2 fabric squares of each material (one for the TIS #1 dye and one for the TIS #3A dye). Use a safety pin to attach one square of each material to the top of a Multifiber #43 strip. Repeat with the second set of squares. Record the order of the material squares in data table.
4. Tie a thread to each safety pin and lower a one set of fabric samples into each stain for about 2-5 minutes.
5. Remove the fabric samples and rinse thoroughly in hot water. Label and set fabric aside to dry. NOTE: The black line on the Multifiber Fabric #43 indicates the “top” of the fabric.
6. Record the color of each fiber in the data table.

**Data:**

|  |  |  |
| --- | --- | --- |
| **Multifiber Fabric #43** | **Color** | |
|  | **TIS#1** | **TIS#3A** |
| Acetate |  |  |
| SEF (modacrylic) |  |  |
| Arnel |  |  |
| Cotton (bleached) |  |  |
| Creslan 61 (acrylic) |  |  |
| Dacron 54 (polyester) |  |  |
| Dacron 64 (polyester) |  |  |
| Nylon (polyamid) |  |  |
| Orlon 75(acrylic) |  |  |
| Silk (spun) |  |  |
| Polypropylene (polyolefin) |  |  |
| Viscose (rayon) |  |  |
| Wool (worsted) |  |  |

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| --- | --- | --- |
| **Fibers from Crime Scene and Suspects** | **Color** | |
|  | **TIS#1** | **TIS#3A** |
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**Analysis:**

1. What type of fiber is the crime scene fiber?
2. Can you make a positive match between the crime scene fiber and any of the suspects?