Fibers Measurement

By the Ankersmid CIS-100 laser channel

Introduction

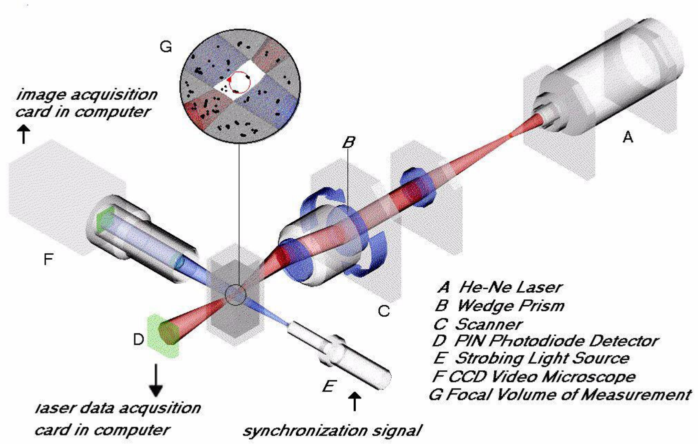
Analyzing fibers physical properties is an important and fundamental requirement in the pulp & paper industry. A variety of parameters related to fibers, such as fiber length, width, curl index and more, affect both the operation of the paper mill and the quality of the finished paper product. Sheet formation, refining control, tensile strength, tear resistance and other properties/operations are all affected by fiber characteristics. For this reason, fiber analysis is important to the researcher in the R&D lab and the operator in the paper mill.

Requirement

Electro-optical methods for measuring particle size (such as laser scattering/ diffraction) assume particles measured are spherical in shape. As a result, it is common convention that in order to measure fibers, image analysis techniques are required. Since these techniques are more complex and time consuming comparing with laser based systems, there is a real need at the production line for a simple, fast and easy to use method for fibers characterization.

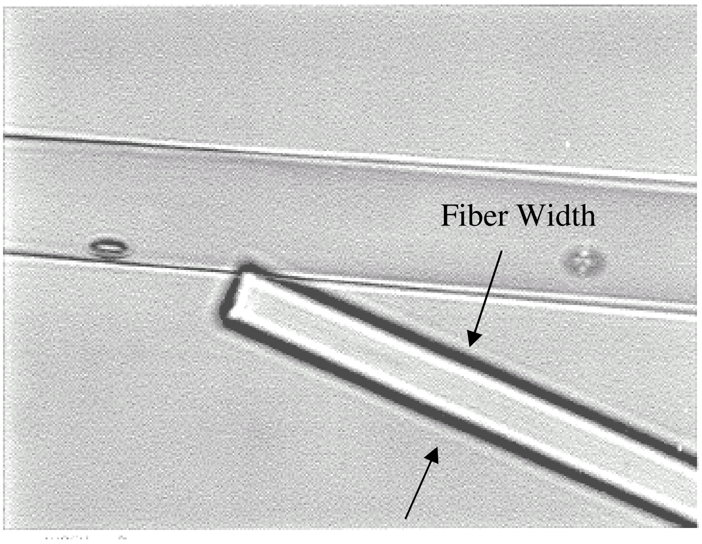
The solution

Ankersmid CIS-100 particle size and shape analyzer is successfully employed fiber width analysis. The CIS systems laser channel is based on a unique time-size mapping called Time-Of-Transition (TOT) theory to directly measure particles' size distribution and concentration.
A He-Ne laser beam circularly rotated by a wedge prism and focused down to a 1.2µ spot, scans the sample measurement volume. As particles within the sample volume are individually bisected by the laser spot, interaction signals are generated. These signals are then detected by a PIN photodiode. Since the beam rotates at a constant speed, the duration of interaction provides direct measurement of each particle's size.



The interaction signals are collected by a dedicated data acquisition card and analyzed in 300 discrete size intervals. Sophisticated pulse analysis algorithms are employed to reject out-of-focus and off-center interactions.

When the circling beam encounters non spherical particle, some interactions of the beam with the particle will lead to acceptable pulses and some to asymmetric ones which are rejected. When a fiber passes, through the circling beam, interactions perpendicular to the length of the fiber will lead to acceptable pulses; the size recorded will correspond to the width of the fiber.



Instrumentation and configuration
The modularity of the system and its interchangeable cell modules allow optimal flexibility in sample preparation (wet or dry) and measurement phases. The Liquid flow cell Model GCM-104L and the Liquid Flow Controller LFC-101 are used for these analyses. The sample was prepared in the 1 liter container of the LFC-101, pumped through the ACM-104A cell and recycled back to the container in a continuous flow manner. The LFC-101 is versatile, combining the functions of stirring, dilution, circulation, sonication, drainage and flushing in one unit to facilitate rapid and easy analysis.
Recommended set-up configuration for fiber width measurement is summed in table no. 1.

Table no. 1: Measurement Set-up Configuration

Laser lens	**Type**	**Range [µ]**
	Lens A-100	0.5-600
Measurement Cell	Liquid flow cell, model ACM-104A	
Dispersing Liquid	Water	
Accessories	Liquid Flow Controller, model LFC-101	

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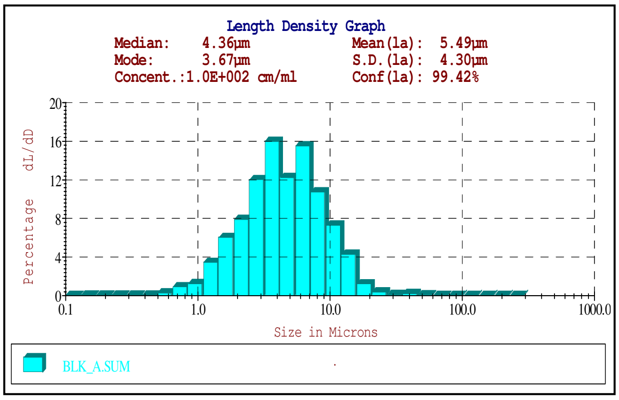
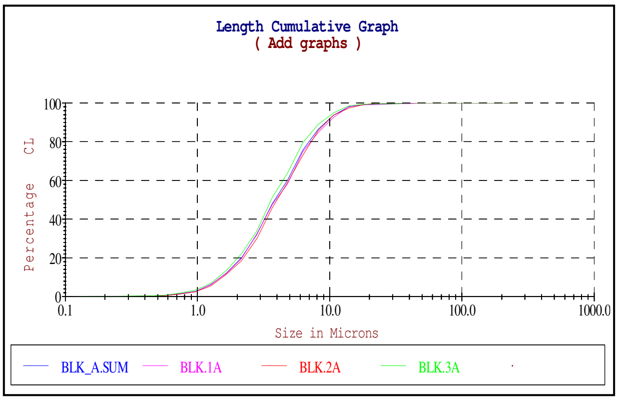
Results

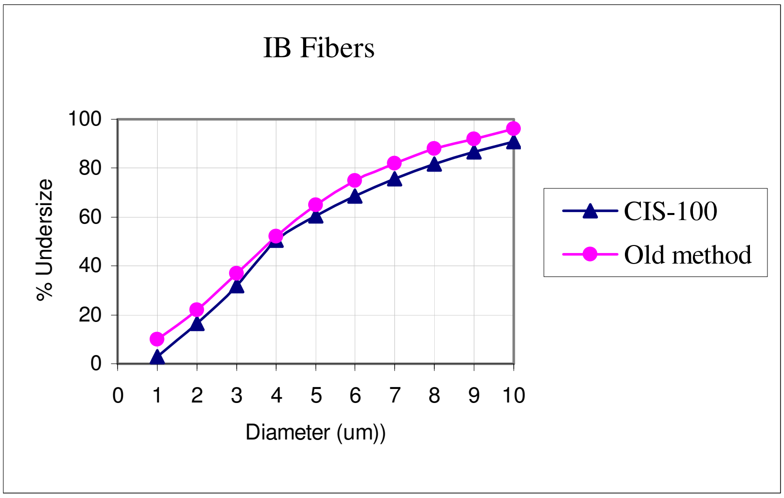
Instead of spending hours in analyzing slides using a microscope and image analysis software, fiber width results are obtained in few minutes. Repeatable and non-dependence of operator results are available.





Graph no. 1 & 2: Fiber width histogram and cumulative graph

A comparison of results obtained by the CIS-100 and by the "old method" is presented below.



Graph no. 3: Fiber width CIS-100 vs. Old method

Conclusion

Using the CIS-100 laser channel based on the TOT theory allow quick and accurate measurement of fiber width for the convenience of QC departments and the efficiency of production.
For R&D needs as well as when additional information on other fiber parameters is required, the video channel in conjunction with the Ankersmid Shape image analysis software is available.

References

1. Karasikov, N.; Krauss, M.; Barazani, G., In *Particle Size Analysis,* Lloyd, P.J Ed.; John Wiley & Sons: New York **1988.**

2. Weiner, B. B.; Tscharnuter, W. W.; and Karasikov, N.; Improvements in Accuracy and Speed Using the Time-of-Transition Method and Dynamic Image Analysis for Particle Sizing, Theodore Provder, American Chemical Society, **1998**

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