COATINGS THAT PREVENT END CHECKS

As wood dries, the surface fibers give up their moisture first and tend to shrink but are restrained from so doing by the interior fibers, which have not begun to shrink; thus, drying stresses develop that tend to cause checks. Wood dries more rapidly at end-grain than at side-grain surfaces. The tendency to check is therefore more pronounced in the end grain. A moisture-resistant end coating is often used to protect such surfaces from checking during air seasoning or kiln drying, especially with the more valuable items of wood that are difficult to dry and hardwood logs that are to be stored for long periods of time. End coatings should be applied as soon as possible to the freshly cut end surfaces, for end checks, once started, tend to go deeper into the wood as drying progresses. End coatings are also used to prevent loss of moisture from the ends of short kiln samples, and for this purpose the most highly water-resistant coatings are advisable.

To be satisfactory for large-scale use, an end coating should have the following qualities:

1. Adequate resistance to water movement under all conditions of temperature and humidity to which it may be subjected during the drying of the wood.

2. Ease of application.

3. Sufficient toughness and adhesiveness to withstand rough handling and to prevent blistering and cracking during kiln drying.

4. Freedom from abrasive substances that may be injurious to saws or cutters during machining of the wood.

5. Low cost to cover a given area.

The degree of water resistance required depends upon the species and size of the wood. In general, greater water resistance is required for the dense hardwoods and stock of large cross-sectional dimensions than for the lighter hardwoods, the softwoods, and ordinary lumber. Highly refractory woods, such as oak and black walnut, require the most highly water-resistant coatings available.
End coatings may be divided into two classes: those that are liquid at ordinary temperatures and can be applied without being heated, and those that are solid at ordinary temperatures and must be applied hot. Cold coatings can be applied readily to logs and lumber as well as to kiln samples and dimension stock. Hot coatings are well suited for use on small stock that can be easily handled, but they are not readily applied to logs and lumber.

**Cold Coatings**

The two best cold coatings tested at the Forest Products Laboratory are phenolic-resin varnish pigmented with aluminum paste or powder, and filled hardened gloss oil. Both are tough and easily applied.

Aluminum paste or powder can be dispersed in a variety of vehicles to form water-resistant paints. Even with the most water-resistant vehicles, such as a phenolic-resin tung-oil varnish, two coats are required to form a highly water-resistant coating. Three coats of this aluminum paint produce the most water-resistant end coating the Forest Products Laboratory has yet tested. About 2 to 2-1/4 pounds of aluminum should be used per gallon of vehicle. Aluminum paints should be mixed immediately before use, because the desirable leafing property of the aluminum particles diminishes as the paint stands in the mixed condition. Aluminum coatings do not cause serious abrasion of cutting tools, but they are expensive.

The filled hardened gloss oil developed by the Forest Products Laboratory is made by thoroughly mixing 25 parts (by weight) of barytes and 25 parts of magnesium silicate with 100 parts of a hardened gloss oil made according to the following formula:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Parts by Weight</th>
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<tbody>
<tr>
<td>Rosin</td>
<td>100</td>
</tr>
<tr>
<td>Hydrated lime</td>
<td>6 to 8</td>
</tr>
<tr>
<td>Mineral spirits</td>
<td>57.5</td>
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</tbody>
</table>

The hardened gloss oil should be made up by a varnish manufacturer because of the technical operations involved. When freshly made, two coats of filled hardened gloss oil are required to obtain a highly effective end coating. If desired, some of the solvent may be evaporated after the pigments are mixed with the gloss oil to obtain a thickened mixture that will give satisfactory results under many drying conditions when applied in a single coat. When thus thickened, the mixture is somewhat difficult to apply. Large quantities should not be mixed at a time, for eventually the settling of pigment and loss of solvent combine to make the coating unfit for further use. The filler contained in this coating is slightly abrasive to cutting tools. Filled hardened gloss oil is moderate in cost.
A heavy paste consisting of a pigment such as white lead in a vehicle such as linseed oil makes a simple coating that is moderately effective when applied in a single coat. The paste should be prepared with only enough oil to allow its application with a trowel or stiff brush. This type of coating is generally available and is admirably suited for shop, farm, or home use in drying small lots of material. Ordinary paints and varnishes are too thin to be effective as end coatings, although they are helpful if several coats are applied. Linseed oil alone is not suitable.

Cold coatings are usually applied by brush, although they can be sprayed with proper equipment. They also can be applied to small items by holding the ends against a roller that is rotated while partly submerged in the coating. Cold coatings should be allowed to dry a few hours before being subjected to kiln temperatures.

Hot Coatings

Hot coating materials include pitch, asphalt, rosin, and paraffin. They are low in cost and high in water resistance when applied in a single coat. They maintain a high degree of water resistance even after prolonged heating if the drying temperatures are kept about 30°F. or more below the softening point of the coating. These materials are more or less amorphous and do not have definite melting points. Standard softening points can, however, be determined by empirical methods. One such method that is applicable to end-coating materials is the ring and ball method (A.S.T.M. Designation: E28-42T).

Hot coatings can be prepared that will withstand any normal kiln temperature, but those with higher softening points tend to be less adhesive, more brittle, and more difficult to apply than those with lower softening points. A coating with the lowest softening point that will safely withstand the temperatures encountered during the drying should be used. Certain combinations of hot-coating materials can be mixed to obtain desired softening-point characteristics and improved adhesiveness and toughness.

Coal-tar pitches are particularly high in water resistance. The pitches with higher softening points are especially brittle. For low kiln temperatures, 155°F. coal-tar pitch is effective. One of the most water-resistant coatings tested at the Laboratory is 213°F. pitch, but it is not readily used alone because it is brittle when cold and does not adhere well to the wood. Asphalt may be added to 213°F. pitch to increase the toughness of the coating. One such combination, formulated at the Forest Products Laboratory, consists of 60 parts (by weight) of 213°F. coal-tar pitch, 25 parts of 155°F. coal-tar pitch, and 15 parts of 225-235°F. asphalt. This end coating is suitable for use with kiln temperatures up to 165°F.
Asphalts are tougher and more plastic than pitches having the same softening point. Asphalts are derived from a number of sources, particularly from natural deposits and as a by-product of the distillation of petroleum. They vary in their softening point and water-resisting properties. Many are suitable as hot coatings for kiln drying. Both coal-tar pitches and asphalts are low in cost.

The combination of rosin and lampblack forms a very effective coating for use with kiln temperatures up to 150° F., and it can be used with only slightly diminished effectiveness up to 170° F. Seven parts by weight of lampblack are used to 100 parts of rosin. Rosin is about as brittle as 213° F. coal-tar pitch, but the addition of lampblack makes the coating less objectionable from this standpoint. It is moderate in cost.

Paraffin has proved satisfactory as an end coating for stock being air seasoned but cannot be used for stock being kiln dried because of its low softening point. Its cost also is moderate.

Hot coatings can be easily applied to material of short length that can be manipulated by hand. The temperature at which hot coatings should be applied varies with the type used; pitch and asphalt coatings are applied at approximately 400° F., rosin coatings at approximately 300° F., and paraffin at approximately 150° F. The coatings can be applied by dipping the ends of the stock into the molten coating to a depth of one-half inch, but better results are obtained by firmly holding the ends against a power driven roller that is rotated while partly submerged in the heated coating. If the coatings are applied uniformly, a thickness of one-twentieth to one-sixteenth inch is sufficient. Hot coatings are not as dulling to woodworking tools as is filled hardened gloss oil, but they are somewhat messy both in application and in machining operations subsequent to drying.

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