Background

NZWTA Ltd has a wool testing laboratory with equipment to carry out tests to accurately and reliably describe the characteristics of wool, and predict its processing performance. The tests are performed using the procedures specified by the International Wool Textile Organization (IWTO). These test methods are constantly being reviewed and refined by IWTO in order to achieve the greatest accuracy and precision in determining objectively measured results.

The Yield Test

Yield is the weight of clean wool, after the removal of impurities, expressed as a percentage of the greasy wool weight. These impurities may be natural, such as grease and suint, or acquired, such as seeds and burrs along with sand, soil or other mineral matter. In addition, wool naturally absorbs moisture and this can vary from day to day depending on climatic conditions. Because it is used to estimate the quantity of usable wool fibre in a lot it is a significant factor in wool trading, although it does not, as such, affect the processing efficiency of the wool.

The skilled wool buyer can attempt to appraise these impurities and arrive at a yield which is used as the basis of establishing a price for the material. However, with the need for independence, and consistency, nearly all wool is traded on a tested basis.

Yield Measurement

Sampling

Samples for testing are drawn by core sampling. Core sampling produces a statistically precise sample of sufficient size for the test house to perform the required tests in a laboratory. The samples are representative of the lot irrespective of the number of bales.

The yield test, IWTO-19, involves the removal of natural and acquired impurities, including the moisture, to arrive at a percentage termed WOOL BASE. This Wool Base is used as the basis of all the mathematical calculations later applied to establish a variety of yields demanded by the various sections of the industry.

Blending

The first stage in testing is to ensure that the core samples drawn from all bales in the lot are thoroughly blended. This ensures that sub-samples drawn later for testing are as representative of the bulk as possible. This blending is carried out in a sealed drum where the wool is agitated by compressed air until it is thoroughly mixed. After blending, test sub-samples are accurately weighed out and then used as the basis of all calculations. It is essential that no fibre or vegetable matter impurities are lost during this process.

Testing

The testing process involves a washing and drying process to remove most impurities and moisture. After the test sub-samples have been weighed they are scoured in hot water and detergent where wool grease, suint (dried sweat), dust and dirt are removed. The wool is rinsed to remove detergent and the minimize fibre loss. The sub-sample is then dried at 105°C until the sample is dry. This constant dry weight is recorded for use in later calculations. After scouring there will still be residual impurities remaining in the wool and these must be measured by more sophisticated methods.

Residual impurities – Vegetable Matter (VM)

The most important impurity is vegetable matter. The percentage of the vegetable matter present will have an effect on the commercial processing of the consignment. The amount of vegetable matter is determined by weighing a 40g test specimen of the dried scoured sub-sample and dissolving this in hot 10% caustic soda solution. Once the wool is dissolved, only the alkali insoluble impurities, including all vegetable matter, remain. These insolubles are then rinsed, dried and weighed. This total weight of alkali insoluble is then expressed as a percentage of the 40g test specimen and forms an important part in the calculation of Wool Base.

Residual impurities – Ash Content

Other impurities remaining in the scoured sub-sample will be small amounts of mineral matter (referred to as ‘ash’) and residual grease which can either be natural fats or detergent which has not been completely removed by rinsing.

The percentage of ash is determined from a 10g test specimen of the dried scoured sub-sample which is incinerated at a temperature of 750°C for two hours. Residues representing mineral matter not removed during scouring along with metallic elements naturally occurring in the wool structure remain, and after weighing can be expressed as a percentage.

Residual impurities – Fatty matter Content

The percentage of Residual Grease is determined on a Sox let apparatus which uses Ethyl Alcohol as the extraction solvent. Hence this test is commonly referred to as the Alcohol Extractable Matter test, to reduce the confusion with Residual Grease test conducted on scoured wool which uses Dichloromethane as the extraction solvent.

In this test, a 10g test specimen of the scoured, oven-dry sub-sample is subjected to a washing cycle in ethyl alcohol which dissolves the fatty residues and transfers them in solution to the Sox let flask. After 20-22 cycles the ethyl alcohol can be evaporated off leaving only the fatty residues which can then be weighed and expressed as a percentage.

Both the Ash Content and the Alcohol Extractable Matter can also be measured using Near Infra (NIR) Analysis. Where these are used, NIR instruments are calibrated to the respective tests by testing thousands of samples on the reference method and also collecting spectra over the NIR range from these samples. A series of mathematical transformations and equations are then calculated to allow say NIR Spectra to 'predict' the equivalent reference results. These instruments are very accurate, and are constantly monitored to ensure this accuracy is maintained.

In basic terms the Total *Residual* Impurities can be expressed as the following:

Alkali Insoluble% + Ash Residue% + Fatty Residue%

At each stage of the testing process these values are transferred electronically to the computer system from the testing apparatus. The computer examines whether or not the differences between test results on the same lot are statistically acceptable. If not it indicates the need for additional tests to be done before a certificate can be issued.

When a test meets the range checking criteria the computer will issue a certificate showing a variety of yields which the buyer can then use to determine the price he is willing to pay for the specific lot. Where all sampling and testing has been conducted in accordance with the appropriate IWTO Regulations and Test Methods, this Certificate is referred to as an IWTO Test Certificate.

The IWTO Test Certificate

The IWTO Test Certificate usually contains the following features:

Identification

On each certificate it is essential that the bales certified are positively identified. This is done by specifying the sale centre, the date of sale, the wool broker and the catalogue lot number and /or reference number. This combination can never be duplicated. On Post Sale or Combination Certificates the shipping brand identifies the consignment.

Quantity

The quantity of wool, on all certificates of yield, is shown by the number of bales in the test and more importantly by the gross weight, declared tare and nett weight of the consignment at the time the core samples were drawn. A calculation of the clean weight is made using the nett weight of the consignment and the test data. This is shown on each Certificate under "Calculated Commercial Yields".

Test Results

Through analysis the laboratory is able to determine WOOL BASE, VEGETABLE MATTER BASE, and the percentage of Hard Heads and Twigs. All commercial yields are based on these factors by mathematical calculations. It is important that the percentage oh Hard Heads and Twigs is shown separately since, in the calculation of processing losses on combing yields, these are deducted from the VEGETABLE MATTER BASE. They would normally fall out of the wool during carding without any wool clinging to them and would therefore not contribute to any processing loss of wool fibres.

Calculated Commercial Yields

Commercial yields are calculated using the WOOL BASE (WB), VEGETABLE MATTER BASE (VMB) and HARD HEADS BASE (HH). All calculated yields include standard allowances for moisture content and for the small amounts of residual ash (dust) and alcohol extractable matter (grease) left after processing.

The allowance for added moisture is expressed as REGAIN – the weight of added moisture expressed as a percentage of the woolbase plus the allowance for ash and alcohol extractives. Some yields include an allowance for fibre lost during processing and others make allowances for oil added during processing.

IWTO SCHLUMBERGER DRY TOP AND NOIL YIELD (1% TFM)

This is the most commonly used commercial core test yield, and predicts the amount of Top and Noil that can be combed from the greasy wool. It is the main basis for trade for wools traded in Western Europe.
An allowance of 2.27% is made for residual ash and alcohol extractives. 18.25% Regain is added to the Top and 16.25% Regain is added to the Noil. The Total fatty Matter Content (TFM) is 1% and a Tear Ratio (Conditioned weight of the top to Conditioned weight of Noil) is 8 : 1 is assumed. The conversion factor of 1.207 applied to Woolbase takes account of these factors.

The Schlumberger combing yields include a “Processing Allowance” for fibres lost during Processing. The fibre loss is directly related to the Vegetable Matter Base minus the Hard Heads – Twigs Base and is calculated according to the following formula:

$$\text{Processing Allowance} = 7.7 - \frac{(\ 40.6\ )}{(7.8 + VMB - HH)}$$

The calculation for Schlumberger Dry Top & Noil is Yield :

$$\text{Schlum Dry} = (WB \times 1.207) - \text{Processing Allowance}$$

IWTO CLEAN WOOL CONTENT (IWTO CWC)

This yield is calculated from Wool Base. An allowance of 2.27% is made for residual ash and alcohol extractives, and 17% Regain is included.

$$\text{IWTO CWC} = \frac{WB \times 117}{(100 - 2.27)} = WB \times 1.1972$$

IWTO SCOURED YIELD @ R %REGAIN (SCD, 16)

This yield is calculated from Wool Base **and Vegetable Matter Base**. An allowance of 2.27% is made for residual ash and alcohol extractives, and R % Regain is included. This yield estimates the yield after scouring and before further processing occurs to remove Vegetable Matter

$$\text{Scoured Yield at 16\%} = \frac{(WB + VMB) \times (100 + \text{Regain\%})}{(100 - 2.27)} = \frac{(WB + VMB) \times 116}{97.73}$$

$$= (WB + VMB) \times 1.1869$$

$$\text{Scoured Yield at 17\%} = \frac{(WB + VMB) \times 117}{(100 - 2.27)}$$

$$= (WB + VMB) \times 1.1972$$

JAPANESE CLEAN SCOURED YIELD (JCSY)

This yield has been used as the basis for trade with Japan. An allowance for residual ash and alcohol extractives of 1.5%, and moisture at 16% Regain is included. The calculated yield removes all Vegetable Matter, however no allowance is made for fibre loss during processing.

$$\text{Japanese Clean Scoured Yield} = \frac{WB \times (100 + \text{Regain\%})}{(100 - 1.5)} = \frac{WB \times 116}{98.5}$$

$$= WB \times 1.177$$

ASTM CLEAN WOOL FIBRE PRESENT

This yield ASTM *(American Society for Testing & Materials)* Clean Wool Fibre Present uses a regain of 13.64 % and ash and alcohol extractives of 2.27%.

$$\text{ASTM CWFP} = \frac{WB \times (100 + \text{Regain\%})}{(100 - 2.27)} = \frac{WB \times 113.64}{97.73}$$

$$= WB \times 1.1628$$

IWTO Combined Certificates

Presale lots are often combined to produce suitably sized consignments for exporting to processors. When the wool is exported in its greasy state, these lots are often combined into an IWTO Combined Certificate. This has many advantages, the most important being the increased precision gained by the number of sub-samples incorporated into the combined result.

The Combined Certificate consists of at least two pages. The first page shows the identification of the consignment by shipping brand, the number of bales and the combined weights of the components. It also shows the weight-biased mean of the WOOL BASE and VEGETABLE MATTER percentages together with the range of VEGETABLE MATTER BASE values. The second and subsequent pages show the details of the components.

When calculating the mean WOOL BASE the varying weights and yields of the components are taken into consideration.

Since anomalies can occur, due to multiple decimal place calculations, the IWTO test method for Combined Certificates stipulates that calculated commercial weights on each component shall be simply added together. This produces the combined clean weight of the consignment and is reported on page one of the Certificate.

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