Caution When Comparing Moisture Vapor Transmission Rates

When it comes to evaluating advanced protective covers, the asset owner should view advertised moisture vapor transmission rates (MVTR) cautiously. Breathable covers should prevent penetration of moisture while allowing water vapor to diffuse through them [1].

To determine the MVTR for cover material, a recognized standard test method should be used and it should be applicable to the material from which the cover is manufactured.

In addition, factors which influence the test results may represent some aspect of the cover or are related to the test itself.

Cover dependent factors which affect MVTR include, but are not limited to, the chemical affinity between the cover and the vapor, voids and imperfections in the cover, crystallinity of the polymer, and whether polymer additives are used.

The most fundamental cover related factor is material thickness. A decrease in MVTR is observed as the thickness increases [2]. The composition of the coating dominates the MVTR of the coated fabric.

Test dependent factors include the water vapor gradient across the specimen and the atmospheric temperature. An increase in water vapor gradient across the specimen significantly skews the result. Results may vary by as much as 40% when tests are conducted at different temperatures [3].

Thermoplastic polyurethane coatings are widely used in the textile industry. Four different test results were obtained for Estane 58237 thermoplastic polyurethane coated fabric when tested to ASTM E-96. The data highlights that for this standard, there are two procedures: B and E. The cup that the material seals contains either water or a desiccant.

Let's assume the baseline test was ASTM E-96 Method B; conducted at 23°C and at 50% relative humidity which resulted in a MVTR of 700 g/m^2/day. Increasing the temperature and humidity on the other side of the material to 38°C and 90% RH actually decreased the humidity gradient through the material. This condition resulted in a 57% reduction in MVTR to 300g/m^2/day.

Similar logic holds when examining results for Method E, also conducted at 23°C and 50% relative humidity Increasing the temperature and humidity on the other side of the material to 38°C and 90% RH resulted in a 2900% increase in the MVTR!

ASTM	Procedure	Temperature	RH	MVTR
		Centigrade	%	g/m2/day
E-96B	Upright Cup, Water	23	50	700
E-96B	Upright Cup, Water	38	90	300
E-96E	Upright Cup, Desiccant	23	50	300
E-96E	Upright Cup, Desiccant	38	90	9000

Table 1. MVTR for Estane 58237

This test data highlights the impossibility of comparing MVTRs if the test conditions: temperature, humidity and desiccant use are not documented.

Durable lightweight advanced protective covers employ breathable fabrics to allow moisture, a corrosion prerequisite, to escape thereby contributing to asset protection.

As highlighted in this technical bulletin, comparing products based solely on MVTR test results is fraught with danger, especially when the test conditions are not documented. Different test methods should be used for covers manufactured from fundamentally different materials.

The presence of vapor corrosion inhibitors (VCIs), integrated into advanced protective covers, lowers the corrosivity beneath the cover and mitigates the effects of high moisture content beneath the cover.

References

[1] Transhield Technical Bulletin-0002; What are the benefits of a breathable cover?

[2] Whelan, M. E., Macttattie, L. E., Goodings, A. C., Turl, L. H., The Diffusion of Water Vapor Through Laminae with Particular Reference to Textile Fabrics, Textile Research Journal, Vol. 25, No. 3. 1955, pp. 197-223

[3] Stevens, M., Tuomela, S., Mayer, D., Water Vapor Permeation Testing of Ultra-Barriers: Limitations of Current Methods and Advancements Resulting in Increased Sensitivity, Mocon Inc., White Paper 07-4102.

[4] Samms, J., High Moisture Vapor Transmission Thermoplastic Polyurethanes, Noveon, Inc., 2002

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