TECHNICAL DATA ON JUTE, HEMP, RAMIE, SISAL, PINEAPPLE AND COIR FIBERS

TEXTILE CONSERVATION CENTER NOTES

NUMBER FIVE

Introduction:

This technical leaflet focuses on vegetable fibers that are obtained from the stalks, leaves or seeds of a wide variety of plants. Those fibers obtained from stalks are called bast fibers. The examples discussed are jute, hemp, ramie, and nettle fiber. A trade synonym for bast fiber is "soft fiber," (referring to the tactile sensation of these fibers).

Fibers freed from leaves are called leaf fibers or "hard fibers." The leaf fibers dealt with in this paper are sisal or agave fiber, and pineapple (or piña).

Other vegetable fibers are produced from the so-called seed hair group, which includes coconut fiber or coir produced from the husk of the coconut, kapok, and cotton. (Cotton is classified in the seed hair group as the fibers are found attached to the seed. See Textile Conservation Center Notes Number Three.)

It is possible to obtain a number of fibers from such diverse sources as hibiscus, redwood tree bark, cedar bark or the inner pulp of the so-called mulberry tree. Some information regarding these fibers and their properties is available from paper science research. Unfortunately, there has been little research concerning these fibers or their properties.

A partial list of vegetable fibers follows:

Bast fibers ("soft" fibers)	Leaf fibers ("hard" fibers)
hemp	manila
jute	agaves
ramie, rhea (China grass)	sisal
sunn	henequen
hibiscus varieties	cantala
rosella	maguey
mallow	mauritius hemp
paco-paco	caboga
nettle varieties	pineapple
lime tree	pita
Urena lobata	bromelia
milkweed stem	banana
bass	
banana	
flax	

Seed hair fibers

kapok
coir
milkweed
ochroma

Miscellaneous

paper mulberry
redwood bark
rice root
Spanish moss
cedar bark
paper twines
lace bark (Lagetta)

(source: Matthew's Textile Fibers)

This discussion of the more unusual vegetable fibers is not designed to be exhaustive. It covers those fibers for which enough useful information exists and describes some of the common problems of these groups. In terms of present day use, the following order of popularity is observed on world markets:

1. Jute
2. Flax (see Textile Conservation Center Notes Number Four)
3. Hemp
4. Sisal
5. Kenaf
6. Ramie

(Cook, Vol. I, 1964; figures, p. 4)

Jute:

There are a number of species of jute based on geographic locale. The genus Conchorus, cultivated in India, provides the largest portion of jute in the world market. A number of indigenous plant fibers have been marketed as jute from Indonesia, Central and South America and parts of Asia. The fiber is freed from a stalk by a laborious hand-process; prior to spinning into yarn, the fibers are "softened" by adding an oil and water emulsion. This oil content, which can lead to staining problems, is usually in the range of 5 per cent but can range as high as 20 per cent.

Environment: Light

Jute contains a high percentage of lignin, a complex plant material which acts as a cement to bind woody fibers together. Lignin is light sensitive and accordingly, jute deteriorates rapidly under sunlight. Bleached jute, which contains less lignin, is reported to be less sensitive to sunlight but yellows on exposure. Unbleached jute darkens on exposure to light and, without protection from light damage, deteriorates rapidly. Therefore, jute textiles or those items with jute blends such as rag rugs, some early pile mats and many ethnographic artifacts must be carefully protected from ultraviolet and visible light.

The Center recommends the blocking of all sunlight from impinging on jute objects and the installation of UV-filters for all fluorescent tubes. Fluorescent tubes may produce UV rays to a level as high as 30 per cent of the UV found in a clear north sky. With UV-blocking glazing and filters, the Center recommends a general light level of 10 to 50 lux (1-5 footcandles or 1-5 lumens/square foot) whenever possible. At this light level, some adjustment will be necessary for color definition by the viewer. It is important to note that the optimum light level for prevention of photodegradation would be total darkness.

Environment: Temperature/Humidity

Jute textiles have a moisture absorbence of 10-12.5 per cent dependent on growth and process factors. The fiber is markedly responsive to moisture and has a low resistance to "rot," although some researchers report varied results in micro-organism resistance. The fiber is also comparatively brittle and these factors combine to suggest that moisture content is important in jute textiles. The Center recommends a relative humidity of 50-55 per cent with a temperature range of 60-65 degrees Fahrenheit whenever possible. High humidity offers the possibility of microbial damage while low humidity presents a problem with brittleness of the fiber.

Environment: Airborne Pollutants

The rapid oxidation of this fiber when exposed to light has been noted. This seems to suggest that the presence of ozone, an oxygen-rich product often produced through photo-chemical smog, would produce deterioration of jute textiles. The bleaching effect of ozone has been noted as well. Jute sensitivity to acidity is also noted. The Center recommends regularly serviced air conditioning devices to avoid as much of this damage as possible. This is especially important in urban areas or in buildings heated by coal.

Special Notes on Jute: Oils

The sprinkling of raw jute with oil (sperm oil, mineral oil, etc., Sharp, p. 157) is a common practice, as mentioned previously. Oil contents as high as 10 per cent or more can be found. High oil contents can lead to staining of other fabrics when jute is used for mounting in display cases. It may be possible that the slow oxidation of this oil may lead to the deterioration of jute as well. This topic is under investigation. If jute is used for fabrication of display cases, it should be dry-cleaned to dissolve the oily component prior to use. The instability of jute and the lack of information about the oils commonly used in its processing strongly suggest that it is not suitable for conservation or mounting/repair usage.

Special Notes on Jute: Wet Cleaning

Jute fiber is sensitive to water, losing a high percentage of its strength when wetted. In addition, it is also sensitive to alkaline conditions. Alkaline treatment is used to produce a "wooly look" yarn caused by partial destruction of the fiber. These factors combine to suggest that jute is a poor candidate for the most elementary of wet-cleaning tasks. Oxidized jute is especially hazardous as the swelling when wetted could produce irrevocable harm. Aged jute should always be handled with extreme care.

Special Notes: Jute and Hemp

These fibers resemble one another very closely and are difficult to determine microscopically. Organizations or individuals wishing to positively identify jute or hemp samples are invited to submit them to the Center for examination.

Hemp:

True hemp, a bast fiber, obtained from the stalk of the plant Cannabis sativa is often imitated by other so-called "hemp" fibers. A small list of these "hemps" follows as an example of the confusion:

Black-fellow's hemp	Commersonia fraseri
Bowstring hemp (Africa)	Sansevieria guineensis
Bowstring hemp (Florida)	S. longiflora
Bowstring hemp (India)	S. roxburghiana
Cebu hemp	Musa textilis
Colorado River hemp	Sesbania macrocarpa
Cretan hemp	Datisca cannabina
Cuban hemp	Fourcroya cubensis
False hemp (American)	Rhus typhina
Sisal hemp	Agave sisalana
Giant hemp (China)	Cannabis gigantea
Hayti hemp	Agave foetida
Ife hemp	Sansevieria cylindrica
Indian hemp	Apocynum cannabinum

(Matthew's Textile Fibers, p. 344)

True hemp is presently cultivated throughout the world and is known from the classical period, when according to Herodotus, the Scythians employed the plant for its narcotic value. The fiber is freed from the stalk much like flax and yields a dark brown fiber with a lignin content of approximately 5 per cent. The fiber is harsh and stiff but can be processed to produce a fine soft yarn. This type of hemp is largely of Italian derivation and results from processing rather than cultivation. The fiber is also considered to be quite strong.

Environment: Light

Little is reported in the literature concerning hemp and the effect of light. Noting that light is often implicated in the deterioration of lignin and as lignin is found in hemp at a 5 per cent level (or higher), the fiber should be protected from natural and fluorescent light. (See section on jute for foot candle ratings and additional information on light.)

Environment: Temperature/Humidity

A brittle fiber, hemp has a moisture regain of 10-12 per cent. The fiber resists microbial attack suggesting that higher than normal humidity may be tolerated by this fiber. A relative humidity of 50-55 per cent is recommended and lower humidities should be carefully watched for excessive hemp brittleness. A temperature level of 60-65 degrees Fahrenheit is also recommended with this humidity range to insure a slow growth for most microorganisms that may be present. Lighter weight hemp fabric may also demonstrate some elongation with high humidities as the fiber has an elongation of 1-6 per cent.

Environment: Airborne Pollutants

Without specific research on the effect of air pollutants, it is difficult to discuss their effects on hemp. Considering that the fiber has a high concentration of cellulose, activity in the form of sulfurous emissions and/or ozone should be avoided. The Center recommends air conditioning whenever possible.

Ramie and Rhea

These stalk fibers are obtained from Boehmeria nivia and B. tenacissima respectively and are both sold as China grass. This extremely strong fiber has a low percentage of lignin (0.6 per cent) and a moisture absorbence of 1.5-10 per cent. Capable of high quality fabrics, the ageing properties of ramie are excellent given that predynastic (200-3300 B. C.) mummies are often wrapped in fabrics of this fiber.

The care considerations for this fiber should be viewed the same as those for hemp fiber although due to the lower lignin content of ramie, the fiber should be less light sensitive. It is also more resistant to rot than the fibers discussed thus far in this leaflet.

Nettle

Once cultivated in Northern Europe as a fiber source, Urticaceae divica is often found in artifacts of early cultures. Obtained from the stalk by boiling and beating, the fibers are very low in lignin, but weak. Slightly green in color in its natural state, the fiber also has good rot resistance when compared with other vegetable fibers. The optimum care of the fiber if unknown but it should be well preserved if handled as hemp and ramie.

Sisal

The first leaf fiber to be discussed is sisal, a fiber found as the rigid material in the leaves of Agave rigida and many others of the agave group. Very common in Central and South America, sisal has a lignin content of approximately 6 per cent. It was cultivated by the Aztecs and other Indians, who used the fiber for cordage, rope, and textiles.

Although little is known about requirements for the proper care of sisal, until more work is done on its properties, it can probably be treated as hemp or ramie. With the high lignin content, it will probably darken with exposure to sunlight as well as experience accelerated ageing with ultraviolet light. The fiber is considered strong in relation to other fibers but it is extremely stiff and repeated flexing should be avoided.

Pineapple

Another textile obtained from a leaf, this fiber is called piña in the Philippines where it is cultivated. It can be processed as an extremely fine and white yarn. The lignin content is reportedly very low, and as a result, the fiber should be less light reactive than the other fibers in this group. The care, display and storage should be similar to hemp, ramie or sisal although this fiber is usually of a much lower fiber weight and correspondingly less strong.

Coconut

This brown, coarse fiber called coir, is obtained from the husk of the common coconut. It is the only seed hair fiber discussed in this grouping. Used for mats and cordage by many tropical cultures, this fiber is extremely abrasion resistant. Impervious to high moisture levels, the fiber is extremely rot resistant which has resulted in its ocean-spread dissemination throughout the world. Another fiber may also be obtained from the leaf of the coconut palm and is claimed to be extremely strong and water resistant. This fiber is produced from the torn strips of the palm leaf which curl on the sides during drying forming rounded fibers. This may be found in mattings, sandals, hats and the like.

Further Reading:

Bally, W. "Jute and Its Substitutes." Ciba Review, # 108: February, Basil, Switzerland, 1955.

Cook, J. G. Handbook of Textile Fibres. Vol. I. Merrow Publishing Co., Ltd., Herts, England, 4th ed. 1968.

Marchandier, M. A Treatise on Hemp. T. Becket, P. A. DeHondt: London, 1758.

Matthews, J. M. The Textile Fibers. John Wiley and Sons, Inc., 4th ed. 1924.

Schaefer, C. T. "Flax and Hemp." Ciba Review, #49: April, Basil, Switzerland, 1945.

Sharp, Peter. Flax, Tow and Jute Spinnings: A Handbook. James P. Matthew and Company, Dundee, 1882.

Vetillart, M. Etudes sur les Fibres Vegetales Textiles. Lib. de Firmin-Didot et Cie: Paris, 1876.

Weindling, L. Long Vegetable Fiber. Columbia University Press, N. Y., 1947.

Woodhouse, Thomas. The Jute Industry. Sir Isaac Pitman & Sons, Ltd., Kingsway, 1921.

Woodhouse, Thomas. The Finishing of Jute and Linen Fabrics. MacMillan & Co., Ltd., London, 1928.

Zylinski, Tadeus. Fiber Science. Office of Technical Services, U. S. Dept. of Commerce, Washington, D. C., 1964 (translated from Polish).

TEXTILE CONSERVATION CENTER NOTES

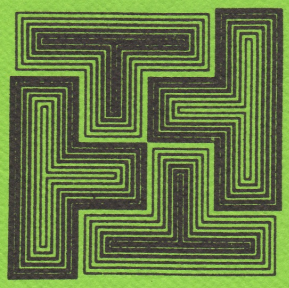
Number Five

TECHNICAL DATA ON JUTE, HEMP, RAMIE, SISAL, PINEAPPLE AND COIR FIBERS

by

MICHAEL M. BOGLE
Conservator
Textile Conservation Center
Merrimack Valley Textile Museum

Consulting Technical Editor
Kate Kent
Research Fellow
School of American Research
Santa Fe, New Mexico



Merrimack Valley Textile Museum
800 Massachusetts Avenue
North Andover, Massachusetts 01845

TEXTILE CONSERVATION CENTER NOTES NUMBER FIVE is one in a series of fifteen technical leaflets published by the Merrimack Valley Textile Museum. For information on other leaflets in this series write:

Publications Department
Merrimack Valley Textile Museum
800 Massachusetts Avenue
North Andover, Massachusetts 01845