Various Formulas are Used to Calculate Yield

Yield is the amount of useful fiber that can be obtained from a known weight of grease or raw wool.

To allow for different methods of processing, different mathematical formulas have been developed for calculating yield. All formulas start with the wool base and most also use the vegetable-matter base. Depending on the specific formula, different allowances are made for percent moisture, vegetable-matter base or residual grease. These standard allowances are specified in pertinent testing regulations.

**Greasy Wool**
Wool in its unscourd form contains wool fiber and varying amounts of other materials including water, wax, suint, dirt and vegetable matter. With the exception of water, most of the other impurities are removed during scouring.

**Wool Base (WB)**
Wool base is the amount of pure dry wool fiber expressed as a percentage of the total weight of the greasy material.

Wool base of a commercial lot is determined in a laboratory by scouring representative core samples, determining the oven dry weight and then measuring the residual impurities. These impurities are measured in varying ways: ashing at 700°C for residual inorganic material (sand, dirt and minerals present within the wool protein), extraction with alcohol for grease and dissolving the wool in hot caustic soda for vegetable matter. All these tests are highly controlled and similar throughout the world.

**Vegetable-Matter Base (VMB)**
Greasy wool also contains varying amounts of vegetable matter in the form of seeds, straw, burrs, twigs, etc. The amount and type of vegetable matter also affects the yield of useable wool fiber after processing. The vegetable-matter base is the weight of dry vegetable matter expressed as a percentage of the total weight of greasy wool. Vegetable-matter base is taken into account in some yield calculations depending on the specific type of yield required.

**Moisture**
Wool has a great affinity for moisture. However, the amount of water it contains depends very much on ambient temperature and relative humidity. Wool’s ability to either absorb or release moisture relatively quickly can have a significant impact on yield. It is generally assumed that at the time of sampling raw wool, its moisture content had time to equilibrate with the surrounding atmosphere. This assumption can be in error when the wool is sampled in rapidly changing conditions or in very dry or very humid conditions.
YIELD DETERMINATION EQUATIONS

In 1997, the U.S. wool industry requested that the U.S. commercial laboratories henceforward report yield in terms of both ASTM Clean Wool Fibers Present (CWFP) and IWTO Estimated Commercial Top and Noil yield for Schlumberger dry-combed wool containing one percent total fatty matter (Schlumberger Dry). Both the ASTM and IWTO yields are derived from wool base. In practicality, the two definitions of wool base are the same.

ASTM Clean Wool Fiber Present (CWFP)
Traditionally, U.S. raw wool was bought and sold on the CWFP basis, which consists of:
- 86% Wool Base
- 12% Moisture
- 0.5% Residual Grease
- 1.5% Alcohol Extractables

\[ \text{CWFP \%} = \frac{\text{Wool Base}}{0.86} = \text{Wool Base} \times 1.1628. \]

IWTO Yield Measurements
Because U.S. wools are sold in the international marketplace, some common internationally accepted yield calculations might also be used on U.S. wool-test certificates.

IWTO Scoured Yield, 17% Regain (IWTO-SCD 17\%)
is an estimate of scouring or “washing” yield, before any further wool processing takes place that can remove vegetable matter. The equation used to determine this yield is:

\[ \text{IWTO SCD 17\%} = (\text{Wool Base} + \text{Vegetable Matter Base}) \times 1.1972 \]

The factor of 1.1972 is used to allow for 17 percent regain in moisture content and an allowance of 2.27 percent for residual grease and ash in the sample.

IWTO Estimated Commercial Top and Noil Yield for Schlumberger dry-combed wools (SCH DRY YIELD) is probably the most common internationally used yield calculation; it attempts to predict the amount of wool top and noil that can be combed from the greasy wool and, in a rather complex way, accounts for the amount of wool that is lost when removing specific types of vegetable matter. Similar to IWTO – SCD 17\%, allowances are made for residual grease, ash and moisture regain. The conversion factor of 1.207 is applied to the wool base to correct for these factors. The SCH DRY yield also includes a factor for fibers removed with vegetable matter during processing (Processing Allowance). The simplified equation used to determine this yield is:

\[ \text{IWTO SCH DRY} = (\text{Wool Base} \times 1.207) – \text{Processing Allowance} \]

For Schlumberger dry-combed wools, Processing Allowance = 2.5 + VA (an allowance for vegetable matter). The vegetable matter allowance is mathematically related to the vegetable-matter base (excluding certain types of vegetable matter) and can be either calculated or accessed from tables.

Photos taken at Yocom-McColl Testing Laboratories