CONVERTING OTR/WVTR VALUES BETWEEN FILMS & PACKAGES

Dispel the confusion using real-life examples of unit conversion in various applications.

Covering the basics:

- Converting units can be confusing. Be clear about which units of measurement you are using.
- When converting transmission rate between the package unit as cc/day vs. the film unit of cc/(m^2 • day), pay attention to the actual test area of the package as this can alter your results.
- Transmission Rate (TR) is the quantity of gas that is able to pass through a specified area of material over time.
- Oxygen transmission rate, also referred to as "OTR," is the steady state rate at which oxygen gas permeates through a film at specified conditions of temperature and relative humidity.
- Water vapor transmission rate, also referred to as "WVTR", is the steady state rate at which water vapor permeates through a film at specified conditions of temperature and relative humidity.

Learn how to convert Oxygen and Water Vapor Transmission Rate values for films and packages.

OXYGEN & WATER VAPOR TR UNIT CONVERSIONS

TECHNICAL NOTE

Unit Conversions used for OTR and WVTR

Transmission Rate (TR)	TR Unit Conversions
Oxygen (OTR)	cc/(package • day) and cc/(m^2 • day)
Water Vapor (WVTR)	g/(package • day) and g/(m^2 • day)

EXAMPLE A:

A packaging engineer found the perfect pouch for his product. It was tested for Oxygen Transmission Rate (OTR) on a MOCON® OX-TRAN® instrument and the results were 0.06848 cc/(package · day). The engineer is now trying to make a similar pouch. When speaking with the film vendor, he was asked to specify the OTR of the film using the unit cc/(m^2 · day).

How do you convert a tested package OTR value to the required film OTR specification?

1. Verify:
   - The OTR of the tested package (or pouch). In this case, 0.06848 cc/(package · day)
   - The surface area (area that allows for permeation) of the pouch (13 cm x 15 cm, 2 sides), 390 cm^2, or 0.039 m^2
2. Convert it from cc/(package · day) into cc/(cm^2 · day) using this equation:
   - OTR of the film = 0.06848 cc/(package · day) ÷ 0.039 m^2 = 1.756 cc /(m^2 · day)
3. You can also convert it to cc /(100in^2 · day):
   - Since 1 inch = 2.54 cm = 0.0254 m; 100 $inch^2$ = 100 x $(0.0254\ m)^2$ = 0.0645 m^2
   - Thus the OTR of the film = 1.756 cc /(m^2 · day) x 0.0645 m^2 = 0.1133 cc /(100in^2 · day)

EXAMPLE B:

A packaging engineer tested a barrier polymer film with an OTR of 1.754 cc /(m^2 · day). Now, she wants to estimate what the final OTR for a pouch would be that has a permeable surface area of 390cm^2 or 0.039 m^2.

Here is how she calculates it:
OTR of the package = 1.756 cc /(m^2 · day) x 0.039 m^2 = 0.06848 cc/(package · day)

EXAMPLE C:

A packaging engineer tested a barrier polymer film with an OTR of 0.1133 cc /(100 in^2 · day). Now he wants to estimate what the final OTR for a pouch would be that had a permeable surface area of 390 cm^2, or 0.039 m^2. This is how he calculates it:

- From Example A, we know that:
  100 $inch^2$ = 100 x $(0.0254\ m)^2$ = 0.0645 m^2
- Then, 0.1133 cc /(100 in^2 · day) ÷ 0.0645 m^2 = 1.756 cc / (m^2 · day)
- OTR of the package = 1.756 cc /(m^2 · day) x 0.039 m^2 = 0.06848 cc/(package · day)

These examples represent the ideal package for theoretical estimation only. In real-life applications, due to machine processing and seal quality, the package will usually transmit more than the calculated value that was converted using the film test results. Due to these variables, best practice always involves testing the complete package to confirm any theoretical estimations made during package development.

Need assistance with testing your complete package? We can help.

To learn more, please see our white paper Shelf Life and the Importance of Testing the Whole Package.

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