Fibre Fineness

Fibre fineness is one of the most important parameters of the wool fibre. It determines how the fibre will be used. The handle and visual appearance of the overall product is affected by the fineness of the wool. Clear price differentials exist for different fibre diameters and in *almost* all cases the price increases as the diameter decreases.

The measurement unit of fineness is micrometer or commonly abbreviated in the wool industry as MICRON. A micron is one millionth of a meter.

At the present time there are three main methods used for measuring and certifying fibre fineness; LASERSCAN (IWTO-12), OFDA (IWTO-47) and AIRFLOW (IWTO-12).

Laserscan Method

Laser technology has wide applications in many scientific fields and is now being applied to the measurement of fibre diameter for wool. The Commonwealth Scientific and Industrial Research Organisation (CSIRO)'S expertise in this field has led to the development of SIROLAN LASERSCAN for producing accurate and precise measurements of mean fiber diameter and diameter distribution, with minimal sample preparation.

The additional information, including diameter distribution, provides wool growers and buyers alike with accurate and useful information when assessing the commercial value of individual lots.

What is the process?

Firstly, samples are scoured to remove excess grease and dirt, after which the sample is dried and then allowed to condition in a standard atmosphere (20°C and 65% Relative Humidity). Fibre snippets of approximately 2mm in length are then cut using a minicoring machine, especially designed for the task. The snippets are then placed in a pre-measurement bowl where they are dispersed in a transport liquid, then flow through to the measurement cell. In the cell fibres intercept the laser beam and changes in the beam's intensity are converted to diameter readings by the computer. Sensors around the edge of the measurement cell enable the instrument to calculate the fibre curvature in degrees/mm. This measurement is indicative of the fibre crimp of the wool sample and may be used in the measurement of wools ability to fill space.

When the appropriate number of snippets have been measured, the Laserscan's computer calculates:

I. The average fibre diameter of the specimen;
II. Three measures of fibre diameter distribution:
   - Standard deviation
   - Coefficient of variation
   - Percentage of fibres less that 30 microns (comfort factor); and
III. Fibre curvature (in degrees/mm)

OFDA Method

The OFDA instrument is essentially an automatic microscope set above a prepared slide of fibre snippets. The instrument magnifies and captures images of the individual fibres using a video camera. It marks the edges of the fibres and measures the distance either vertically or horizontally between the sides of the fibres. Because it knows the slope of the fibre it can calculate the shortest distance between the sides, which is the diameter.

The instrument can measure mean fibre Diameter (MFD), Coefficient of Variation of Fibre Diameter (CVD), Comfort Factor (CF). Using its ability to measure the opacity of the fibres, the instrument is capable of measuring medullation. The instrument can also provide measurement of the radius of curvature of the fibre (in degrees per millimetre).

What is the process?

This sample is processed to remove any vegetable matter and remaining dirt using a Shirley Analyzer. The Shirley effectively cards the sample, untangling the fibre and produces an open web of fibres. The carded, blended sample is then placed in a standard laboratory atmosphere of 20°C and 65% relative humidity. Moisture is absorbed by the sample from the atmosphere until equilibrium is reached. This process can take in excess of 12 hours and is crucial to the accuracy of the measurement process.

The wool sample is guillotined or minicored to give 2mm snippets of wool. The fibres are spread onto a hinged glass slide using an automatic spreader. Slides can be kept for later reference. No liquid is used and after measurement the fibres are simply vacuumed or brushed off.

Airflow Method

For many years this method was, and for certain fibres still is, the mainstay of routine fibre diameter measurement and is quick, simple, inexpensive and accurate on most wool types.

The principle of the Airflow method is to apply a constant air pressure to a fixed mass of wool in a standard volume chamber and to measure the resulting flow of air through the sample. The surface area of the wool fibres creates a resistance to the flow of air, and this flow can be accurately measured on an Airflow meter. Finer wool causes greater resistance to the flow of air than coarse wool. Using international accepted IH (Inter-laboratory Harmonization) wool tops of known fibre diameter it is possible to calibrate the Airflow meter to produce very accurate results.

The measurement theory of the airflow method assumes that fibres have a constant density of 1.31g per cubic centimeter. Therefore, a fixed weight of wool of the same average diameter will always give the same amount of fibre surface and average micron result. Two exceptions to this are noted in IWTO-28.

1. Medullated Wools - Medullated fibres usually have a hollow inner core and are effectively tubes. Therefore their overall density is lower than that of non-medullated fibres. A finer result is produced using the airflow method than if the fibres were measured using the LASERSCAN or Projection Microscope.

   The effect of medullation is most evident on Drysdale wools where results can be several microns finer.

2. Lambs wool - Results obtained from lambs wool, like medullated wools, are systematically finer than LASERSCAN, OFDA, or Projection Microscope Results. The difference is not as dramatic as it is for medullated wools mainly due to two effects. Firstly, lamb wool may differ in density to adult wool and often contains some degree of medullation and secondly, lamb wool has a fine pointed tip.

   Despite these disadvantages wool buyers are aware and accept the limitations of the method and adapt their valuing procedures to take these into account.

The Test Process

The Airflow test method utilizes the core sample which has been taken in accordance with the IWTO Core Test Regulations. Two sub-samples of 150g are scoured to remove wool grease, dust and dirt. The quality of the scouring is important as excessive grease can cause incorrect fibre diameter results. Following scouring the sub-samples are dried after which approximately 10g is removed from each sub-sample and combined into one global sample.

This sample is processed to remove any vegetable matter and remaining dirt. A Shirley Analyzer is used to perform this task. The Shirley effectively cards the sample, untangling the fibre and produces an open web of fibres. To ensure that the sample is completely homogenous an additional blending step is incorporated after Shirley Analyzing. The carded, blended sample is then placed in a standard laboratory atmosphere of 20°C and 65% relative humidity. Moisture is absorbed by the sample from the atmosphere until equilibrium is reached, which is the stage at which the rate of absorption is the same as desorption. The process of absorption can take in excess of

12 hours and is crucial to the accuracy of the measurement process.

When the sample is at equilibrium it is ready for measurement. IWTO-28 requires that two airflow meters be used if a certificate is to be issued. This reduces the effects of differing equipment, thus producing a more accurate result. Two 2.500g ± 0.004g test specimens are weighed out, with each specimen going to one of the two Airflow meters. For each specimen, two measurements are conducted. The four results are compared and if the range between readings is outside the limits set in the standard, additional specimens are weighed and read on each Airflow meter. For a single test up to six specimens can be read. All results obtained are averaged to produce the final result. The Mean Fibre Diameter and the number of test specimens are both shown on the Certificate.

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