FIBER TESTING TERMINOLOGY

Normal Distribution

The graph of a normal distribution, the normal curve, is a bell-shaped curve. Many biological phenomena including animal fiber diameter distributions for single-coated animals, result in data distributed in a close approximation to normal. Hence, statistics applicable to normally distributed populations (mean, standard deviation, and coefficient of variation) are used to define these fiber diameter distributions. The normal curve is symmetric about a vertical center line. This center line passes through the value (the high point of the bell) that is the mean, median and the mode of the distribution. A normal distribution is completely determined when its mean and standard deviation are known.

Approximately 68.0 percent of all measurements lie within one standard deviation of the mean and approximately 95.0 percent of all measurements lie within two standard deviations of the mean. More than 99.5 percent of all measurements will lie within three standard deviations of the mean.

Fiber Diameter Measurement and Distribution

Fiber diameter is measured in microns. One micron is equal to 1/1,000,000th of a meter or 1/25,400th of one inch. Mean Fiber Diameter (MFD) is in common use internationally. MFD, Standard Deviation (SD) and Coefficient of Variation (CV) all relate to the (approximate) normal distribution of the animal fiber diameters. SD characterizes dispersion of individual measurements around the mean.

In a normal population, 68% of the individual values lie within one SD of the mean, 95% within two SD's and more than 99.5% within three SD's. Since SD tends to increase with increasing MFD, some people prefer to use CV (=SD*100/MFD) as a method of comparing variability about different sized means.

Comfort Factor

Comfort factor is the percentage of fibers over 30 microns subtracted from 100 percent. Ten percent of fibers over 30 microns corresponds to a comfort factor of 90 percent.

Curvature

Fiber curvature is related to crimp. Average Fiber Curvature (AFC) is determined by the measurement of two millimeter (2mm) snippets in degrees per millimeter (deg/mm). The greater the number of degrees per millimeter, the finer the crimp. For wool, low curvature is described as less than 50 deg/mm, medium curvature as the range of 60-90 deg/mm, and high curvature as greater than100 deg/mm.

Typical values might be illustrated by a 30 micron Crossbred wool fleece with typically low curvature and broader crimp with a frequency of approximately two crimps/cm. In contrast, a 21 micron Merino fleece typically has a medium curvature and a medium crimp with a frequency of approximately four (4) crimps/cm. A 16 micron Superfine Merino fleece typically has a high curvature and a fine crimp with a frequency of approximately seven (7) crimps/cm.

Definition of Medullation

A medullated fiber is an animal fiber that in its original state includes a medulla. A medulla in mammalian hair fibers is the more or less continuous cellular marrow inside the cortical layer in most medium and coarse alpaca fibers. By definition (ASTM), a kemp fiber is a medullated fiber in which the diameter of the medulla is 60% or more of the diameter of the fiber.

Medullation Measurement

Medullation measurement can be performed using either a projection microscope or the OFDA 100. Using IWTO nomenclature, a kemp fiber is classified as an "objectionable fiber" when measured on the OFDA 100. The OFDA100 measures opacity and therefore only white or light colored fibers can be measured. A reasonable assumption is that colored fibers have similar levels of medullated fibers as their white and pastel counterparts.

Spinning Fineness

This number (expressed in microns) provides an estimate of the performance of the sample when it is spun into yarn by combining the measured mean fiber diameter (MFD) and the measured coefficient of variation (CV). The original theory comes from Martindale, but the formula used comes from Butler and Dolling and normalizes the equation so that the spinning fineness is the same as the MFD when the CV is 24%.

Length & Strength

Length is measured in millimeters (mm) and the reported measurements readjusted to an annual growth period. Strength is measured in Newtons/kilotex (N/ktex) and is the force (measured in Newtons) required to break a staple of a given thickness (measured in kilotex). On the earth's surface, one kilogram exerts a force of 9.8 Newtons (= 1kg * acceleration due to gravity measured in meters/second^2). Kilotex indicates thickness in terms of mass per unit length expressed as kg/km.

Intrinsically, alpaca fibers appear to be very strong, an average of 50 N/ktex or better is not unusual. From a processing point of view, a mean staple strength greater than 30 N/ktex is considered adequate for processing wool on today's high-speed equipment.

Resistance to Compression

The resistance to compression (RTC) of alpaca fibers is measured in kilopascals (Kpa). A pascal (Pa) is a unit of pressure equivalent to the force of one Newton per square meter. In the commercial sector, RTC values >11 kPa are considered high, 8 to 11 kPa medium, and <8 kPa is low. The intrinsic resistance to compression of alpaca is low because of the relatively low levels of crimp. Thus, alpaca is not suited to end-uses that require high resistance to compression (or high bulk).

Position of Break

Truly sound fibers break in the middle section of the staple. Intrinsically, alpaca fibers appear to be very strong, in the 50 N/ktex range. A mean staple strength greater than 30 N/ktex is considered adequate for processing wool on today's high-speed equipment.

Clean Yield

Yield is based on bone-dry, extractives-free wool (alpaca) fiber or wool (alpaca) base (WB). Many different "commercial" yields are used in the international marketing of wool fibers. These are values calculated to predict the amount of clean fiber obtained after commercial scouring and/or after combing. Allowances are typically made for grease, ash, vegetable matter, and moisture. Various percentages of moisture are added in these calculations of commercial yield, which in some cases (very clean wool or some alpaca yields) may result in the clean yield exceeding 100%.

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