

REDUCING THE TEST AREA OF A BARRIER FILM FOR PERMEATION ANALYSIS

Learn common reasons to reduce the test area of a barrier film while conducting OTR or WVTR permeation analysis.

Background

There are a variety of reasons to reduce the testing area of a barrier undergoing oxygen transmission rate (OTR) or water vapor transmission rate (WVTR) film testing. The most common reasons include: 1) The OTR or WVTR reading is too high for the upper limit of the instrument's test range; 2) The film sample is limited in size and availability (this is often the case for one-off, custom or special R&D samples); or 3) The sample comes with defects or areas that needs to be excluded from the test.

Procedure

To reduce the testing area of a film sample, masks or reduced-area cartridges are commonly used. There are a few choices to reduce the testing area with the latest instruments: the MOCON® OX-TRAN® 2/22 Oxygen Permeation Analyzer, the MOCON PERMATRAN-W® 3/34 Water Permeation Analyzer, and the MOCON AQUATRAN® 3 Water Permeation Analyzer.

The reduced test area options are as follows:

- 5.64 cm² Reduced Test Area Cartridge (permanent and reusable)
- Adhesive-backed, aluminum foil masks such as 5 cm², 20 cm², 30 cm² and 40 cm² (disposable)



10cm² and
5.64cm² reduced
test area cartridges

WHAT ARE THE EFFECTS OF REDUCING YOUR TEST AREA?

When a smaller test area is used, fewer molecules permeate, reducing the flux. Thus fewer molecules will go through the sensor. This will affect the original sensitivity of the instrument, which has been defined with a standard testing area of 50 cm². When reduced testing areas are used, both the lower limit of detection (LLOD) and higher limit of detection (HLOD) increase.

For example: The original LLOD for the OX-TRAN® 2/22 H is 0.05 cc/(m² · day) for a sample with a standard testing area of 50cm². The HLOD with a standard sample area is 200 cc/(m² · day). However, the LLOD of the OX-TRAN 2/22 H when using a 5.64 cm² Reduced Test Area Cartridge is 0.4 cc/(m² · day) and the HLOD is 1770 cc/(m² · day).

This new LLOD can be calculated as follows:

Area (standard) / Area (masked) x LLOD = 50/5.64 x 0.05 = 0.44 cc/(m² · day); Conversely the HLOD also increases by the same factor (50/5.64) x 200 = 1770 cc/(m² · day).

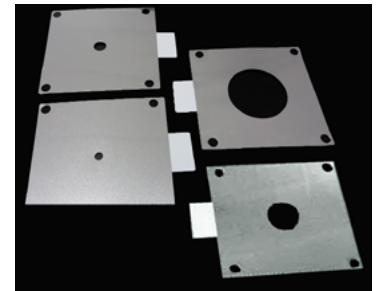
This means that if your transmission rate values are near 0.4 cc/(m² · day), they will not be accurately measured when using the 5.64cm² Reduced Test Area Cartridge on the OX-TRAN 2/22 H instrument.

See more examples in the following table:

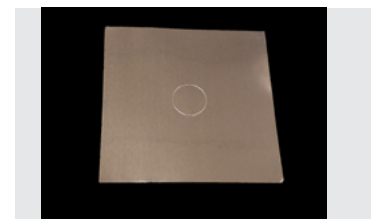
Test Area	OX-TRAN LLOD cc/(m ² · day)		
	2/22 H	2/22 L	2/22 10X
50 cm ² Standard Cell	0.05	0.005	0.0005
20 cm ² Foil Mask	0.13	0.013	0.0013
5.64 cm ² Reduced Test Area Cartridge	0.4	0.04	0.004
5 cm ² Foil Mask	0.5	0.05	0.005
1 cm ² Foil Mask	3	0.3	0.03

The table shows that the LLOD can be significantly higher for masked and reduced-area samples than for standard samples. For this reason, it should be noted that there can be difficulties when reducing the test area for high-barrier, low-permeation materials. Therefore, when it is necessary to test at lower levels with limited testing areas, it is recommended to use the 2/22 L or even the 2/22 10X, with their lower LLOD capability.

Next Generation Aluminium Foil Masks: 20 cm², 5 cm² · 1 cm² and 0.3166 cm²



Aluminium Foil Mask: 5 cm², 5" X 5" No post holes for Mounting



Recommendations

- It is advised to use the full-size (50 cm² testing area) sample as much as possible for high-barrier materials.
- When using foil masks, please check the adhesion compatibility between the test sample and the adhesive on the mask. Poor adhesion could lead to errors due to more sample being exposed than expected, and thus the actual test area could be larger than the mask's specified size.
- If there is poor adhesion between the mask and the sample, it is recommended to use the 5.64 cm² Reduced Test Area Cartridge.
- When analyzing reduced area samples within an order of magnitude of the LLOD, subtract the innate test cell leak rates from the test results to account for instrument noise.

Questions?

Call AMETEK MOCON to speak with a certified technical support specialist.

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