Technical
Information

Moisture-Exclusion Effectiveness

Catalog number 002-745

A test procedure to measure the relative moisture-exclusion effectiveness (MEE) of a wood finish or coating

This is a simple method based on one developed by the U.S.D.A. Forest Products Laboratory and has been used for a number of years. Our version is geared to screening a few samples; if you are interest in comparing a large number of different coatings, we suggest you read the FPL Research Paper referenced at the end of our test outline. As with any test, care in sample preparation and accurate measuring will control the consistency and credibility of the results.

Test method

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The coatings to be evaluated are applied by brush to 3" x 5" x ⅝" clear wood samples with carefully rounded corners and edges (Figure 1). The wood samples, preferably from the same board, are conditioned to room temperature and humidity for one week before coating. This conditioning should be done in as dry an environment as possible (we use 30% RH @ 80°F). The greater the difference between the dry and wet conditions, the more pronounced the changes will be in the sample's MEE. Each coated sample has an end-matched, uncoated control sample (adjoining pieces of the same board). After coating, the samples are allowed to cure for another week. Then the samples, including the uncoated controls, are weighed and then exposed to high humidity (85% relative humidity) in a closed container. The samples are weighed daily until they reach equilibrium and demonstrate no further weight gain. Moisture-exclusion effectiveness is calculated at any time by comparing the coated samples with their uncoated controls:

$$\text{MEE} = \frac{U - C}{U} \times 100$$

U = weight of moisture* absorbed by uncoated wood
C = weight of moisture* absorbed by coated wood
* Record the sample's weight before testing and then subtract that weight from the sample's weight during the test to determine the amount of moisture weight gained.

Equipment required

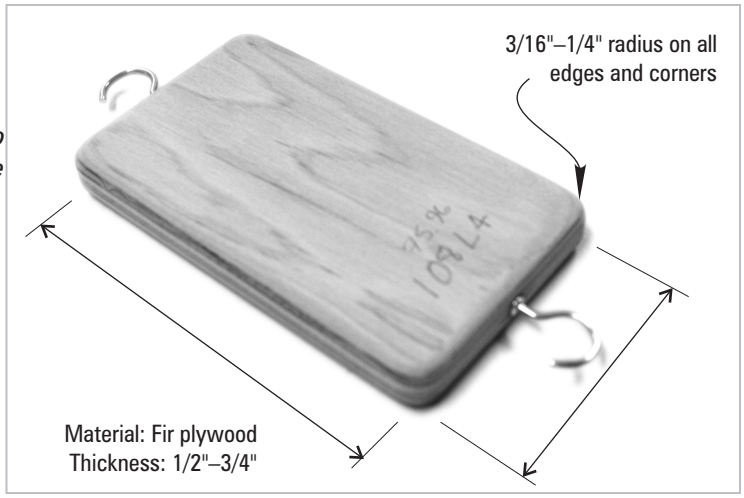
A minimal amount of woodworking equipment is required for making samples. In addition to these tools, you will need the following:
1. A balance or scale sensitive to 0.1 grams
This can be a problem if you can't get access to a good scale through a local school or lab. Ohaus balances, Model #700 or #860, are available for about $107-$127 (1988 prices) from Fisher Scientific Company, 711 Forbes Ave., Pittsburgh, PA 15219, Telephone: (412) 562-8300
2. A moisture chamber
This can be an aquarium, a cooler or a five-gallon pail with top. An aquarium works best because of the "greenhouse effect" when you leave it covered in the sun.

Sample preparation

Cut 3" x 5" x ⅝" wood samples. To help reduce the wood density as a variable affecting the moisture absorption characteristics of the samples, try to make all samples from the same board. Dimensions are arbitrary but should be consistent. We prefer to use balsa wood because it gains weight rapidly when exposed to moisture. Mark all samples and their end-matched controls for identification. To remove any sharp corners or edges that will result in poor or discontinued coating coverage, rout all corners and edges to 3/16" to ¼" radius and sand edges and sides smooth with 120-grit sandpaper. Then vacuum brush the samples to remove sanding dust. Drive finishing nails or eye hooks into opposing corners of each block. These will allow you to suspend the samples in the moisture tank and will aid in coating.

*Figure 20— **Moisture exclusion effectiveness test sample***

Finishing nails or cup hooks in opposing corners allow sample to be secured to a wire and facilitate coating procedure.



Sample conditioning

Hang all samples in a reasonably clean, safe spot for at least a week or until they reach equilibrium moisture content (EMC) in the dry environment. The longer they can equilibrate, the better.

Coating the sample

When the samples have reached EMC, weigh each one and record its uncoated weight. For each finish or coating you want to evaluate, select three pairs of end-matched mates, enough to test one, two and three coats of the finish with an end-matched uncoated control sample for each.

Proceed with the coating per the manufacturer's directions, allowing sufficient cure time between coats where necessary. When applying multiple coats to samples, alternate the corner hook or nail from which you suspend the sample during cure. This will tend to balance whatever sagging occurs with each coat for a more even final film thickness.

The average film thickness of each coat or multiple coats can be figured by obtaining the coating or film weight (coated sample weight minus original weight) and plugging it into the following calculation:

$$\frac{\text{Film weight per unit area*}}{\text{Density of coating materials}} = \text{Film Thickness}$$

* The surface area for 3" x 5" x ⅝" sample with rounded edges is approximately 37 square inches.

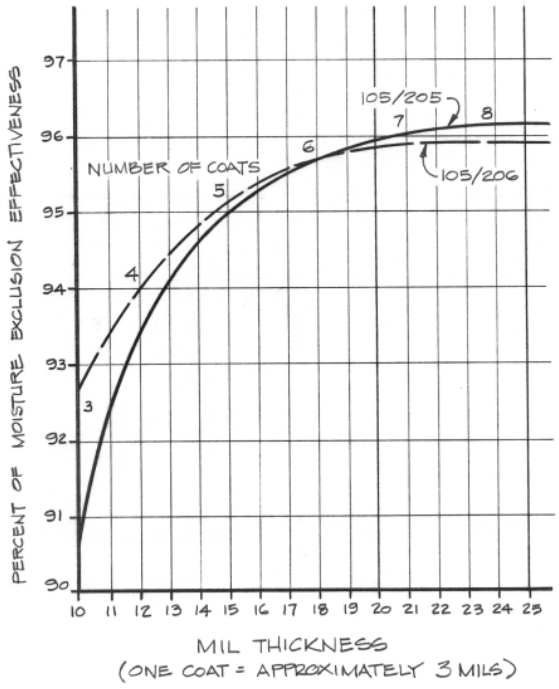


*Figure 2—**Effect of film thickness on MEE***

Film thickness has a dramatic effect on MEE up to about 5 or 6 coats. Additional coats provide less additional moisture exclusion effectiveness. Maximum effectiveness is achieved with about 8 coats or a 24 mil thickness.

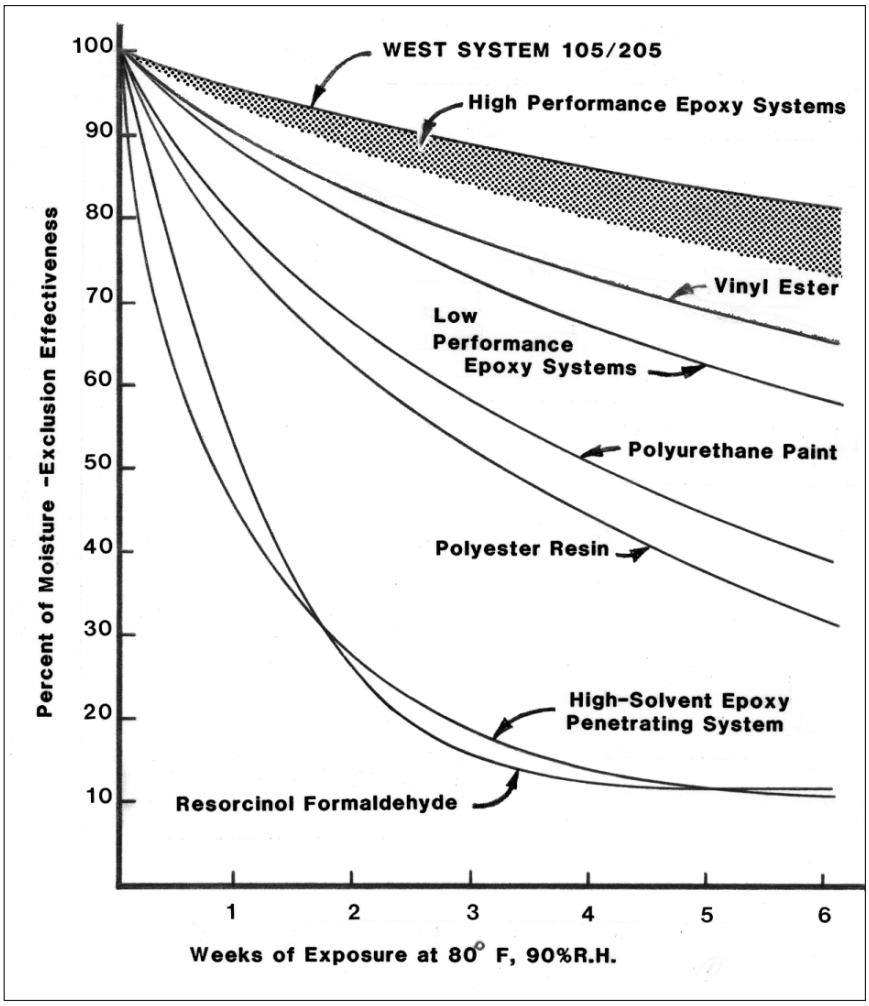
Measuring moisture-exclusion effectiveness (MEE)

After the coats have cured for a week, and weights have been taken and recorded, place the samples and their end-matched uncoated controls in the moisture chamber. For the highest possible relative humidity, the moisture chamber should have standing water and should be placed in a warm area. You can immerse the samples, but coatings are much more effective against a short immersion in water than they are against one or two weeks' exposure to moisture-saturated air. Distilled water is preferred by testing laboratories and is usually called for in industry and governmental specs.

Record the weight of all samples after 1, 2, 3, 7, 14, and 21 days. Uncoated samples will soak up moisture quickly and reach equilibrium or saturation after about a week. Fungus may form on the uncoated samples, but this should not affect the weight measurements. Coated samples will absorb moisture slowly and reach equilibrium after three or four weeks. Calculate MEE from the measured weight changes using the formula outlined in the METHOD section above. Note that the moisture content of the uncoated samples will be constantly changing so the MEE is not an absolute value.

To compare the MEE of different coatings use sample weight measurements taken all on the same day.

*Figure 21— **Moisture exclusion effectiveness of various marine coatings***



Further reading

The U.S.D.A. Forest Products Laboratory Research Paper FPL 482, "The Moisture-Excluding Effectiveness of Finishes on Wood Surfaces," published in 1985, details a study which investigated a number of variables for a broad range of wood finishes. It is available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 and is well worth reviewing. Of note is the observation that two-component sheathing epoxy adhesive was second only to complete encapsulation in paraffin wax as a moisture-excluding barrier.