a closer look

Water-based finishes

KNOW THE SCIENCE AND MAKE SMARTER CHOICES

BY JEFF WEISS

No finishing topic creates more controversy, head scratching, and general mayhem than water-based finishes. Much of the misunderstanding stems from the rather checkered history of these finishes. They've always promised fast drying time, low odor, easy cleanup, and nonflammability, but early versions were hard to apply and gave many woods a cold, dead look.

However, today's formulations match the clarity, hardness, and durability of most, if not all, of the solvent-based clear-coat cousins that they are increasingly replacing. As the founder of a company that makes water-based finishes, I'll shed some light on their history, describe the increasingly sophisticated science behind them, and give some tips on how to apply them. In this way, I hope to give you the confidence to make the switch.

Water-based finishes started life on the floor

The history of many of today's water-based wood-finish resins can be traced back more than a century to the floor-care industry. Early developments included water emulsion paste-wax blends for protecting wood and tile floors. These blends had the advantage of being lower in odor and less flammable than solvent versions. After the Second World War, we began to see the development of polymer acrylates for tile floor finishes and waterborne urethanes that featured the early polyester, and later polycarbonate, resins used to waterproof fabric and leather. In the early 1980s, these technologies became the first generation of water-based finishes for wood floors.

Water-based latex and acrylic paints were developed before water-based clear finishes for two reasons: First, the market volume for paint is much greater; second, paint was easier to develop because early water-based resins demonstrated poor clarity and were better suited to blending with pigments.

In many ways, water-based clear finishes are following the same track as water-based paints, but are about 20 years behind in terms of market share. In the early 1980s, solvent-based wood finishes occupied almost 100% of the industrial and DIY market. Today, their share is estimated at 70% and is rapidly declining, with most of the decline within the last seven years.

The link between solvent finishes and air pollution

The event that transformed water-based finishes from various niche products into increasingly widespread use was the Clean Air Act of 1970. One of the terms popularized by the act was

Complex formulations

Careful measurement, then into the tank. *Many different components, in precise increments, combine to make today's products perform better. Each one is measured by weight to the nearest tenth of a pound (top). After each component is weighed and a lid is attached to the top of the drum, it is lifted by forklift and placed over the top of a 550-gal. tank (right).*

Mixed together. *A spigot on the drum is opened and the contents are allowed to slowly enter the liquid already in the tank. Each batch of finish is mixed for at least six hours.*

Photos: Mark Schofield

Types of water-based finishes

RESIN TYPE	PHYSICAL CHARACTERISTICS (POOR/GOOD/EXCELLENT)		BRAND EXAMPLES	SPRAY/ BRUSH/WIPE
Acrylic Blends Commonly marketed as the water-based equivalent of solvent lacquer finishes, these finishes are designed only to be sprayed. They harden rapidly and give good gloss development. Those made with styrene acrylics have good corrosion resistance to household chemicals such as salt or vinegar, but yellow with age.	**Hardness**	G-E	M.L. Campbell UltraStar	S
	Chemical resistance	G		
	Clarity	G-E	Target Coatings Ultima Spray Lacquer	S
	Burn-in	E	Becker Acroma Akva Line 212 lacquer	S
	UV resistance	P-G		
	Repairability	G-E	Van Technologies VanAqua-280	S,B
Copolymers Due to rapidly changing technologies, these resins offer a unique range of performance values that are difficult to compare to old-world solvent-based finishes. They generally fall into the post-catalyzed lacquer and pre-catalyzed conversion varnish range of performance.	**Hardness**	G-E	Minwax Polycrylic	B
	Chemical resistance	G-E		
	Clarity	G-E	Varathane Diamond Polyurethane	B
	Burn-in	P-G		
	UV resistance	G	Benwood Stays Clear	B
	Repairability	P-G		
Urethanes These finishes develop a hard, chemical-resistant film, so they are used for wood floors, architectural trim, tabletops etc. This durability also means that successive coats tend to form layers rather than melting together like acrylic blends.	**Hardness**	E	General Finishes High Performance	B
	Chemical resistance	E		
	Clarity	G-E	Target Coatings EM9300 Polycarbonate Urethane	S,B,W
	Burn-in	P		
	UV resistance	G-E	Van Technologies VanAqua-480	S,B
	Repairability	P		
Urethane/ Acrylic Blends These are the most common type of water-based finish because the blend can be fine-tuned for specific uses.	**Hardness**	G-E	Hydrocote Resisthane Plus	S,B
	Chemical resistance	G-E		
	Clarity	G-E	Enduro Clear Poly Topcoat	S
	Burn-in	P-G	Aquazar Interior Water-Based Polyurethane	S,B
	UV resistance	G		
	Repairability	P-G	Olympic Interior Polyurethane	B
Hybrids The newest type of water-based finishes, they combine the warm tones, clarity, penetration, and in some cases exterior protection of solvent finishes with the low odor and quick-drying benefits of a water-based finish.	**Hardness**	E	Target Coatings Hybrivar WB Alkyd Varnish	S,B,W
	Chemical resistance	E		
	Clarity	G-E	Hydrocote Danish Oil Finish	S,B,W
	Burn-in	P-G		
	UV resistance	P-G	Target Coatings UltraSeal-WB shellac	S,B,W
	Repairability	E		

volatile organic compound (VOC). Aromatic solvents such as toluene, xylene, mineral spirits, and various ketones found in solvent-based finishes create low-level, or ground-standing, ozone—commonly known as smog. These VOCs also cause upper respiratory problems and can aggravate asthma.

Efforts to improve air quality placed limits on the amount of VOCs a finish can contain. These restrictions, in turn, gave a boost to water-based finishes. With a few exceptions, water-based coatings also contain VOCs. But because their components contain far fewer VOCs than those in solvent finishes, it is much easier to formulate a water-based finish to comply with clean-air regulations.

In recent years, state regulations on air quality have become more restrictive than federal ones. In particular, those of southern California and a coalition of northeastern states increasingly set the parameters used when formulating finishes. For example, the national limit for solvent lacquer is 680 grams of VOC per liter, whereas the northeast limit is 550 grams, and

The right brush. *Water-based finishes are best brushed with a fine-haired, artificial-bristle artist's brush. Larger, denser brushes tend to introduce too much air into the finish, leaving bubbles on the surface.*

in southern California the limit is 275 grams. The benefit for woodworkers is that these restrictions are causing a migration to water-based finishes. As that market grows, companies are devoting more time and money into developing better finishes.

So what is a water-based finish?

To better understand water-based finishes, it helps to know what goes into them. Water-based is a generic term for coatings in which the resin is suspended in a water medium. In basic terms, a primary glycol solvent dissolves the resin, allowing it to form a crude film, and water acts as the diluent (or secondary solvent) that evaporates with the glycol as the film dries.

Two families—Water-based coatings can be either waterborne or water-reducible. Waterborne coatings start with a resin, which can be a urethane, an acrylic, or a blend of the two in a solution of water and surfactants. This is known as the crude resin. Next, glycol ethers and performance additives based on the intended use of the finish are blended in. These include leveling agents to help it flow out during brush or spray applications, defoamers to minimize bubbles, anti-scuffing agents to stop marring, and ultraviolet additives to protect the wood from sunlight.

The second group of water-based finishes is known as water-reducible coatings. They consist of oil-based resins such as tung, linseed, and castor oils, blended with alcohols, glycol ethers, and neutralizers to allow the absorption of water and create a homogenous solution of oil and water. Like waterborne finishes, these coatings contain synthetic resins and performance additives. They are sometimes referred to as hybrids.

Application is now much easier

One legacy of the early water-based finishes designed for floors is that they developed a reputation as being hard to apply. They performed well with tools used for finishing floors, but due to their low viscosity, most could not be sprayed successfully. They were also a challenge to brush, as many dried too fast or developed runs and sags. Generally speaking, water-based finish manufacturers suggest dilution rates ranging from 5% to 20% by liquid volume to help thin the viscosity of the coating or to slightly retard the drying time. However, some can be reduced more than 50% with basic tap or distilled water and will still maintain their film-formation qualities, although thinner and less protective. Refer to the specific product's technical data sheet or contact the manufacturer for the best dilution rate.

The right brush makes all the difference—Instead of large, high-volume paintbrushes designed for thick house paints, I recommend the use of fine arts and special-purpose brushes that feature shorter bristles and a thin nap. Consider such brands as daVinci's Cosmotop and Top-Acryl Series, Winsor & Newton's Athena and Monarch Series, as well as Purdy's Syntox brushes. Appropriate sizes range from 1 in. to 3½ in. wide.

Many finishes can be sanded within an hour. On most finishes, if re-coated within the first 24 hours, the next series of coats will chemically bond, or burn in, with the previous coat. But check the specific instructions on the can.

New advances in finishes for spraying—As large industrial users are restricted in the amount of VOCs they can release, water-based finish manufacturers are creating finishes for them that more closely match solvent finishes in both application and performance. With proper guidance from the manufacturer, you can switch to water-based finishes in an afternoon with minor tip size and air pressure adjustments. (For more on spraying, see "Spray-Gun Choices," pp. 60-65.)

Like solvent finishes, water-based finishes have a shelf life, in most cases about a year. Signs of a finish past its prime include gelling in the can and either a pink or greenish/blue color.

Water-based finishes for all

Woodworkers have much to look forward to as they explore the range of water-based finishes now available. As research and development continues, more and more water-based finishes will successfully replace the solvent-based finishes of the past. □

SOURCES OF SUPPLY

BRUSHES

www.homesteadfinishing.com

www.finishingzone.com

www.dickblick.com

Explosion-free spraying. *Solvent-based finishes should be sprayed in an explosion-proof spray booth. Water-based finishes can be used in a simple knockdown booth in a garage or basement.*