Protecting Wood with Character™

Waterlox Tung Oil Based Varnishes, VOC Regulations and the Environment.

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Table of Contents

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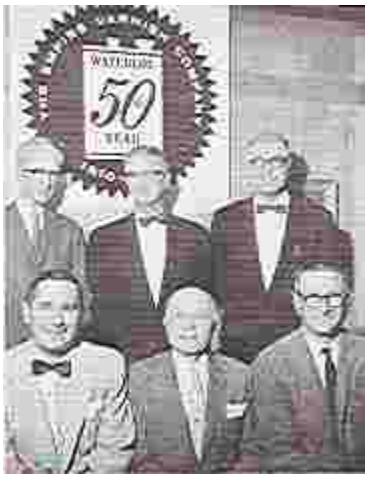
Who is Waterlox



The Hawkins family has worked for four generations to provide finishing solutions that enhance and protect the natural beauty of wood. Waterlox Coatings Corporation is a producer of unique clear wood finishes which utilize tung oil-based formulas. Waterlox is a small, family-owned and operated business dating back to 1910 and currently employs 15 employees in Cleveland, Ohio, where the company has been located since 1963. Waterlox's existence is based solely upon its unmatched and unparalleled tung oil-based products and their attributes.

1910 - Our Beginnings R.L. Hawkins, Sr. establishes The Empire Varnish Company to produce a full line of exterior and interior paints, varnish, enamels and stains.

1930's – Introducing Waterlox Products The introduction of Waterlox Transparent leads to other tung oil-based finishes that become the company's most prominent product line. The Waterlox Division is established.

1940's – Family Pride RL Hawkins, Jr. joins his father's company.

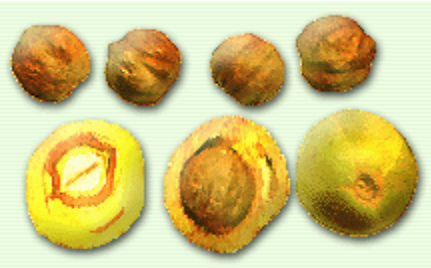
1960's - Change and Development The Empire Varnish Company becomes Waterlox Chemical and Coatings Corporation. R.L. Hawkins Jr. is named President.

1970's & 1980's- The Next Generation J.W. Hawkins (3rd Generation) joins the company, becomes president (1985) and continues to run the company today.

1990's - New Name, New Products A name change to Waterlox Coatings Corporation signifies a continued commitment quality coatings.

2000's - New Look Waterlox launches a brand new look for its tung oil line of clear wood finishes. Kellie Hawkins Schaffner (4th Generation) joins the company, reaffirming the Hawkins family commitment to quality, value, reliability and knowledge.

What is Waterlox



Architectural coatings for wood are formulated to protect wood surfaces from numerous environmental factors which can cause damage, such as moisture, household spills/chemicals and foot traffic (floors). Waterlox resin-modified tung oil-based varnishes are clear wood coatings used on interior and exterior wood surfaces. As the main ingredient, tung oil has been used for centuries as a waterproofer, dating back to the 14th century when the Chinese used tung oil to waterproof their seaward vessels. Tung oil is considered to be a superior drying oil to that of linseed oil (another popular drying oil used as a base in architectural coatings) because the molecules are smaller (micro-porous), thereby allowing it to have superior penetrating ability and form a seal against moisture that will not crack, flake, peel or blister. Linseed oil also contains 65% Linolenic Acid; whereas, tung oil contains no Linolenic Acid. Linolenic Acid is the component in linseed oil that yellows when exposed to UV light. Therefore, Waterlox tung oil-based varnishes do not yellow like linseed oil-based products.

Waterlox tung oil-based products are waterproof, dirt-resistant, washable and insensitive to household chemicals. They are also easy to apply and maintain. Waterlox tung oil–based varnishes penetrate deeply into the wood, keeping it elastic and healthy. They also dramatically reduce the swelling and shrinking of the wood. Sanding between coats of Waterlox for adhesion purposes is not necessary. It is ideally suited for all indoor wood (floors and furniture), wood in moist/humid rooms like kitchens and bathrooms, and is non-toxic when dry so it can be used on toys, children's furniture, butcher blocks, knife handles and wood countertops and cabinetry.

As stated previously, numerous environmental factors can damage wood, moisture being the primary concern due its effect on expansion and contraction, which is aggravated by water. A key characteristic of a tung oil-based coating is deep penetration which seals the wood and prevents the unwanted effects of moisture on wood, such as grain raising and swelling. In fact, the name Waterlox actually means "to lock out water."

Beauty

Waterlox tung oil-based varnishes provide a rich, hand-rubbed patina that enhances the grain. Unlike urethanes that have a "sheet of plastic" appearance and lie on the wood surface, Waterlox finishes penetrate deep into the wood pores forming a bond from within (because the molecules are small enough to penetrate). This penetrating feature gives the wood an "open pore" appearance that is desired by many people seeking a natural-looking wood surface.

Durability

There is a misconception that urethanes are the most durable finishes available for wood floors; however, Waterlox tung-oil based varnishes form an elastic, protective finish that won't chip, peel, crack, flake or wrinkle. While urethanes are slightly harder than our Waterlox tung oil-based varnishes, Waterlox retains a tough yet elastic surface that gives with the blows of everyday life. Because our finishes penetrate into the wood, when scratches or wear areas do occur, they are far less noticeable than with a urethane finish that simply lies on the surface. If noticeable scratches occur, the damaged area is cleaned well with soap and water and a new coat is applied. Sanding down to bare wood or refinishing the entire floor is not necessary because the mode of failure is erosion.

Since a Waterlox finish produces minimal film build, it is slowly worn down from the surface due to use and foot traffic. If a scratch occurs, the finish can be re-coated without sanding because Waterlox tung oil-based varnishes are low-solids, low-viscosity and flow and level with the adjacent areas and blends with them. Scratches in higher-solids urethane coatings are like scratching glass, a deep groove is cut into the harder thicker film that has distinct edges which collects dirt and is very visible. Trying to repair or fill in or touch up with a product that has higher solids and poorer flow and leveling is limited. Sanding of the area or the entire floor is required to repair these higher-solids films because you can not feather the film back up to a level with the adjacent areas. An analogy would be like trying to repair a sheet of plastic with liquid glue. The solids and poor flow and leveling properties of the glue would always leave a visible mark.

Ease of application

Waterlox is easier to apply than oil and water-modified urethanes. Waterlox finishes have a longer "open time" meaning they stay workable longer than waterborne or oil-based urethanes. This is because there is a higher solvent content in Waterlox products; the more the solvent, the longer it takes to evaporate and hence a longer time interval until the film actually starts to dry or polymerize (oxidation). Oil-modified urethanes dry partially by oxidation but also by a chemical reaction. Once the solvent evaporates, the film begins to oxidize and the chemical reaction starts which is a quicker form of polymerization. The film immediately begins to increase in viscosity which leads to poorer flow and leveling.

Water-based urethanes contain primarily water as the solvent. Water evaporates much quicker than the mineral spirits found in Waterlox products and; therefore, like urethanes, the drying process begins within a shorter interval of time. Waterlox tung oil-based varnishes are self-leveling; lap marks, turns, and cut-ins disappear because viscosity increases due to polymerization or drying is delayed. Stain can also be added to Waterlox, thus eliminating time-consuming steps, and, unlike urethanes, you never have to sand or screen between coats for adhesion purposes.

Why professional woodworkers and flooring contractors prefer Waterlox

Waterlox (and a handful of other varnish manufacturers) has survived for more than 90 years in spite of the onslaught of chemistry (urethanes) and the invention of water-based counterparts because it is the preferred coating used by fine woodworkers and discerning contractors looking for hand-rubbed beauty, simplicity, penetration and protection. Such attributes can only be found in an oil-based finish like Waterlox.

Waterlox products are unique because they can be applied in multiple low-solids, low-viscosity thin films. This affords the woodworker, craftsman or flooring contractor the flexibility of building a multi-coat system with superior penetrating properties, resulting in a finished piece that features just the right amount of film build and superior aesthetics. Competitive varnishes in the 1930's, 40's, 50's and even today have always required the craftsman to "thin" their product to have more control over the film build. High–solids coatings designed to meet the stringent VOC laws do not allow the woodworker to "build" multiple coats at their discretion. Too often, just one more coat of higher solids VOC-compliant coating adds too much film build than that which would be required. No longer is open-grain, open-pore look of a hand-rubbed finish attainable.

Eisenhower Presidential Conference Room,
The White House, Washington, D.C.

Understanding the landscape of alternatives

Urethane - coatings vehicles containing polyisocyante monomer reacted to yield polymers containing any ratio, proportion or combination of urethane linkages, active isocyanate groups or polyisocyante monomer.

Drying Oil - an oil which can readily take up oxygen from the air and change to a relatively hard, tough elastic substance when exposed in a thin film to the air.

Varnish - a liquid which is converted into a transparent solid film after application as a thin layer. An organic protective coating similar to paint but containing no pigments comprised of a vegetable oil and solvent. Film formation is due to polymerization of the oil.

Vegetable oil – oil extracted from the seeds, fruits or nuts of plants and generally considered to be a mix of glycerides. Vegetable oils are a form of biomass.

Comparing current alternatives

First and foremost, Waterlox tung oil-based varnishes have no competitors. No other finish manufacturer utilizes tung oil, resin and mineral spirits to produce a product that has the same characteristics as Waterlox. Here are some examples of alternate products:

Waterlox vs. Urethane - Waterlox forms a protective finish that won't chip, peel, crack or wrinkle. Waterlox never requires sanding for adhesion purposes. So touch-ups can be done at any time without sanding down to the bare wood. Waterlox gives you a naturally beautiful, protective finish that never looks like a sheet of plastic.

Typically, a urethane coated floor needs to be sanded/screened between and before re-coating. More often than not, the floor has to be taken back down to bare wood. Otherwise an additional single coat of urethane would apply unevenly. Of course, this process requires electricity to power the sanding machines, not to mention the necessary disposal of the sanding dust.

Another factor is each time a floor is sanded to bare wood, at least 1/8" to 3/16" of wood is removed. Therefore, sanding a floor can only be done a limited amount of times until the entire floor has to be replaced…another needless utilization of resources.

Since Waterlox tung oil-based varnishes require no sanding to promote inter-coat adhesion, no electricity is used and therefore only a single coat is required to restore the floor. Also, touch-up or spot repairing of Waterlox is easily accomplished because of its low-solids, low-viscosity and excellent flow and leveling characteristics which are not found in higher solids, higher viscosity products.

Also, water-based urethanes encounter some of the same problems as their solvent-borne counterparts. Since they do not penetrate the wood like a Waterlox tung oil varnish, a deep scratch or damage to the film that exposes the bare wood in a minute area has the potential to delaminate, which is a catastrophic failure on wood floors. This usually requires the entire floor to be sanded to bare wood and recoated. Again, this expenditure of resources is prevented with Waterlox. And finally, water-based urethanes are also difficult to touch up or spot repair, requiring the contractor or homeowner to sand larger areas because they do not have the flow and leveling and open time characteristics of an a oil finish, like Waterlox.

Waterlox vs. Raw Tung Oil, Straight Oil and Danish Oil – Waterlox dries better and forms a film that's strong enough to walk on. Waterlox is also waterproof, while raw tung oil and Danish oil will water spot. Waterlox is a varnish based on tung oil, not straight oil. The resin/solids portion of the product is still 85% tung oil, but it is cooked together with 10% phenolic resin (which is a synthetic waterproofing and chemical resistant resin) and 5% other mixed resins for mar and scuff resistance. And since Waterlox is 85% tung oil (of the resin solids) all the great attributes of the oil are still present, such as the rich patina of the wood, excellent penetration, the ability to recoat without sanding and a rich hand-oiled look.

Waterlox is also a permanent floor finish that does not oxidize. It cross-links with itself to form a continuous film that does not oxidize or react with the oxygen in the air. And because Waterlox contains phenolic resin, it is in fact waterproof and will not water spot (when properly applied).

In comparison, Danish oils or straight oils oxidize on the surface when exposed to air. That is, the oxygen in the air and UV light reacts with the oil and crystallizes on the surface. This causes the dead flat sheen of Danish oil on wood. This condition is not only unattractive, it can lead to exposure of wood fibers which act as wicks. Exposed to water, these wood fibers carry the water into the wood and turn the wood black underneath the oil because of tannin bleed-up and mold growth. In addition, while Danish oils or straight oils impart some water resistance, they will in fact water spot (due to the aforementioned oxidation). They have little or no mar and scuff resistance and must be periodically buffed (to remove mar and scuff marks) and replenished due to the fact that when the oil oxidizes, "oil" is lost from the surface of the wood.

Library of Parliament Reading Room
Ottawa, Canada

Waterlox vs. Linseed Oil – Waterlox provides deeper penetration to seal wood fibers beneath the surface than linseed oil. Waterlox is also waterproof and will not water spot like linseed oil. As mentioned previously, linseed oil contains 65% linolenic acid; whereas, tung oil contains no linolenic acid. Linolenic acid is the major triglyceride component in linseed oil that yellows when exposed to UV light. Therefore, Waterlox tung oil-based varnishes do not yellow like linseed oil-based products.

Waterlox cradle to grave scenario (lower overall environmental impact)

In comparison with VOC compliant, waterborne coatings, Waterlox tung oil-based varnishes have a number of advantages from an environmental aspect based on product life cycle and maintenance. First of all, tung oil-based coatings are a biomass derived from renewable resources. This minimizes reliance on petroleum-based products. Second, Waterlox can be coated and recoated without sanding and removal or stripping of the existing coating. This allows for application and touch-up or recoating without the time and energy needed to sand and remove the coating.

There is a balance between the energy and resources needed for stripping (including the possible use of solvents) and the VOC's of the tung oil-based varnishes. The tung oil-based varnishes last longer than the waterborne formulations, thereby reducing the frequency of refinishing. However, the number of times a floor is recoated is not calculated into VOC requirements. If it were, over the lifetime of a wood floor, it is possible that more VOC's would be emitted using a waterborne coating than using the tung oil-based varnishes. Couple this with reduced vehicle emissions due to fewer trips to the site and the energy savings from the lack of sanding and there is a net reduction in environmental impact when using a product like Waterlox.

The advantage of stricter VOC regulations

Reducing VOC emissions in our environment is absolutely the correct action to take. Air quality is a major environmental issue. That's why we wholeheartedly support government agencies and manufacturers working together to find the most logical and meaningful ways to protect the planet. And to that end, we feel it is imperative that we study and understand not just the products themselves, but the net effect of how they are manufactured, how they are applied, the frequency of application, their effectiveness in preserving resources down the road…in other words, the overall environmental impact. With an eye on factors such as these, the coatings industry has been directing its research in this direction for decades. New inventions such as latex paints, for instance, were introduced when VOC emissions were not even a consideration.

At Waterlox, we've been doing our part to protect the environment for over 90 years. As one reads this document and familiarizes themselves on where, how and why our products are used, it quickly becomes apparent that the advantages of using Waterlox are not just its greater aesthetic appeal, but its reduced environmental impact.

The disadvantage of stricter VOC regulations

While Waterlox maintains a low overall environmental impact, the proliferation of VOC reduction regulations across the country is threatening its use. To develop a useable and valuable coating, Waterlox modifies tung oil with resins and solvents to deliver the natural characteristics of the tung oil to the wood surface, as well as to allow it to build up to a film. Water cannot be added to these types of coatings, and reformulation options for VOC reduction in this type of coating are limited to two basic options.

There are two options for reducing VOC's in Waterlox.

One is to increase the weight and volume of solids. This would produce a thicker film and thereby reduce penetration and increase drying times, reducing the flow and leveling (aesthetics). And would also require more energy to manufacture and move throughout plant operations. More waste would be generated to clean the facility, as well.

The second option for reducing the VOC's in Waterlox is to use an exempt solvent (discussed below) which would reduce the inter-coat adhesion characteristics, causing lifting, wrinkling and orange-peeling. It would also have a greater tendency to 'skin' or 'gel' in the container.

In the end, strict VOC regulations can undermine products that actually have lower overall environmental impact than many seemingly "greener" products because of how (and how often) they are applied. Within the varnish category, manufacturers who produce oil-modified solvent-borne urethane varnishes have had to raise the solids of their products to lower the VOC content. This results in a much higher viscosity product which does not flow, level or apply properly.

To off-set these disadvantages, manufacturers of alkyd and urethane based floor finishes have turned to the resin manufacturers for help. Resin manufacturers have synthesized lower-molecular weight polymer chains, which help lower the viscosity of the product and in turn lessen

the problems with flow, level and application. Conversely, lower-molecular weight polymer chains do not have the same properties of their higher-molecular weight counterparts.

Low molecular weight polymers do not possess the excellent mar and scratch, water and chemical resistance properties of their conventional counterparts. Additionally, inter-coat adhesion is compromised. This leads to films that will wear out quicker under foot traffic and lead to possible damage from water and household chemicals when films are worn down. In addition, failure of the finish to penetrate the wood pores can lead to delamination of the coating.

Because of the relatively limited market for Tung Oil based floor finishes resin manufacturers have devoted no time or monies towards their research and development departments to synthesize alternative oils or alkyds to replace or modify Tung Oil based varnishes.

Why the exempt compounds listed by CARB cannot be used in Waterlox Tung Oil Finishes

The following is a list of "Exempt Compounds" suggested to be used in low VOC solvent-borne coatings listed by CARB. The comments column next to the compound explains why they are not suitable in Waterlox tung oil-based varnishes.

Waterlox tung oil-based varnishes are designed to be multiple-coat systems used not only by professional contractors, but also by homeowners. Because they are multi-coat systems, the ability to recoat the previous coat is paramount. There must be adequate inter-coat adhesion without wrinkling or an adverse affect to the prior coat. Additionally, flammability, odor, evaporation rates and solvency power of the exempt compound has to be taken into consideration.

Flammability – Waterlox believes in the need to market its products with a "combustible" rating (flash point > 100º F). Most exempt compounds are less than 100º F.

Odor – Face masks with suitable filter cartridges are recommended when applying all coatings; an offensive and/or different odor is cause for alarm by contractors, homeowners, residents and neighbors alike. Therefore, coatings containing materials that are health hazards or smell offensive to the user are unmarketable.

Evaporation Rates – Solvents or ingredients that have extremely fast evaporation rates are not suitable because the coating will "set" much too quickly which results in very poor flow and leveling characteristics, and are simply difficult to apply. Conversely, solvents that have extremely slow evaporation rates tend to leave the coating "wet" for extended time periods resulting in sagging or running on vertical surfaces, excessive dirt pickup and delaying of the curing process.

Solvency Power/Kari-Butanol (KB) Value – This must also be considered. Too high or too strong of a KB value and the coating will wrinkle or damage the previous coat, regardless of the drying period between the coats. Too low or too weak of a KB value lends the solvent to be incompatible with the system (the tung oil and other resins would not dissolve into solution) or results in product instability (if partially compatible, in-can storage or shelf-life at high or low temperatures would cause the product to gel in the can.)

Table: Exempt Compounds

CAS Number	Ingredient Name	Comments	Detrimental Properties
67641	Acetone	Fast evaporation rate, high KB, low flash point	Wrinkle previous coat(s)
540-88-5	Tert-Butyl Acetate	Fast evaporation rate, high KB, low flash point	Wrinkle previous coat(s)
98566	4-chlorobenzotrifluoride	Fast evaporation rate, high KB, offensive odor	Wrinkle/lift previous coat(s)
75092	Methylene chloride	Fast evaporation rate, high KB	Wrinkle/lift previous coat(s)
127184	Tetrachloroeyethylene	Fast evaporation rate, offensive odor	Wrinkle/lift previous coat(s)
79209	Methyl Acetate	Low flash point, high KB	Too flammable; wrinkle previous coat(s)
556672	Octamethylcyclotetrasiloxane	Low KB and flash point	Finish would never dry to a film
107517	Octamethyltrisiloxane	Low KB, slow evaporation rate	Finish would never dry to a film
141628	Decamethyltetrasiloxane	Low KB , slow evaporation rate	Finish would never dry to a film
541026	Decamethylcyclopentasiloxane	Low KB , slow evaporation rate	Finish would never dry to a film
141639	Dodecamethylpentasiloxane	Low KB, slow evaporation rate	Finish would never dry to a film
69430246	Dimethylcyclosilanes, D6 or>	Low KB, slow evaporation rate	Finish would never dry to a film
17980471	Silane, triethoxy(2-methlpropyl)-	Low KB, slow evaporation rate	Finish would never dry to a film

The first four compounds have extremely fast evaporation rates and very high KB values. Products formulated with these compounds would wrinkle or lift the previous coat(s), along with imparting poor flow and leveling. Specifically:

Acetone is used as a nail polish remover; therefore, its high KB value would wrinkle or lift the previous coat(s) extremely low flash point;

Tert-Butyl Acetate (TBAc) is a xylene or toluene replacement which has a high KB value, would lift or wrinkle the previous coat(s), and has an extremely low flash point;

4-chlorobenzotrifluoride (Oxsol 100) has an extremely offensive odor and high KB value and would also lift or wrinkle the previous coat(s);

Methylene chloride is used as a paint stripper, again it has a high KB value and would also lift or wrinkle the previous coat(s);

Tetrachloroeyethylene or “perc” is a dry cleaning solvent, has an extremely offensive odor and high KB value and would also lift or wrinkle the previous coat(s);

Methyl Acetate has a flash point of -9C which is extremely flammable and it too possess a high KB value which will also lift or wrinkle the previous coat(s).

The other raw materials listed are siloxane fluids used in cosmetics and caulks which have extremely low KB values that would render them incompatible in our varnishes. They possess such extremely slow evaporation rates that coatings containing these ingredients would virtually never dry to a hard film because these materials would act as plasticizers in the film.

Key environmental considerations concerning wood finishes and VOC regulations

Depletion of resources during the manufacturing process
Energy required to prepare the surface
Frequency of re-coating the surface
Fuel/Energy needed to re-coat the surface
Quality of protection (wood preservation prevents need for replacement)
Ease of application (reduce need to repair finish or start-over)

Conclusion

Due to VOC regulations, niche products such as Waterlox tung-oil based varnishes have been adversely affected. Small companies like Waterlox have spent valuable research time and dollars to reformulate products to lower VOC limits with limited resources. However, the continued reduction of VOC's will render products like Waterlox unusable. This would in turn adversely affect a customer base of professional contractors as well as discerning do-it-yourself homeowners and woodworkers who currently have no viable, workable alternative. Moreover, it would actually have an adverse effect on the environment, since the total impact on resources and air quality is lower with Waterlox over the lifespan of the wood surface being protected.

Further, the use of tung oil-based products is extremely low with respect to the total amount of clear architectural coatings produced. The total production for this product category for Waterlox was XXXX gallons in 2007, which is extremely small as compared to 768 million gallons for all Architectural Coatings produced in 2007 nationwide and 57 million gallons of interior solvent Architectural Coatings (US Census Bureau, MA325F, Table 2).

Therefore, we are requesting a separate category with a separate VOC limit. The proposed definition and VOC limit is as follows:

Conjugated Oil Varnish – means a clear or semi-transparent wood coating labeled as such, excluding lacquers or shellacs, based on a natural occurring conjugated vegetable oil (Tung Oil), determined using ASTM Method D-2800 and D-1983, modified with other natural or synthetic resins; a minimum of 50% of the resin solids consisting of conjugated oil. Supplied as a single component product, conjugated oil varnishes penetrate and seal the wood. Film formation is due to polymerization of the oil. These varnishes may contain small amounts of pigment to control the final gloss or sheen.

LIMIT – 450 g/L