

# SOLUTIONS RELATED TO PERMEATION TESTING OF PAPER-BASED MATERIALS

Accurate testing of barrier performance is challenging without understanding the root cause of testing failures.

To serve as barrier materials, coated paper products must go through permeation studies such as oxygen transmission rate (OTR) or water vapor transmission rate (WVTR) tests. However, during permeation testing, inaccurate data can lead to improper decisions. Testing of these coated materials offers several unique challenges:

1. Frequent over ranging of the analyzer
2. Sealing on the sample
3. Edge leakage



*Coated paper packaging material*

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## Due to its porous nature, paper and paperboard are not considered good barrier materials.

For many packaging applications, paper structures are not sufficient barriers. However, by applying a thin polymer coating, a suitable environmentally friendly barrier material can be created.

Development of specialized coatings is only half of the battle; understanding the proper measurement technique is also an important key to launching a successful paper-based packaging structure. Through the early stages of R&D failed tests are common, but understanding the potential causes of the failures is critical to acquiring accurate results.

### Causes for high transmission rate results

1. Paperboard inherently has a bumpy surface that is difficult to seal on. Permeation testing requires a smooth surface to seal properly within the instrument.
2. If the polymer coating is too thin, it can cause test failures:
  - a. A thin coating often leaves the paper surface with some bare spots and/or porosity.
  - b. A thin layer may leave the surface bumpy causing sealing issues between the sample and the test cell interface, thus allowing room air to leak in.

# EXPOSURE TO HUMIDITY CAN CAUSE A SERIES OF COSTLY PROBLEMS

APPLICATION NOTE

## Coated paper testing without intervention vs. removing edge diffusion.

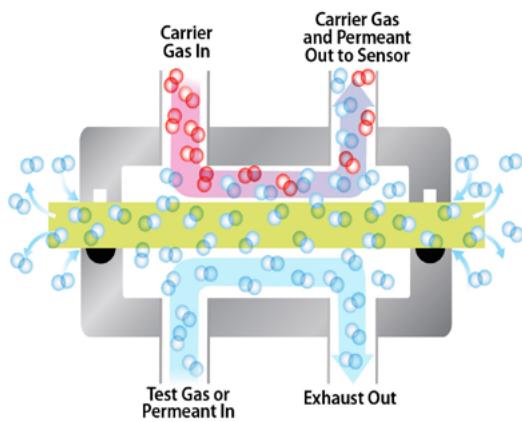


Figure 1. Possible path of edge-effect issue

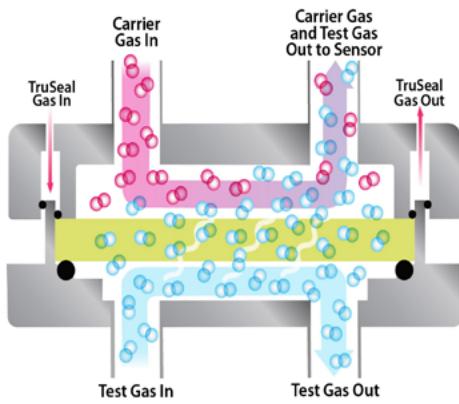


Figure 2. MOCON Edge-Effect Cartridge

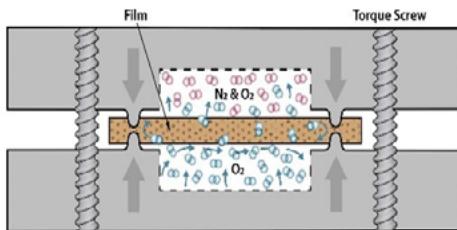


Figure 3. MOCON Edge-Compression Cartridge

3. The coating may be excessively absorbed into the paperboard, thus not forming a continuous layer on top of the substrate.
4. The solvent in the coating can alter the structure of the substrate.
5. Coating itself might not provide an adequate barrier.
6. Ingress of ambient air and moisture via the cross-section of the porous structure at the sample edge (figure 1).
7. High humidity may cause the paper substrate to swell and compromise the coating's effectiveness.

## Optimal OTR barrier film design approach provides the best solution.

paper-based substrates can be made into effective barriers if the following tips are implemented:

- Select a barrier coating with adequate barrier properties. Please understand, a good oxygen barrier is not necessarily a good moisture barrier.
- Use a microscope to examine the coating's thickness and finish to ensure it completely covers the bumpy surface of the paper substrate with a continuous layer.
- Test the compatibility between the polymer coating solvent and the substrate to make sure it does not alter the substrate.
- Start OTR testing with an OX-TRAN® 2/12 R (samples must not be porous) that allows OTR analysis up to high levels while refining your coating processes.
- Once your coating process is optimized, use MOCON® permeation analyzers for more accuracy and increased test throughput.
- All paper-based structures have varying amounts of thickness, porosity and surface roughness. That's why AMETEK MOCON offers specialized cartridges that seal sample edges while testing (see figures 2-3), otherwise foil mask variations may also be suitable.