Natural Fibers Analysis

Image Analysis by microscopy

Natural fibers are nonsynthetic hair-like materials of continuous filaments easily distinguishable during image analysis using optical microscopy, similar to pieces of thread. They include those produced by animals, plants, and geological processes. Animal fibers, consisting largely of proteins, include wool, hair, feathers, and dried saliva from insects (silk). The only naturally occurring mineral fiber is asbestos which is mainly used in fireproofing. Finally, vegetable fibers generally comprise cellulose and include cotton, flax, hemp, jute, kenaf, and many others. Vegetable fibers are the most widely used of fibers, and the most versatile.

Kenaf

Vegetable fibers are used for a variety of products, from cloth to rope, from feed to paper. Fiber crops, also known as synthenoids, are generally harvestable after a single season, which makes them superior to trees in terms of environmental impact and cost. For these vegetable fibers to be useable by industry they first need to be extracted by retting, to separate the bast fibers, then the stems must be removed and typically subjected to mechanical processing to remove soft tissue. Depending on the end purpose of the product derived from the plant, more processing might be needed, especially for vegetable fibers that are multi-purpose, like kenaf's are.

Part of the original image at 400X for a calibration factor of 0.3342 micron/pixel..

Kenaf is an ancient crop rooted in pre-colonial Africa, and has only recently been studied for its multiple properties and uses. Both its bast (exterior stalk) and its core are used in a wide range of products either together or separated. The original uses of these fibers have been for the manufacture of rope, twine, coarse cloth, and newsprint, but new uses have emerged in the last 20 years, such as engineered wood, plastic composites for cars, insulation, clothing-grade cloth, and most surprising of all, as an oil and chemical spill clean up product, since kenaf fibers can absorb more than 30 times its weight, and absorbs oil better than it does water.

Research in this fiber continues, and the use of optical microscopy and image analysis in R&D labs is essential.

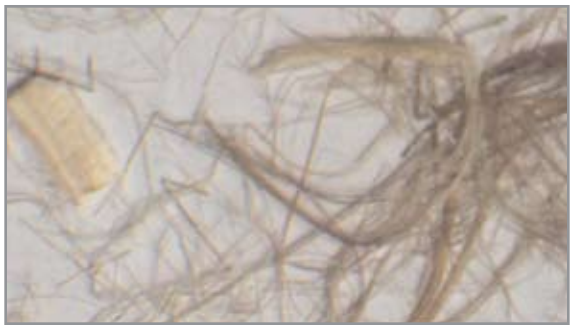
Analysis

A bag of natural fibers mixed with contaminants (pieces of core, unopened strands of fiber) was submitted for analysis by automated optical microscopy. Two types of contaminants were also available in separate bags.

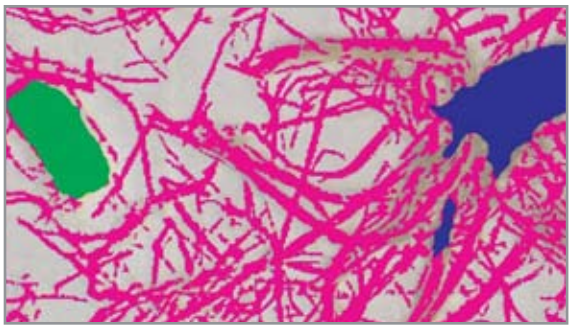
The Clemex Vision PE image analysis system can distinguish the core pieces and the unopened strands of fiber from the regular fibers. Area percentage of each is needed and a count of the core pieces larger than 5 mm is also necessary.

Length, Width and Count measurements were performed on pieces of core. Area percentage of each category compared to all was also performed. The area of each feature of any type was also measured. Automated statistics and graphs were generated and cumulated over the sample. Raw data were linked to their respective objects for validation purposes.

The main difficulty of this analysis was to find criterion to distinguish the contaminants from the fibers. This problem was mainly overcome by using color detection, intensity, shape, and size. However, it may happen that a light unopened strand of fibers would be mistaken for a piece of core. It may also happen that a group of regular fibers would be mistaken for an unopened strand of fibers if the sample is not spread enough. In both cases, the falsely classified feature can be transferred from one category to another after the run. When placing the sample, special attention should be given to the pieces of core to avoid, as much as possible, the contact with a bunch of fibers. Also, a non-reflective glass should be put over the sample to eliminate shadows created by the fibers. We recommend validating the final detection using the mapping view tool followed by a report update.



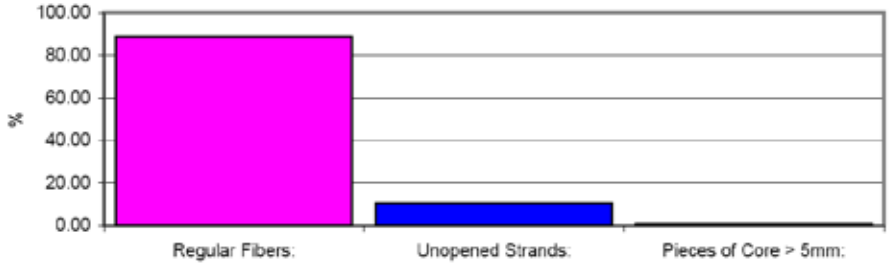
Part of the original image (0.09 mm/pixel).



Fibers and contaminants as measured (Regular fibers in magenta, core pieces in green, unopened strands of fibers in blue).

	Area	%
Regular Fibers:	10325.79	88.64
Unopened Strands:	1235.83	10.61
Pieces of Core > 5mm:	87.99	0.76
Total:	11649.61	100.00

Pieces of Core	**Count:** 2	
	Length:	**Width:**
Minimum:	10.10	5.19
Maximum:	10.80	5.61
Mean:	10.45	5.40
Std Dev:	0.50	0.30



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