# The Identification of Natural Fibres

## Introduction

Fibre identification is an important first step in predicting the behaviour of a textile artifact in various environments. Knowing the identity of the fibre(s) is also helpful in planning appropriate conservation treatment(s) and/or storage methods. This Note describes two simple and practical ways (the burn test and microscopic examination) to identify cotton, flax, silk, and wool — the most common natural fibres in Western artifact collections (for more information about the characteristics of natural fibres, see CCI Notes 13/11 *Natural Fibres*). Other qualitative and quantitative tests are described in the referenced literature, but these may require more sophisticated methods, expertise, and instrumentation. However, they may be available from textile testing services or local university scientific laboratories.

## Factors to Consider

Several factors can complicate the identification of fibres within a textile artifact:

- The poor condition of a degraded historic textile may make it difficult or even impossible to identify the characteristic diagnostic features of fibres.
- Yarns that are blends of two or more fibre types, including man-made fibres, can complicate the interpretation of the results of burn tests. Consequently, another test method such as microscopic examination of fibres should be used to confirm the results of the burn test.
- Neither a burn test nor a microscopic identification is regarded as conclusive on its own, but either can be used as a confirmatory test. Further tests by specialists may be needed to make a positive identification.

Before carrying out tests on artifacts, it is important to obtain curatorial permission. Also, identification methods should be practiced first on fibres from known, expendable textiles.

## Sampling

Fibres can be identified from very small yarn samples. Typically, 0.4 cm (1/8″) or less is clipped from an exposed yarn end in good condition in an inconspicuous area. Both warp and weft yarns should be sampled because some fabrics are made of one fibre type in the warp and another in the weft. As much as possible, samples should be taken from all of the different fabrics making up a textile or costume, including stitching threads. It is important to document the sample location(s) in the written records, accompanied by a photograph. Once taken, fibre samples should be placed in the fold of a white or coloured paper that has been labelled (this makes it easy to see and manipulate them).

## Burn Test to Identify Fibres

A burn test can be used to distinguish plant fibre (cellulose) from animal fibre (protein). The burn test is not usually the sole method of identification, but complements other techniques.

### Materials

- fine scissors
- fine stainless steel tweezers
- unscented candle or other source of flame
- lighter or matches

### Precautions

- Burn tests should be carried out in an area safely away from artifacts and combustible materials.
- Fibre samples produce little smoke but, before carrying out multiple tests, verify that doing so will not accidentally activate smoke detectors.
- If using matches to light the candle, let the odour of the lit match dissipate before beginning the burn tests.
- Practice the technique with known samples from an expendable textile before doing the test on yarns


1030 Innes Road, Ottawa ON K1A 0M5 Canada
Tel.: 613-998-3721 or 1-866-998-3721 • Fax: 613-998-4721

from an artifact. It is important to gain experience in making observations by sight and smell at each stage of the burning process.
- Be aware that the flame will consume the fibres extremely quickly and, because the samples are very small, the burning fibres may be difficult to see.

### Procedure

Holding the fibres or small yarn sample with the tip of the tweezers, note the following:
- visual observations as the sample is brought near the side of the flame, in the flame, and out of the flame
- odour as the fibres burn
- characteristics of the ash including the colour and texture

Compare the results with those in Table 1.

#### *Weighted silk*

Some silk fabrics are weighted by the addition of metallic salts in the dye bath or in other finishing processes. The weight added to silk compensates for the weight lost when silk is degummed in preparation for processing. However, in the late 1800s, processors began using metallic salts in excessive quantities. The salts accelerated the deterioration of the silk by increasing its sensitivity to light and, eventually, causing extensive weakening and fracturing of the fabric. A burn test can be used to determine if a silk fabric is weighted, because only weighted silks leave behind a very fine ash residue in the shape of the yarn or fabric structure.

## Microscopic Identification of Fibres

Microscopy can be used to confirm the results of burn tests, and will make more sense of the results from burn tests on blended yarns. Microscopic examination also helps to distinguish cellulose fibres from protein fibres. Fibres in poor condition, very dark fibres, and those with surface finishes may be difficult to identify with a microscope.

### Materials

- compound light microscope (up to 400× magnification: 10× eyepiece plus 10×, 20×, and 40× objectives); minimum recommended magnification is 100×
- microscope slides
- microscope cover glasses
- microscope slide trays or holders
- small beaker of water or mineral oil, to use as a mounting medium for temporary slides
- fine tweezers
- eye dropper
- fine scissors
- permanent marker and/or pencil, for documentation

Commercially available reference slides of the most common natural fibres — cotton, flax, silk, and wool — are invaluable aids in becoming familiar with the surface and morphological features of fibres (see Suppliers). These can be examined at various magnifications and compared to the characteristics of fibres presented in Table 2. As with the burn test, samples extracted from known, expendable textiles should be used to gain experience before the procedure is carried out on fibres from an artifact.

### Procedure: Longitudinal view of fibres

The sampling procedure described previously can be used to obtain fibres from the textile. Once obtained, the fibres should be mounted on the microscope slide with water or mineral oil (water enables the surface features to be seen more readily; mineral oil shows the interior of the fibres better).

Using fine tweezers, place the fibres in the centre of a glass slide that is free of contaminants such as other fibres. Tease the sample fibres apart with the tips of the tweezers. To simplify identification, the fibres should

**Table 1. Burn characteristics of cellulose and protein fibres in good condition**

| Type of fibre | Burn test | | | | |
|---|---|---|---|---|---|
| | Near flame | In flame | Out of flame | Odour | Ash |
| **Cellulose, e.g. cotton and flax** | • does not shrivel away from flame<br>• ignites immediately with contact to flame | • burns readily in flame | • continues to burn<br>• has an “afterglow” when removed from flame until fibre expended | • smells like burning paper | • fluffy<br>• small<br>• white to grey-coloured |
| **Protein, e.g. silk and wool** | • shrivels away from flame | • burns slowly | • self-extinguishes | • smells like burning hair | • very small<br>• dark<br>• bead-like mass that breaks apart easily |

be separated from one another rather than being in a tightly twisted mass or overlapping one another. Introduce a small drop of mounting medium to the slide. Gently lay a microscope cover glass over the fibres, so as not to disturb their placement. The mounting medium will quickly distribute itself under the cover glass and the sample can then be examined under the microscope. Natural fibres will swell slightly as they react to the mounting medium.

Place the slide on the stage and adjust to the lowest magnification, typically the 10× objective (with a 10× eyepiece, magnification is 100×). Low magnification is useful for "finding" the fibres on the slide by adjusting the coarse and fine focus knobs, and for observing convolutions and surface features such as nodes. To observe morphological features of fibres in detail, use a higher magnification (e.g. a 20× or 40× objective).

The entire length of several fibres should be observed. To do this, locate one cut end and follow the length of the fibre by moving the stage in small increments. Reference books may be helpful for comparing unique surface features that distinguish fibres from one another (see Bibliography). Microscopic identification can be straightforward due to unique, easily identified morphological features. Unusual or confusing features may require expert assistance.

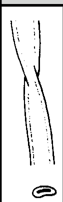
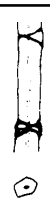
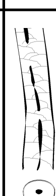
*Mercerized cotton*

Mercerization, a process discovered in the 1850s, improves the lustre, dye affinity, and strength of cotton fibres. This textile process causes the fibre to swell and become more cylindrical in shape, thus losing much of the twist so characteristic of cotton (see Table 2).

## Documentation

It is important to keep a record of all findings. Record the date, number and name of the artifact, description of sample, sampling location, warp or weft threads, colour of fibre, magnification, fibre features, and fibre type. Sketch the fibres observed. Some microscopes feature standard film or digital cameras, from which a photographic record can be obtained.

**Table 2. Longitudinal features of cellulose and protein fibres in good condition**

| Cellulose fibres | Longitudinal features | | Protein fibres | Longitudinal features | |
|---|---|---|---|---|---|
| **Cotton** |  | • looks like a ribbon with twists (convolutions) at intervals along length of fibre<br>• interior central canal or lumen may look like a striation (a minute groove running the length of the fibre)<br>• lumen is large, typically more than half the full width of the fibre | **Cultivated silk** |  | • looks like a cylindrical, smooth rod with periodic bulges<br>• may sometimes have faint striations |
| **Mercerized cotton** |  | • mercerized fibres have fewer convolutions<br>• lumen may look like a striation | **Wild silk** |  | • flattened rod, like a ribbon, with irregularities in fibre diameter<br>• may have more pronounced striations than cultivated silk<br>• may have perpendicular cross-markings, similar to flax |
| **Flax** |  | • single fibres or ultimates have nodes at intervals along fibre length in the form of I, V, or X, similar to the appearance of bamboo<br>• irregular width<br>• interior central lumen is quite small, typically less than half the full width of the fibre<br>• often seen as a bundle of fibres tightly packed in the lengthwise direction, rather than as individual fibres | **Fine wool** |  | • outer surface and edges rough, due to overlapping surface scales<br>• no medulla (the dark central solid line or row of interrupted dots, depending on the animal) |
| | | | **Coarse wool** |  | • outer surface and edges rough, due to closely spaced, zig-zag or jagged-edge surface scales<br>• medulla visible |

## Suppliers

*Note: The following information is provided only to assist the reader. Inclusion of a company in this list does not in any way imply endorsement by the Canadian Conservation Institute.*

*Fibre reference sets in prepared slides, microscopy supplies, microscopes:*
The McCrone Group
http://www.mccrone.com

*Microscopes and microscope accessories:*
SDL Atlas – Textile Testing Solutions
http://www.sdlatlas.com

*Microscopy supplies:*
Scientific suppliers

## Bibliography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by the staff of the CCI Textile Lab


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