Finishing a Bread Board (and comments on wood finishing in general)

James Zangl

Recently, I heard someone on TV declare that the best way to treat a cutting board was with mineral oil, applied regularly. He also said that a Polyurethane would not be safe.
This did require some thought. What he said is kind of true, kind of not and a bit misleading.
Hearing this call to mind a book that I have been rereading “All Creatures Great and Small”, about a country vet in the Dales of England. He is constantly coming into conflict with “the cures” that the grand fathers swore by. We woodworkers have some of those same grandfathers, I suspect.
Since we have had an ongoing discussion on finishes over the past months, I thought I would look some more.
For this set of research, I went to Wikipedia and again Bob Flexner for information and citations. I apologize if I have missed any citations or gotten them wrong. The full articles can be read at Wikipedia or Bob Flexner’s book.

I guess we should start by asking, “Why are we applying the finish?”
There are different answers for something in use or for display. Ad if in use, what kind of use or abuse will the object be subjected to. (is it a baby rattle, a Vase containing water, a decorative bowl) What kind of wood are we using? If it is a protective coating, what are we protecting from? (air, sun, water, baby teeth, cutting knives).

So, is the finish to protect the wood? Or is the finish to make the wood look better, decorative?
In the case of a bread/cutting board is it for protection? Or to keep the board looking nice.
How much will the board be use as a cutting board, or will the board be used as a serving tray or will it not be used at all?

The object in question was a cutting board, and I will take the approach that it is well used, with regular contact with sharp knives. A wooden object, either side grain or end grain, that will receive substantial abuse. Along with knives and cleavers there will be chicken fat, dish detergent and hot water. (someone I know put their end grain walnut/maple cutting board in their dishwasher. It survived, barely).

The host said that Poly was bad and that Mineral oil was good.
So why is one good and the other bad?
What are the alternatives?

Poly is a surface finish that dries extremely hard. Mineral oil is an oil that does not really dry.
There are also various types of oils, varnishes, lacquer, shellac and wax.

Polyurethane
is a polymer composed of organic units joined by carbamate (urethane) links. While most polyurethanes are thermosetting polymers that do not melt when heated, thermoplastic polyurethanes are also available**.**

Polyurethane polymers are traditionally and most commonly formed by reacting a di- or trisocyanate with a polyol. Since polyurethanes contain two types of monomers, which polymerize one after the other, they are classed as alternating copolymers. Both the isocyanates and polyols used to make polyurethanes contain, on average, two or more functional groups per molecule.
Fully reacted polyurethane polymer is chemically inert.[1] No exposure limits have been established in the U.S. by OSHA (Occupational Safety and Health Administration) or ACGIH (American Conference of Governmental Industrial Hygienists). It is not regulated by OSHA for carcinogenicity.

Unlike drying oils and alkyds which cure after evaporation of the solvent and upon reaction with oxygen from the air, true polyurethane coatings cure after evaporation of the solvent and then either by a variety of reactions of chemicals within the original mix, or by reaction with moisture from the air. Certain polyurethane products are "hybrids" and combine different aspects of their parent components. "Oil-modified" polyurethanes, whether water-borne or solvent-borne, are currently the most widely used wood floor finishes.

Polyurethane (PUR and PU) is a polymer composed of organic units joined by carbamate (urethane) links. While most polyurethanes are thermosetting polymers that do not melt when heated, thermoplastic polyurethanes are also available.
From Wikipedia, the free encyclopedia

Poly is thicker, larger molecules, more surface tension than most oils and so will not sink as deeply into the wood, how deeply, depends on the wood, how it is cut, the grain structure, etc.
(End grain Red Oak, the oil may penetrate from one side of a block thru to the other if the oil is kept fresh. White Oak not so much, as the cells have natural barriers. The reason White Oak is used for liquid barrels and Red Oak only for dry goods.)
On a surface that receives no abuse, or a minimum of physical abuse, poly is a great 'plastic' barrier against most liquids, etc. and other abuse, but a knife will break the skin, the protective barrier between the wood and the rest of the world. Little bits of this plastic coating and wood could end in your salad. Of course an unfinished board, you would get bits of wood. With a plastic cutting board, those same bits of plastic could also be broken free. But the plastic is inert and will cause little harm, even if maybe not terribly appetizing.
More importantly, the break in the barrier allows moisture and germs to get under the 'skin'. Cleaning becomes almost impossible without the use of sandpaper, entirely removing the surface coat and starting over.
I would think that Poly is not a good choice for a cutting board, but not because the Poly is in anyway harmful, in itself.

Mineral oil provides no real protection. Water will bead-up on a coat of oil, but leave the water on long enough and it will sink thru the oil. That is why sailors would pour oil on the water to calm the sea. The host maintained that further coats of oil should be applied to "build" up a layer of protection and fill in the pores. The problem is that mineral oil does not dry. Mineral oil remains a fluid and each coat removes the previous application when you wipe the excess. If you do not wipe it 'dry' you will have a muddy mess. Drying oils have a catalyst, either air or added driers, mineral oil and most vegetable oils do not. Any oil will 'wet the wood", darkening the wood according to wood type and giving the wood that glow that we love to see. What is mineral oil?

Mineral oil
is any of various colorless, odorless, light mixtures of higher alkanes from a mineral source, particularly a distillate of petroleum[2], as distinct from usually edible vegetable oils.

The name mineral oil by itself is imprecise, having been used for many specific oils over the past few centuries. Other names, similarly imprecise, include white oil, paraffin oil, liquid paraffin (a highly refined medical grade), paraffinum liquidum (Latin), and liquid petroleum. Baby oil is a perfumed mineral oil.

Most often, mineral oil is a liquid by-product of refining crude oil to make gasoline and other petroleum products. This type of mineral oil is a transparent, colorless oil, composed mainly of alkanes[3] and cycloalkanes, related to petroleum jelly. It has a density of around 0.8–0.87 g/cm3.[4]

The World Health Organization classifies untreated or mildly treated mineral oils as group 1 carcinogens to humans; highly refined oils are classified as group 3, meaning that they are not suspected to be carcinogenic, but available information is not sufficient to classify them as harmless.[5]

The UK Food Standards Agency (FSA) carried out a risk assessment on the findings of a survey made in 2011 on risks due to migration of components from printing inks used on carton-board packaging, including mineral oils, into food. The FSA did not identify any specific food safety concerns due to inks.[6]

People can be exposed to mineral oil mist in the workplace by breathing it in, skin contact, or eye contact. In the United States, the Occupational Safety and Health Administration has set the legal limit for mineral oil mist exposure in the workplace as 5 mg/m3 over an 8-hour workday, the National Institute for Occupational Safety and Health has set a recommended exposure limit of 5 mg/m3 over an 8-hour workday, and 10 mg/m3 short-term exposure has been rescinded according to the 2019 Guide to Occupational Exposure Values compiled by the ACGIH. Levels of 2500 mg/m3 and higher are indicated as immediately dangerous to life and health. However, current toxicological data

does not contain any evidence of irreversible health effects due to short-term exposure at any level; the current value of 2500 mg/m3 is indicated as being arbitrary.[7]
Cosmetics containing mineral oil shouldn't be used for lip care because of their toxicity[8]
From Wikipedia, the free encyclopedia

What about tung oil, walnut oil or linseed oil or one of the other types of finishes or drying oils? Or food safe varnishes?

The drying oils contain added driers and/ or solvents that cure the finish. These solvents and/or driers once evaporated/ cured leave the finish food safe. (I have included Bob Flexner's thoughts on food safe finishes at the end of this writing). The full curing process can be lengthy. It is not the oil that is the issue so much as the solvent/ drier.

Varnish
is a clear transparent hard protective finish or film. It is neither a paint nor stain. In its native state it has little or no color, but may be pigmented as desired, and is sold commercially in various shades.
Varnish is primarily used to seal wood finishes where, stained or not, the distinctive tones and grains in the wood are intended to be visible. Varnish finishes are naturally glossy, but satin or semi-gloss sheens are available.
The term "varnish" refers to the finished appearance of the product. It is not a term for any single or specific chemical composition or formula. There are many different compositions that achieve a varnish effect when applied. A distinction between spirit-drying (and generally removable) "lacquers" and chemical-cure "varnishes" (generally thermosets containing "drying" oils) is common, but varnish is a broad term historically and the distinction is not strict.

Drying oils
There are many different types of drying oils, including linseed oil, tung oil, and walnut oil.
Arguably, drying oils, such as linseed and tung oil, are not true varnishes though often in modern terms they accomplish the same thing.
Drying oils cure through an exothermic reaction between the polyunsaturated portion of the oil and oxygen from the air. Originally, the term "varnish" referred to finishes that were made entirely of resin dissolved in suitable solvents, either ethanol (alcohol) or turpentine. The advantage to finishes in previous centuries was that resin varnishes had a very rapid cure rate compared to oils; in most cases they are cured practically as soon as the solvent has fully evaporated. By contrast, untreated or "raw" oils may take weeks or months to cure, depending on ambient temperature and other environmental factors. In modern terms, "boiled" or partially polymerized drying oils with added siccatives or dryers (chemical catalysts) have cure times of less than 24 hours. However, certain non-toxic by-products of the curing process are emitted from the oil film even after it is dry to the touch and over a considerable period of time. It has long been a tradition to combine drying oils with resins to obtain favourable features of both substances.

Resin
Many different kinds of resins may be used to create a varnish. Natural resins used for varnish include amber, kauri gum, dammar, copal, rosin (colophony or pine resin), sandarac, balsam, elemi, mastic, and shellac. Varnish may also be created from synthetic resins such as acrylic, alkyd, or polyurethane. A varnish formula might not contain any added resins at all since drying oils can produce a varnish effect by themselves.[9]
From Wikipedia, the free encyclopedia

Oil drying agent
An oil drying agent, also known as siccative, is a coordination compound that accelerates (catalyzes) the hardening of drying oils, often as they are used in oil-based paints. This so-called "drying" (actually a chemical reaction that produces an organic plastic) occurs through free-radical chemical crosslinking of the oils. The catalysts promote this free-radical autoxidation of the oils with air.
Typical oil drying agents are derived from ions of cobalt, manganese, and iron, prepared as "salts" of lipophilic carboxylic acids such as naphthenic acids, in order to give them a soap-like chemical formula and make them oil-soluble. [10]

Varieties of drying agents

In technical literature, oil drying agents, such as naphthenates, are described as salts, but they are probably also non-ionic coordination complexes with structures similar to basic zinc acetate. These catalysts were traditionally hydrocarbon carboxylate chelates of lead, but due to lead's toxicity, cobalt and other elements, such as zirconium, zinc, calcium, and iron, have replaced the lead in more popular products. Most driers are colorless but cobalt driers are a deep blue purple color and iron driers are reddish orange. These colored driers are therefore compatible only with certain darker pigmented paints where their color will be unseen.

Japan drier

is a common lay term and generic product name for any oil drying agent that can be mixed with drying oils such as boiled linseed oil and alkyd resin paints to speed up "drying". The name refers to "japanning", a term for the use of drying oils as an imitation or substitution for urushiol based Japanese lacquer.

Separate drying additives for paints became necessary as zinc oxide-based paints were developed as an alternative to the lead oxide paints ("white lead") that had been previously used. Zinc oxide paints were developed in parallel with the introduction of "oil soluble driers" or "terebines" around 1885. These were lead and manganese soaps of linseed fatty acids or resin, also termed lineolates or resinates. Terebines had poor shelf life in mixed paints, as they auto-oxidised and lost their effectiveness. As a result, early factory-mixed paints, unless fresh, were a poor substitute for fresh paint mixed by a painter on site from raw ingredients. This situation lasted until the late 1940s; by then further drier developments had superseded the terebines. In 1925, stable napthenate driers were developed in Germany and commercialized in the US in the early 1930s, in parallel with the development of durable and fast-drying alkyd resin enamels. In the 1950s, metallo-organics based on synthetic acids were introduced as driers. [11]

From Wikipedia, the free encyclopedia

Lacquer is a film, surface finish, minimal penetration because it dries and hardens very fast. But it is a surface almost impervious to most liquids. It is a beautiful hard finish that can be polished to a high gloss. That is until the first knife crosses it. It is a finish best used for a display piece.

This would be terrible for a bread/cutting board that was put to regular use.

Lacquer

The term lacquer is used for a number of hard and potentially shiny finishes applied to materials such as wood or metal. These fall into a number of very different groups.

The term lacquer originates from the Sanskrit word lākshā (लाक्षा) representing the number 100,000, which was used for both the lac insect (because of their enormous number) and the scarlet resinous secretion, rich in shellac, that it produces that was used as wood finish in ancient India and neighbouring areas.[12]

Asian lacquerware, which may be called "true lacquer", are objects coated with the treated, dyed and dried sap of Toxicodendron vernicifluum or related trees, applied in several coats to a base that is usually wood. This dries to a very hard and smooth surface layer which is durable, waterproof, and attractive in feel and look. Asian lacquer is sometimes painted with pictures, inlaid with shell and other materials, or carved, as well as dusted with gold and given other further decorative treatments.

In modern techniques, lacquer means a range of clear or pigmented coatings that dry by solvent evaporation to produce a hard, durable finish. The finish can be of any sheen level from ultra matte to high gloss, and it can be further polished as required. Lacquer finishes are usually harder and more brittle than oil-based or latex paints, and are typically used on hard and smooth surfaces.

In terms of modern finishing products, lac-based finishes are likely to be referred to as shellac, while lacquer refers to synthetic polymers such as nitrocellulose, cellulose acetate butyrate ("CAB"), or acrylic resin dissolved in lacquer thinner, a mixture of solvents such as ketones (acetone, MEK), esters (butyl acetate, methoxypropyl acetate), aromatic hydrocarbons (toluene, xylene), ethers (cellosolve), and alcohols.[13][14]

Synthetic lacquer is more durable than shellac.

<u>**From Wikipedia, the free encyclopedia**</u>

Shellac is food safe, is suspended in an alcohol solvent (sort of safe) that dissolves and leaves a hard film. Shellac is used to coat some candies, so it is apparently food safe. Shellac is water resistant, but not alcohol resistant. A knife will score and cut through the film. Once the surface is broken bacteria can/will get to the wood.

Shellac

Shellac (/ʃəˈlæk/)[15] is a resin secreted by the female lac bug on trees in the forests of India and Thailand. It is processed and sold as dry flakes and dissolved in alcohol to make liquid shellac, which is used as a brush-on colorant, food glaze and wood finish. Shellac functions as a tough natural primer, sanding sealant, tannin-blocker, odour-blocker, stain, and high-gloss varnish. Shellac was once used in electrical applications as it possesses good insulation qualities and it seals out moisture. Phonograph and 78 rpm gramophone records were made of it until they were replaced by vinyl long-playing records from the 1950s onwards.

From the time it replaced oil and wax finishes in the 19th century, shellac was one of the dominant wood finishes in the western world until it was largely replaced by nitrocellulose lacquer in the 1920s and 1930s

Shellac is a natural bioadhesive polymer and is chemically similar to synthetic polymers.[16]

From Wikipedia, the free encyclopedia

What is left for the utilitarian implement?

Wax the wood or leave the wood bare.

Wax will show off the wood and give it a polished look. Great for a display piece. But wax will oxidize and needs to be replenished. And again, you do not build up layers of wax unless there is a chemical hardner in the wax. Each tine you wax an object, the 'wet wax softens and removes the old wax. You are left with one layer of newly applied wax.

Wax provides little or no protection from anything and really should be reapplied after every washing.

Several studies have shown that wood, especially the Maples and Oak have antibacterial properties, to a degree that a wooden board is safer to use than a plastic board.

From The Richard Raffan web site, Richard's view on bowl finishing

Many of these bowls are turned from green, that is unseasoned, wood. Such wood is selected because it will distort; how it distorts depends on how the grain is aligned within the bowl. A bowl turned from seasoned wood will remain round and distort only slightly with seasonal or geographical changes in humidity.

Most of my bowls are made to be used and will look and feel better for it. I use an oil and beeswax finish that provides a good base for a variety of patinas. If any wood salad bowl, plate, platter or chopping board is in daily use, you can hand-wash it in hot water and detergent and set it on a drainer to dry. I've included several photos of bowls and plates (SEE https://www.richardraffan.com/node/102) that have been used for years.

If you prefer a shiny, more antique, patina you need to polish the wood regularly with a wax polish. The old rule of thumb is every day for a week, then once a month. After a few months your wood glows like a cherished antique. A patina like this cannot be applied from a bottle: it is the result of on-going care. Regularly polishing will enhance any surface.

A word on Food Safe finishes from Bob Flexner

The Folly of Food-Safe Finishes

Despite what you've read elsewhere, almost every wood finish should be considered food-safe.

By **Bob Flexner**

…all modern finishes are food-safe once fully cured, a conclusion supported by two recognized experts on finishing, and the United States Department of Agriculture. Note that the USDA does express a residual concern about finishes that chip

It's a shame, but many woodworkers worry about which finish to use on objects that will come into contact with food or children's mouths. The reason for the worry is that woodworkers have been conditioned by several decades of articles in woodworking magazines to believe that ordinary finishes like boiled linseed oil, alkyd varnish and polyurethane varnish may leach poisonous ingredients like metallic driers. And other finishes, like lacquer, catalyzed (two-part) finishes, shellac and water-based finishes, may leach poisonous solvent.

The idea that some finishes are harmful is reinforced by a few manufacturers who label their finishes food- or salad-bowl safe, which implies that other finishes are not.

The Issue of Metallic Driers

Metallic driers are added to oil and varnish finishes to speed curing. Without driers, these finishes take many days or weeks to cure.

Lead driers were once commonly used in oil and varnish finishes, but in the 1970s it was learned that lead is highly toxic, especially to children. The problem was associated with the relatively large amount of lead contained in pigment and not with the tiny amount contained in clear finishes. Nevertheless, to be safe, lead was removed from all commonly available paints and finishes, including oils and varnishes. (Lead is still used in some specialty art and marine finishes, and labels are required to disclose its inclusion.)

Other metallic driers, including salts of cobalt, manganese, zirconium and zinc, continue to be used in all varnishes and curing-oil finishes except raw linseed oil and pure tung oil. Without these driers, these finishes cure extremely slowly.

There is no indication that these driers cause health problems. A very small amount is used, and it is well encased in the cured finish film so that if any is ingested, it passes through the body without causing harm.

Other Finishes

All other common wood finishes also are safe for food and child contact. In fact, commercially made wooden bowls, baby beds and children's toys are usually coated with one of these finishes.

The solvents, which cause some people to worry, evaporate out completely enough so they aren't a problem. And catalysts, which can be toxic in their liquid state, become so fully reacted with the finish that there is no evidence of a problem.

Conclusion

The issue of food safeness in finishes is a classic case of the concept “validation by repetition.” Consistent, long-term repetition in woodworking magazines of a food-safeness issue, despite the complete lack of supporting evidence, has led to a widely held belief in the woodworking community that food safeness is an issue.

It shouldn't be. No other segment of society treats it as such. A more reasonable approach is as follows.

You can't be absolutely sure about the food safeness of any finish you put on wood. There could even be problems with mineral oil and walnut oil that we just don't know of yet. There could also be problems with raw linseed oil, pure tung oil, wax, shellac and salad bowl finish, because we don't know where these substances have been or what they might have come in contact with. None has met the regulations laid out by the FDA.

But, based on FDA regulations, the way finishes are made, the complete lack of any evidence to the contrary, and the countless other untested objects food and children come in contact with, there's no reasonable argument for avoiding the use of any finish.

Bob Flexner is a contributing editor to ***Popular Woodworking*** and the author of the book, **Understanding Wood Finishes**, (Rodale Press) which is a must-read book for any woodworker who wants to understand finishing. Bob's column appears in every issue of ***Popular Woodworking***.

https://www.woodcentral.com/articles/finishing/articles_497a.shtml

1. ^ *Dernehl, C. U. (1966). "Health hazards associated with polyurethane foams". Journal of Occupational Medicine.* ***8*** *(2): 59–62. PMID 5903304.*

2. Mineral oil (Dictionary.com) Archived 30 September 2015 at the Wayback Machine
3. ^ *"Archived copy" (PDF). efsa.europa.eu. Archived from the original (PDF) on 3 June 2018. Retrieved 27 January2007.*
4. ^ *"Mechanical properties of materials". Kaye and Laby Tables of Physical and Chemical Constants. National Physical Laboratory. Archived from the original on 11 March 2008. Retrieved 6 March 2008.*
5. ^ *"Definition of MINERAL OIL". www.merriam-webster.com. Retrieved 10 September 2018.*
6. ^ *"Survey of printing inks and mineral oils". Food Standards Agency. London. 15 December 2011. Archived from the original on 15 May 2012.*
7. ^ *"Oil mist (mineral). Immediately Dangerous to Life or Health Concentrations (IDLH)". www.cdc.gov. 4 December 2014. Retrieved 12 June 2018.*
8. ^ *Warentest, Stiftung. "Mineralöle in Kosmetika - Kritische Stoffe in Cremes, Lippenpflegeprodukten und Vaseline - Stiftung Warentest". www.test.de.*
9. "Make Your Own Oil/Varnish Blend". 8 May 2007.
10. Ulrich Poth, "Drying Oils and Related Products" in *Ullmann's Encyclopedia of Industrial Chemistry*, Wiley-VCH, Weinheim, 2002. doi:10.1002/14356007.a09_055

11. *Oil and Colour Chemists' Association, Australia (2014). "Chapter 29: Paint Driers". Surface Coatings volume 1: raw materials and their usage. Dordrecht: Springer Verlag. pp. 352–361. doi:10.1007/978-94-011-6940-0_29. ISBN 978-94-011-6942-4.*
12. *Franco Brunello (1973), The art of dyeing in the history of mankind, AATCC, 1973, ... The word lacquer derives, in fact, from the Sanskrit 'Laksha' and has the same meaning as the Hindi word 'Lakh' which signifies one-hundred thousand ... enormous number of those parasitical insects which infest the plants Acacia catecu, Ficus and Butea frondosa ... great quantity of reddish colored resinous substance ... used in ancient times in India and other parts of Asia ...*
13. ^ lacquer thinner
14. ^ *"Safety Data Sheet Acrylic Lacquer".*
15. ^ *"Shellac". Cambridge Dictionary. Retrieved 19 October 2020.*
16. https://pubchem.ncbi.nlm.nih.gov/compound/shellac gives the chief component as 9,10,15-trihydroxypentadecanoic acid and also (2R,6S,7R,10S)-10-hydroxy-6-(hydroxymethyl)-6-methyltricycloundec-8-ene-2,8-dicarboxylic acid, molecular formula $C_{30}H_{50}O_{11}$ with a molecular weight of 586.7 g/mol