Protective Finishes and Coatings

Protective finishes and coatings for wood used indoors can perform for many years without refinishing or severe deterioration. The durability of finishes on wood exposed to natural weathering processes, however, depends primarily on the wood itself. Other factors which contribute are the nature and the quality of the finish used, application techniques, the time between refinishing, the extent to which the surfaces are sheltered from the weather, and climatic and local weather conditions. Wood properties that are important in finishing are moisture content; density and texture; resin and oil content; growth pattern and orientation; and defects such as knots, reaction wood and diseased wood (Browne 1962).

The primary function of any wood finish is to protect the wood surface from natural weathering processes (sunlight and water), and help maintain appearance. Weathering erodes and roughens unfinished wood (see Weathering). Wood can be left unfinished to weather naturally, and such wood can often provide for extended protection of the structure (Feist and Hon 1984). Different finishes give varying degrees of protection from the weather.

The protection that surface treatment provides against light and water will be affected by the weather resistance of the bonding agents used in the finish (e.g., drying oils, synthetic resins and latexes), as these agents are subject to some degree of photolytic degradation. The mechanism of failure of paints and other finishes has been described by Hamburg and Morgans (1979) and will not be discussed further here. Protection of wood exposed outdoors by various finishes, by construction practices and by design factors to compensate for effects of weather has been addressed in great detail (Cassens and Feist 1986).

Two basic types of finishes (or treatments) are used to protect wood surfaces during outdoor weathering: (a) those that form a film, layer or coating on the wood surface, and (b) those that penetrate the wood surface leaving no distinct layer or coating. Film-forming materials include paints of all descriptions, varnishes, lacquers and also overlays bonded to the wood surface. Penetrating finishes include preservatives, water repellents, pigmented semitransparent stains and chemical treatments (Banov 1973).

1. Film-Forming Finishes

1.1 Paints

Film-forming finishes such as paint have long been used to protect wood surfaces. Of all the finishes, paints provide the most protection against erosion by weathering, and offer the widest selection of colors. A nonporous paint film will retard penetration of moisture and reduce problems of paint discoloration by wood extratatives, paint peeling and checking, and warping of the wood. Proper pigments will essentially eliminate uv degradation of the wood surface. Paint, however, is not a preservative; it will not prevent decay if conditions are favorable for fungal growth. The durability of paint coatings on exterior wood is affected by the wood surface and the type of paint.

Paints are commonly divided into oil-based or solvent-borne systems and the latex or waterborne systems. Oil-based paints are essentially a suspension of inorganic pigments in an oleoresinous vehicle that binds the pigment particles and the bonding agent to the wood surface. Latex paints are suspensions of inorganic pigments and various latex resins in water, and form porous coatings. Acrylic latex resins are particularly durable, versatile materials for finishing wood and wood-related materials. Latex paints are used to a greater extent than oil-based paints for finishing wood, particularly for exterior use.

1.2 Varnishes and Lacquers

Clear varnishes or lacquers give wood an attractive initial appearance. Other treatments either change wood color or cover it completely. Unfortunately, clear varnish finishes used on wood exposed to sun and rain require frequent maintenance to retain a satisfactory appearance. The addition of colorless uv light absorbers to clear finishes has found only moderate success in aiding retention of natural color and original surface structure. It is generally accepted that opaque pigments found in paints and stains provide the most effective and long-lasting protection against light. Even using relatively durable clear synthetic resin varnishes, the weatherproof qualities of the wood-varnish system are still limited because uv light, which penetrates the transparent varnish film, gradually attacks the underlying wood. Eventually, the varnish begins to flake and crack off, taking with it fibers- of the wood which have been degraded photochemically. Durability of varnish on wood to weathering is limited, and many initial coats are necessary for reasonable performance. Maintenance of the varnish surface must be carried out as soon as signs of breakdown occur. This may be as little as one year in severe exposures. Lacquers and shellacs are not suitable as exterior clear finishes for wood.

2. Penetrating Finishes

2.1 Water Repellents

A large proportion of the damage done to exterior woodwork (e.g., paint defects, deformation and decay) is a direct result of moisture changes in the wood and subsequent dimensional instability. Water repellents and water-repellent preservative treatments are used to protect wood from decay and moisture. Such treatments reduce absorption of water and retard growth of decay microorganisms. These penetrating treatments can also be used as natural finishes for...
wood (Cassens and Feist 1986). Pretreatment of wood with water repellents or water-repellent preservatives is very important in the finishing of wood (such as millwork) for exterior uses.

2.2 Stains
When pigments are added to water-repellent preservative solutions or to similar transparent wood finishes, the mixture is classified as a pigmented penetrating stain (sometimes referred to as an impregnating paint). Addition of pigment provides color and greatly increases the durability of the finish. The semitransparent pigmented penetrating stains permit much of the wood grain to show through they penetrate into the wood without forming a continuous layer. Therefore, they will not blister and peel even if excessive moisture enters the wood. The durability of any stain system is a function of pigment content, resin content, preservative, water repellent and quantity of material applied to the wood surface.

Penetrating stains are suitable for both smooth and rough-textured surfaces however, their performance is markedly improved if applied to rough-sawn, weathered or rough-textured wood. They are especially effective on lumber and plywood that does not hold paint well, such as flat-grained surfaces or dense species. Penetrating stains can be used effectively to finish exterior surfaces such as siding, trim, exposed decking and fences. Stains can be prepared from both solvent-based resin systems and latex systems; however, latex systems do not penetrate wood surfaces. Commercial finishes known as heavy-bodied, solid color or opaque stains are also available but these products are essentially similar to paint because of their film-forming characteristics. Such stains, which can be oil- or latex-based, find wide success on textured surfaces and panel products such as hardboard.

2.3 Preservatives
Although not generally classified as wood finishes, preservatives do protect wood against weathering and decay, a great quantity of preservative-treated wood being exposed without any additional finish. There are three main types of preservative: (a) preservative oils (e.g., coal-tar creosote), (b) organic solvent solutions (e.g., pentachlorophenol), and (c) waterborne salts (e.g., chromated copper arsenate). These preservatives can be applied in several ways but pressure treatment generally gives the greatest protection against decay (see Preservative-Treated Wood). Greater preservative content of pressure-treated wood generally results in greater resistance to weathering and improved surface durability. The chromium-containing preservatives also protect against UV degradation.

See also: Decay During Use; Radiation Effects; Surface Properties