Practical Approaches to Wood Finishing

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The major purposes of wood finishing are stabilization, protection, and aesthetics. The first two purposes are related to the hygroscopic nature of wood, while aesthetics is concerned with developing a product that is visually appealing.

Wood reacts to changes in the moisture content of the surrounding environment. This response causes shrinkage and swelling, which results in defects such as splitting, cracking, and warping. (For more information on shrinkage and swelling in wood see OSU Extension Facts F-5009, "Dimensional Changes in Wood"). A finish acts as a barrier and stabilizer, reducing the development of defects from changing moisture conditions. The protection provided by finishes also plays an important role during the service life of wood products, reducing or preventing damage from environmental conditions and everyday use. The aesthetic or decorative purpose of wood finishes can be classified into three major groups—texture, color, and sheen. Finishes are fashion oriented and are a significant factor in the marketability of wood products.

Surface Preparation and Finish Types

Surface preparation is the first step in the finishing process. Generally after planing, the wood surface will need some degree of preparation prior to finishing. Sandpaper, steel wool, or various finishing pads are commonly used to smooth and clean the surface to eliminate roughness and other defects that might influence the quality of the finish. Many types of material are used to manufacture sandpaper. Silicon carbide, zirconia, ceramic, and garnet are the minerals most commonly used. Cloth, paper, or a combination of different films is used for the backing layer of the sandpaper. Figure 1 illustrates a schematic of typical sandpaper construction.

A typical furniture finishing process includes the following stages:

- sanding
- bleaching
- filling
- staining
- sealing
- washcoat
- glazing
- topcoat
- rubbing

Depending on the type of finish desired, some of these steps may be eliminated, or other finishing processes may be added. For example, bleach is applied if lightening or removing the natural wood colorant is required. Because bleaching is an expensive and hazardous operation, the highest quality solid wood or veneer should be selected to balance the cost of the total finishing process. Sodium hydroxide and hydrogen peroxide are most commonly used as bleaching agents.

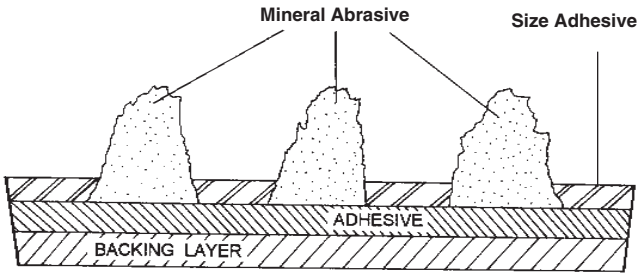


Figure 1 . A schematic of a typical sandpaper construction.

The purpose of staining is to change the color of wood. Either oil-soluble or water-soluble stains can be used for wood staining. Nongrain-raising stains (NGR) are water-soluble dyes that can be thinned using alcohol. They are usually applied using low air pressure in the range of 25-30 psi. Stains are formulated in a wide range of intense colors at a relatively low cost in comparison to the total cost of finish and their functions.

Filling can also an important part of the finishing process. Filling covers pores of species such as oak, ash, and walnut. Depending on the anatomical characteristics of the species of wood, not all surfaces need to be smoothed with a filling agent. Linseed oil and varnish-based wood filler paste are the most popular types of fillers. Fillers are applied to the surface as a thick coat, and excessive filler is later wiped off by rubbing across the grain with a coarse fabric. Paste wood filler cures within several days, while water-based fillers cure faster. Because curing time is shorter for water-based fillers, it is very difficult to remove excess filler after application. Fine sandpaper (200-220 grit) can be used to clean the surface and make it ready for the next coat of finish.

A sealer is any finishing material applied with the primary purpose to stop the absorption of succeeding coats. There is a misconception that a special chemical should be used as a sealer since a regular finish will not seal the surface.

However, any coat of finish can be considered a sealer. No matter what type of finish is used, the first coat will cause raising of fibers on the surface, to some extent resulting in a rough surface. This can be eliminated by the application of a sanding sealer, which usually contains zinc stearate. Application of a sanding sealer is one of the most critical steps in the finishing process. It will increase the smoothness of the surface so that the remaining finish coats will adhere to the surface. A major disadvantage of a sanding sealer is its lower resistance to water than finish itself. The sealer should be applied only once; otherwise, extra coats may weaken the finish.

Glaze stains are usually applied to more expensive furniture. They can add depth, richness, and decor. Most glazes have a pigment suspended in an oil varnish or water-based binder.

In general, finishes can be classified into two main groups: penetrating and film finishes. Penetrating finishes are usually oils and don't cure as a hard surface layer, while film finishes cure to form a hard surface layer and can be built up to any desired thickness. If a film-type finish is used, topcoats can be applied to increase the thickness of the film, add decorative color, and modify sheen after the initial sealer coat. Figure 2 shows topcoat glaze and sealer coat on a surface.

Application of Spraying

Airless and electrostatic spraying techniques have been significantly improved since their development in the 1940s. Airless spray (conventional spray) is still considered the most versatile finishing application. Lower amounts of finish and energy expenditure are major advantages of airless spraying techniques. Liquid paint is broken up or atomized by the pressure difference between the tip of the spray gun and the air just in front of the spray gun. Pressure level, viscosity of finish, temperature, and geometry of the spray gun nozzle are some of the factors influencing the degree of atomization.

Viscosity—the fluidity of the finish—is a critical property for proper atomization. If the finishing liquid is too viscous, results can include pinholes, bubbling, or surface roughness due to improper distribution of the liquid. On the other hand, viscosity that is too low will cause sagging of the finish. In a general finishing application, 70-80 centipoise viscosity should yield desirable results. Figure 3 illustrates a typical relationship between viscosity and temperature.

High-volume, low-pressure (HVLP) spraying has become a very popular technique in finishing. This system utilizes the same volume as conventional spray techniques, but uses lower pressure at the nozzle. The amount of material bounced from the surface being sprayed is reduced, resulting in 65-90% coating efficiency. This method is ideal for low-capacity production lines.

Ultraviolet coating has also been successfully used in many automated finishing lines. Light energy at wavelengths of about 0.04 to 0.8 micrometers breaks certain chemical bonds and helps cure finish films. Since many ultraviolet coatings are 100% solid, this method also substantially reduces volatile organic compounds used during the finishing operation.

Another method applies an electrostatic finish to the wood and requires that the part being sprayed be electrically conductive. Therefore, moisture content of wood should be at least 10-13%. This method is ideal for chairs, cabinet doors, table legs, and bed rails. Usually, parts are transported on an overhead material conveyor. A uniform high-quality coat and lower volatile organic compounds are two main advantages electrostatic finishes have over conventional spraying methods.

Application of finish spray is one of the most important factors influencing the amount of finish, homogeneous distribution of finish on the surface, and quality of the subsequent coats. The spray should be applied differently depending on vertical or horizontal orientation of the panel. In both vertical and horizontal panel applications, the spray gun should be held approximately 5-11 inches from the panel and should be moved parallel to the panel rather than in a swinging motion, which may produce uneven distribution of the finish. Ideally, the spray pattern at the edge of the panel should be centered, and the next application should overlap about 40-50% of the previously sprayed area on the return. In horizontal applications, spray the edges first; spray the face last in overlapping parallel bands. Figures 4A, 4B, and 4C illustrate finish spraying for various applications.

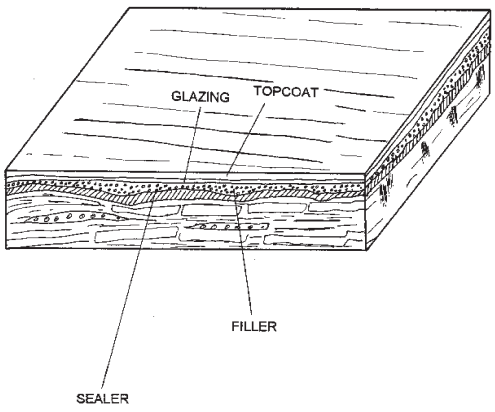


Figure 2. Location of topcoat, glaze, and sealer on wood surface.

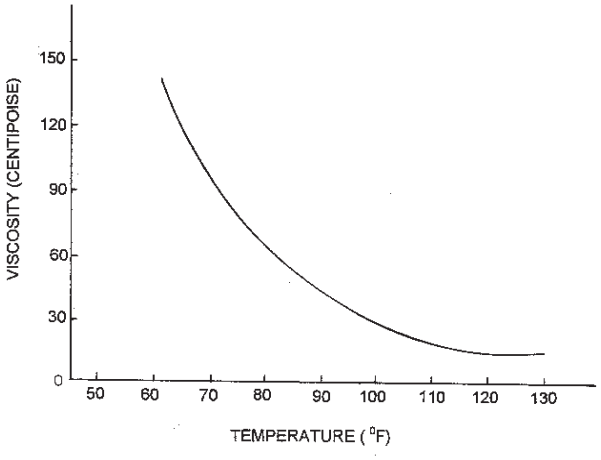


Figure 3. Relationship between temperature and viscosity of the finishing material.

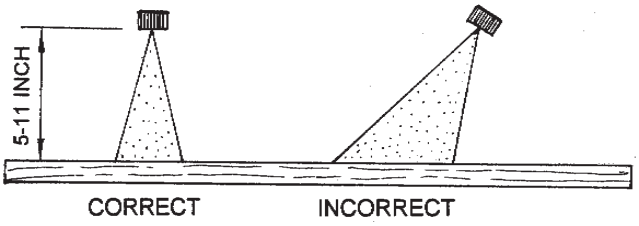
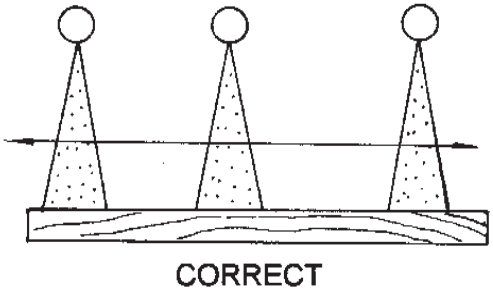


Figure 4A. Spraying distance in both horizontal and vertical applications.



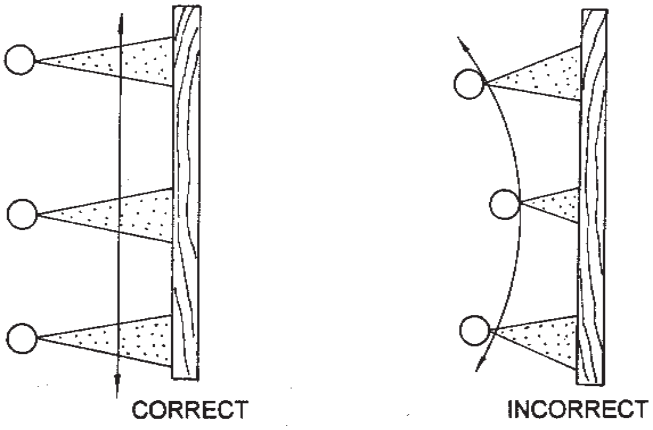


Figure 4B. Application of finish to a vertical panel.

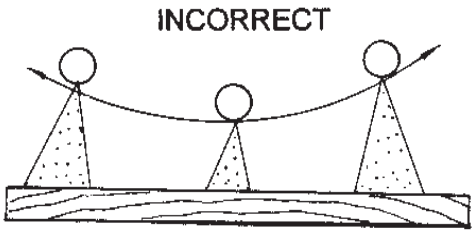


Figure 4C. Application of finish to a horizontal panel.

The main objective of any spraying line is to apply finish to the products in a safe, efficient, and effective way under the right conditions. Removing flammable and toxic fumes and having sufficient air ventilation, proper temperature, and controlled humidity are some important factors necessary to achieve this objective.

Clean air circulation plays an important role in keeping the environment at the desired temperature and relative humidity. It also acts as a drying medium for the part being sprayed. This effect is more prominent when spray booths are used instead of other types of finishing lines.

Conclusion

Unless a proper, defect-free finish is applied to wood products, their final value will be low, even though high-value, well crafted products are used. All steps of the finishing process should be closely monitored, and possible problems related to finishing material, application techniques, or environmental conditions should be eliminated in order to have high-quality, value-added finished products.

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Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

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