GAUGE (Thickness) Information

Gauge, or thickness, is a basic descriptive film property. Values are expressed as mils in the US standard and microns in the metric (or SI) system.

The word gauge has two other meanings in the film industry that should be mentioned but are not the subject of this discussion.

1. "Gauge" is used as a unit of measure equal to a hundredth of a mil. For example, "70 gauge" refers to 70 hundredths of a mil, or .70 mil thickness.

2. "Gauge" can also refer to the general profile of a roll of film. For example, "that roll has bad gauge" means that the film is not flat across the width of the roll. This poor gauge profile manifests itself as hard and soft areas and permanent stretch lanes, which can cause processing problem

Relevance and non-relevance to performance

Gauge, in and of itself, is not a functional parameter, but it has a direct relationship with many important functional properties. As thickness increases, yield goes down and $/MSI goes up. Most other properties improve, like strength and WVTR. The most notable exception is haze, which will tend to increase with increasing thickness.

Film gauge is usually not a critical property, and most ExxonMobil products do not have specified tolerance limits for this property. Instead, yield is the related property that is measured, controlled, and guaranteed. *It is not appropriate to calculate yield from a thickness measurement.*

Micrometers lack the necessary accuracy and precision, and they only measure thickness at a small point. A representative yield value must be measured over a large film area, as described in the test principles section of the discussion about yield.

There are two circumstances when it is important to measure thickness in the laboratory.

1. When measuring certain film properties (tensile, WVTR and OTR), the gauge of the sample is always measured and noted.

2. Unlike solid films, cavitated OPPalyte films can have various thicknesses even when yield is constant. So, the optical gauge of these films is measured in the Quality Control (QC) laboratory, and the process is adjusted if the value is outside an acceptable range.

INNOPACK GLOBAL LTD
P O Box 317074, Hobsonville 0664, Auckland 41/A William Pickering Road, Rosedale, Auckland 0632
Denise Blake (GM) denise@innopack.co.nz or Dwayne Matthews (Sales Manager) dwayne@innopack.co.nz

What affects film thickness

For solid, uncoated films, average film thickness is a direct function of film yield and resin density. It is controlled automatically on the orienter by a feedback control loop that measures average film yield, compares it to a target, and adjusts extruder screw speed to compensate for any difference. To back up the on-line controls, yield is regularly measured by the QC laboratory. The average film thickness for plain and coex OPP films can be calculated from yield with the following equations:

$$\text{Gauge (mil)} = \frac{\text{30,579 mil}}{\text{Yield (in2/lb)}} \qquad \text{Gauge (µ)} = \frac{\text{1,104 µ} \cdot \text{m2/kg}}{\text{Yield (m2/kg)}}$$

The average film thickness of cavitated white opaque films (OPPalyte) is a function of yield and the degree of cavitation. (The more cavitation, the thicker the film.) With these films, yield is controlled with extruder screw speed, and cavitation is controlled by optically measuring gauge in the laboratory and adjusting the appropriate process parameters, as necessary.

For coated films, primer and top coats are applied to one or both sides of a base film with a separate coating line. Coating weights are precisely controlled, and the added thickness is easily estimated. Coated film yields are regularly measured by the QC laboratory.

Related terminology

Mil - Mil is a thousandth of an inch. A 0.70 mil film is 0.0007 inches thick.
Micron - Micron (µ) is 10-6 meters and 25.4 mils. A 1 mil film is approximately 25µ thick.

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