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Staining wood

CPES [Clear Penetrating Epoxy Sealer™ and MultiWoodPrime™ are the same product. they are packaged under two different labels for their two different uses, wood restoration and wood-priming, both as an adhesion-promoting primer and porosity-sealing primer. In this application note we will be using CPES to represent this product, under either label.

There are two fundamentally different effects that people seek to achieve by staining wood. These are two different basic purposes. ***One basic purpose is to enhance the natural wood grain patterns, and the other is to achieve an even color tone.***

Both are art. They have other purposes, too.

Going somewhere: Antique and classic boats, particularly the “runabouts” (motorboats as opposed to sailboats) were traditionally finished with a clear varnish protecting the wood, and the color of all the wood was intended to be the same. It was simply the agreement of all those who made, sold, bought and used such boats that the standard of beauty was an even color tone. I could guess that long ago a consistent color-matching batch of lumber might have come from one particular tree, was therefore scarce, therefore admired. It could have been as simple as that: Beauty and scarcity equate to value.

Achieving a uniform color tone to the highly discriminating eye was still a challenge, as the natural porosity of the tree varied from year-to-year depending on the weather hundreds of years ago, up to present time. This was solved by the invention of *filler stains*.

Accumulation of more pigment in the more porous regions of wood gives a darker appearance in those areas. Hundreds of years ago woodworkers invented simple ways to give uniform color to wood. By adding, for example, wood flour or talc (particles that have a nondescript color similar to wood) to the pigment-binder-solvent mix, a thicker liquid or paste was obtained that plugged up the porosity of the wood. The visual effect thus became a uniform color tone.

Separating inside from outside: Doors and other architectural woodwork are normally not painted because the owner wants to enjoy the natural art of the grain patterns of the wood. Staining is used to emphasize these patterns, and to create stronger and different visual effects than what results from plain wood with some clear finish.

Wood has a varying natural porosity, and wiping on a stain will cause more of the pigments of the stain to accumulate in the more porous regions of the wood. In this manner, the stain creates contrasting color patterns.

That was then; this is now.

The invention of Clear Penetrating Epoxy Sealer™ (also known as CPES, also ™) thirty years ago and the need to confront the actual condition of old wood adds several dimensions to what was originally the simple activity of staining and varnishing (and varnishing, and varnishing, and stripping and restaining and revarnishing again and again). Now, there is a better way.

Today we have a better understanding of the mechanism of adhesion of stain, varnish or paint to wood, and how coatings fail. The essay [Clear Coatings](#) addresses how all clear finishes fail, and the articles [How Does Wood Rot](#) and [How to Get More Life from Paint on Wood](#) address how painted coatings (including varnish) fail.

Knowing how things fail, we can design better coating systems.

Clear Penetrating Epoxy Sealer bonds varnish to wood with flexible epoxy glue.

In old, weathered, slightly deteriorated wood, CPES deeply impregnates the wood, gluing the remaining wood fibers back together. This returns strength and mechanical stability to the wood, and usually accomplishes a sufficient degree of restoration that the wood again becomes serviceable. Thousands of antique and classic runabouts have been restored, preserving much if not all of the original wood.

Restoration and preservation of the wood of such a boat is more important than its color. This fundamental principle explains why CPES has to go on the wood first, in that application.

If one put a filler stain on old, slightly deteriorated wood first, little if any of the CPES would get through the filler stain into the wood. Imagine painting on top of paint. You know the topcoat does not soak through. Paint goes on in layers, like onions have layers.

Not much sticks well to old, slightly deteriorated wood. That is why most things applied to old, slightly deteriorated wood fail soon. If we can treat that wood with CPES then we have a new surface to which other things can stick. Even on new wood, everything sticks better when those surface wood fibers are glued into the bulk of the wood. That is what CPES does.

If you put a filler stain on older wood before CPES, that interferes with wood restoration and creates a second liability. Now, the bond between the varnish binder resin of the filler stain and the wood depends on the bond between the filler stain and the old, deteriorated wood surface. You know those old fibers are no longer stuck together all that well. Not only does the filler stain mixture not bond strongly to such old wood, but those few surface fibers to which it does stick are themselves not well-bonded to the bulk of the wood.

We can apply here a second fundamental principle, that ***a chain is only as strong as its weakest link.*** CPES glues the surface wood fibers together with the bulk of the wood, as it accomplishes restoration. This gives a surface with integrity, and other coatings or stains may be reliably attached to it.

The reason that CPES is applied first to the wood of an antique or classic runabout depends on these two fundamental principles. Now we can address the matter

of secondary importance, which is how to apply a stain and varnish topcoat, to end up with a uniform color appearance. This also leads to an understanding of the proper treatment of new wood, so as to obtain either a varying or a uniform color tone.

Many different products are sold for wood “staining” applications. Some of these create new liabilities and should be avoided.

Waterborne stains (Latex stains, also known as “water-reducible” or “water-cleanup” stains) should be avoided. These contain binder resins which commonly dissolve in the solvents of varnish or CPES. Brushing moves the pigments around and creates brush-mark patterns of stain pigments, and looks very bad. A general lack of adhesion of one system to another results from unpredictable resin alloy coatings on the wood.

The only kind of stain that should be used under varnish or in conjunction with CPES is the oil-base stain whose binder resins are similar to varnish, namely those derived from linseed oil from the flax plant, or other “drying oils”, primarily from other plants. These products clean up (before cure) with mineral spirits, often referred to as “petroleum distillate”. That should help you to recognize them from reading the label.

Another liability of some stains is that they achieve their wood coloring effect by using dyes. “Interior” wood stain manufacturers may do this to reduce costs. A dye, by definition, is something that *transmits* one color and absorbs all others. White light (sunlight) contains all colors. Sunlight seen through a green-dyed liquid or green glass would look green. A pigment, by definition, *reflects* one color and absorbs all others. A pigment is opaque. Orange paint reflects only the orange component of sunlight and thus looks orange.

Dyes are not light-stable (meaning, they fade with time) and should be avoided, unless one is trying to achieve a specific artistic effect such as is often done on expensive furniture. Dyes are often found in “interior” stains, meaning those promoted for the milder environment inside buildings, rather than for the more harsh environment exterior to buildings, where they may be exposed to natural sunlight and the bleaching effect of its ultraviolet component. Interior stains will fade readily if exposed to the ultraviolet of sunlight. Paint manufacturers also use less expensive pigments in interior stains, and these are another reason they fade. Even interior fluorescent lights cause fading, as they have about fifteen percent of the ultraviolet of natural sunlight. Window-glass removes only a fraction of the ultraviolet of sunlight. The best solution is to use only “exterior” oil-base stains and a topcoat containing ultraviolet absorbers, and enough of them. This also requires a thick enough topcoat so that enough of the ultraviolet component of sunlight is absorbed so as to give sufficiently long-lasting protection to the wood, The result of all that will give owner satisfaction.

In order to bond that topcoat to the wood, one uses CPES.

Oil-base stains may be *transparent*, meaning that they do not entirely hide the wood color underneath, or filler-stains, which have a higher solids content and tend to be *opaque*, and thus to give their own color to the wood rather than allowing a contribution from the wood itself. In a thin enough coat, filler stains will be only partly opaque. Restoration of an antique or classic boat may require only certain color stains which are only available from the Sandusky Paint Company in certain “original” colors, and may only be available in a filler-stain formulation. I prefer that the transparent stains be used wherever the application allows them, and these are the ordinary oil-base stains available

through, for example, most ACE or similar hardware stores. They are “interior” grade, not necessarily light-stable, and require a clear overcoat that contains sufficient ultraviolet Absorbers, and which is applied in a sufficient film thickness, as to protect not only the stain but the wood from the bleaching effect of the ultraviolet component of natural sunlight or fluorescent bulbs [which have about fifteen percent of the ultraviolet content of sunlight].

Removal of old finishes should only be done by sanding, heat-gun, or using the solvent MEK in accordance with the application-note Stripping Paint. Some chemical paint strippers leave harmful residues on the wood, which destroy adhesion of fresh coatings.

Depending on whether the wood is old or new and the visual effect one seeks, a filler stain and the CPES are used together in different ways. Here are three:

Even color tone: Old wood such as an antique or classic runabout

1. Sand to clean sound wood.
2. CPES to seal wood porosity. You should be able to sand within 24 hours, even though it won't be fully cured.
3. Sand with 80 grit, or 100, or 120, etc., depending on how much you want to darken the wood. Coarser grit will hold more stain and thus give the wood a darker tone. Finer grit will hold less stain and thus not darken the wood so much. Sand parallel to the grain, *only enough to remove the surface resin film* of CPES and expose wood surface fibers.
4. Stain: Brush filler-stain on wood *parallel* to the grain and wipe off with cheesecloth *perpendicular* to the grain..
5. Allow the stain to fully cure so it is resistant to the solvents of the CPES. This typically takes four days.
6. CPES
7. Topcoat

Even color tone, eliminates “blotchiness” of stained wood: New, sound wood

1. Sand to clean sound wood.
2. CPES to seal wood porosity. You should be able to sand within 24 hours, even though it won't be fully cured.
3. Sand with 80 grit, or 100, or 120, etc., depending on how much you want to darken the wood. Coarser grit will hold more stain and thus give the wood a darker tone. Finer grit will hold less stain and thus not darken the wood so much.

Sand parallel to the grain, *only enough to remove the surface resin film* of CPES and expose wood surface fibers.

4. Stain: Brush filler-stain on wood *parallel* to the grain and wipe off with cheesecloth *perpendicular* to the grain.

5. Allow the stain to fully cure so it is resistant to the solvents of the CPES. This typically takes four days.

6. CPES

7. Topcoat

Varying color tone: New sound wood such as a front door

Sand as you wish, to expose the natural wood porosity. You should experiment on a scrap of wood or a non-visible area, so you know what to expect.

A more smooth final sanding, with a finer grit, such as 220, and then vacuuming [or blowing off with compressed air] to remove the sanding debris, will leave a smooth surface to which little stain will adhere. In the more porous areas more stain will accumulate.

1. Apply a transparent oil-base stain. The pigment accumulates in more porous areas, emphasizing porosity by color. It does not seal wood porosity. This allows better impregnation of wood. Brush on and wipe off, and see how it accumulates more in the more porous areas of the wood, emphasizing the grain patterns.

Allow the stain to fully cure so it is resistant to the solvents of the CPES. This typically takes four days.

2. CPES

3. Topcoat