Hesse Lignal
inspiring you

WATER-BASED LACQUER FOR PROFESSIONAL INTERIOR FITTINGS

Handbook for successful application

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Are you among the applicators ...

- who have previously had bad experiences with water-based lacquers?
- who still remember the old rule-of-thumb for water-based lacquers: "Only coat with lacquer when the weather is good enough to dry clothes!"?
- who are concerned that the application of water-based lacquers would not work?
- who believe that the quality of a water-based lacquer coat is insufficient?
- whose customers complain of the strong smell of their new furniture?

Then you can either continue to avoid water-based lacquers and maintain your opinions. Or alternatively:

A judgement can be refuted, but never a prejudice!

(Marie Ebner-Eschenbach, 1830-1916; Austrian author)

You can continue reading for some tips and solutions on how to apply water-based lacquers professionally.

Maybe this will pique your interest and you will reach the conclusion, like many others have before you, that it is at least worth giving these often-misunderstood miracles another shot?

We will gladly assist you with this. And if you take the following tips to heart, then the result will truly convince you.

If you like, we can also put you in touch with colleagues who have years of experience in successfully applying hydro lacquer systems. As previously stated:

People tend to believe the bad over the good.

(Giovanni Boccaccio; 1313-1375; Italian author)

>>> 01

Can water-based lacquer even be used without problems? Yes, but the conversion begins in the mind!

>>> 01

Or are you among the ever-growing group of water-based lacquer applicators?

And do you nevertheless believe that HYDRO systems can do (almost) anything that solvent-based systems can? As long as you take the properties into account and adjust the production parameters accordingly.

You already use a water-based lacquer; the lacquer system of the future with particularly interesting properties?

- You are already reducing VOC by using a particularly low-emission lacquer system?
- You can now take part in public tenders?
- You no longer have a strong smell of solvent in your operations?
- You are open to new things and are a step ahead of many of your colleagues?
- You want long-term planning security in an ever-changing legal jungle of regulations?
- You have only supplied "odourless" furniture for a while now?

Then perhaps you will find some background information here to help you learn about the particular properties of these high-tech systems. Ideally, this will lead to the optimisation of your internal workflow and, subsequently, a higher quality output.

General information about water-based lacquers

>>> 02

Water-based lacquers are misunderstood miracles for surface coatings

Water-based lacquers, HYDRO lacquers or water-soluble lacquers are generally defined as lacquers which mainly use "water" as a solvent. Regardless of whether these dispersion lacquers contain an alkyd, acrylate or polyurethane dispersion binder or even a combination of these.

What they all have in common is that they can be diluted with water. This is not so important for you as an applicator. The water-based lacquers are usually provided ready-for-use. Dilution is only required in certain cases. The technical information sets out which special cases require dilution.

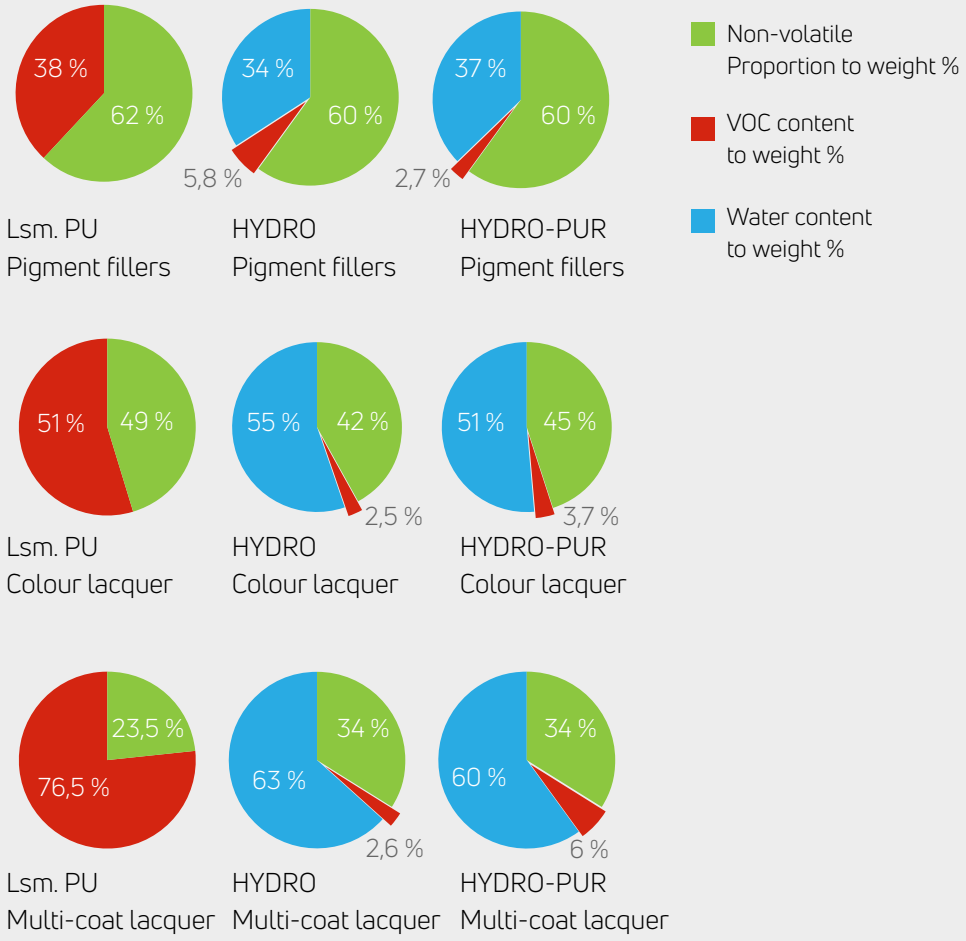
Water-based lacquers are misunderstood miracles for surface coatings. This applies to use in both workshop and industrial settings. Because they now cover the entire quality range of surface coatings. Depending on the requirements, they are suitable for low-level uses (such as the "watercolours" you will have used in school) up to various 1C(omponent) and 2C systems and even high-tech products using UV or EBC (electron beam) curing.

It is no coincidence that they have been used successfully for years for coating parquet flooring and stairs. They have been used for decades for automobile and industrial coatings. They are even used increasingly for furniture coatings. As such, they are replacing the classic solvent-based lacquers in more and more areas. This has been a slow yet steady process but the advantages are clear.

Waterbased lacquers are:

- Almost odourless during application and
- Do not contain any aromatic hydrocarbons (benzene, toluene, xylene etc.)
- Low emission in the sense of the VOC/Decopaint Directive. There is therefore a minimum of VOC emissions during the entire processing phase.

Content of solvent for various PU and water-based lacquers



Context: The details provided as approximations only serve to provide a rough comparison and therefore only apply to the lacquer (even for 2C systems)!

- The minimal proportion of system-related solvents means that our special water-based coatings (with a VOC content < 3 %!) even meet the VOC requirements stipulated in public tenders.
- Special water-based lacquers even meet the requirements for some environmental labels (e.g. "Blue Angel" and similar.)
- No more odour declarations! Even freshly-coated furniture surfaces are almost odourless
- As such, the often unavoidable "rush jobs" before delivery/installation will no longer result in any olfactory problems
- In most cases, they have a higher solids content than comparable solvent-based systems; This means:
  - either better-bodies surfaces when applied evenly or
  - lower application quantities required to achieved an even, good body

- Mains water as a thinner (if required) and cleaning agent; no expensive special thinners required. They are only used to remove dried residual lacquer

- In many cases, far lower m2 costs in comparison with a solvent-based system

- For some uses, one layer of a suitable hydro lacquer will be enough to achieve an attractive and high-quality lacquer surface!

- HYDRO lacquers are, with a few exceptions, light fast

- Our liquid water-based lacquer is neither highly flammable nor combustible (no danger of ignition during processing!) => is therefore not a hazardous material!
  - This may have a positive impact on the required explosion protection, permitted storage quantities and possibly even on insurance premiums.

- Water-based lacquer coatings are generally at least "normally flammable" (B2 according to DIN 4102); (for comparison: CN systems are "slightly flammable" (B3 according to DIN 4102).

- Water-based lacquers can, after a brief drying phase,be dried efficiently using a suitable drying tool (halogen, IR, circulation fan etc.).
  - The time gains are more significant than with solvent-based systems; and with those systems, forced drying is often not even possible.

- Even as a 1C system, special water-based lacquers almost achieve the resistance of a universal 2C solvent-based PU system.

- The resistance of special 2C HYDRO systems only slightly differs from that of a solvent-based PU system and it is definitely sufficient for most applications
  - (This does not, however, apply to 1C HYDRO systems containing an optional added hardener.)

- For water-based lacquer finishes, you can interchange finishes between 1 and 2C systems without the risk of "raising", as is the case for solvent-based PU systems

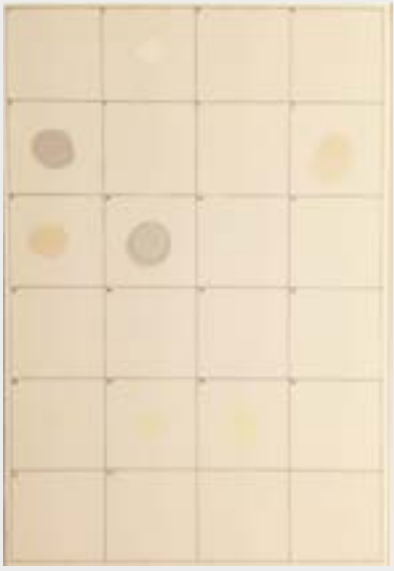
- Special 1C HYDRO pigment fillers can also be coated with other lacquer systems (e.g. CN or PU(colour) lacquers).

>>> 02

Advantages of 2C-HYDRO systems

The 2C water-based lacquer systems, i.e. those requiring an additional hardener for optimal complete hardening, belong to the high-tech systems in the water-based lacquer family. Unlike the 1C materials, to which an optional hardener can be added, they obtain better properties by means of an additional chemical reaction (e.g. isocyanate or similar).

Photo comparison: Chemical resistance according to DIN 68861 Part 1b



1C HYDRO Colour lacquer
(Competition)

1C HYDRO Colour lacquer plus hardener
(Wettbewerb):

1C HYDRO Colour lacquer
(latest generation)
Hesse HYDRO PRO-COLOR
HB 65285-9010

"True" 2C HYDRO Colour lacquer
Hesse HYDRO-PU COLOR HDB
54705-9010

The binders, which can optionally be hardened, generally do not have good chemical or mechanical resistance without the hardener. With the hardener, they only (barely) approach the properties of the "true 2C water-based lacquers. In many cases, they do not have the properties of a high-quality 1C HYDRO system made from the latest generation of raw materials.

The prerequisite for the desired cross-linking of binders and hardeners is, at any rate, a sufficient quantity of the corresponding reaction partners also present in the lacquer binder. And, for water-lacquers which can be given an optional hardener, this is not the case.

The exquisite "true" water-based lacquers do not, however, dry professionally without an added hardener; just as little as with an exquisite solvent-based PU.

After adding the corresponding hardener and following the complete hardening process, you still have:

- even better mechanical resistance (abrasion, elasticity, bonding) and
- even better chemical resistance (even DIN 68861 1b, IKEA norms)
- even better resistance against aggressive hand cremes and a better
- barrier against wood contents/wood colourants
- Higher safety reserves for very high-demand surfaces (kitchen, bathroom etc.)

In comparison with solvent-based PU systems:

- Significant reduction of VOC content
- low odour
- generally light fast
- risk-free combinations of 1C/2C finishes are possible

>>> 03

Water-based lacquers have unique properties

Water-based lacquers have unique properties:

The general behaviour of water as a naturally-occurring solvent and its effect on the properties of water-based lacquers

- Water has a much higher surface tension than other lacquer solvents:
- Swelling of water-sensitive substrate materials wood, as a natural substrate material, was dependent on the elixir of life, water. Hence why the trees have open pores and structure their fibres so as to take in as much water as possible. Furniture made from wood must therefore be protected properly with lacquer.

Comparison surface tension/substrate wetting

On MDF:

On beech:

Photos: Substrate swelling due to brief application of water

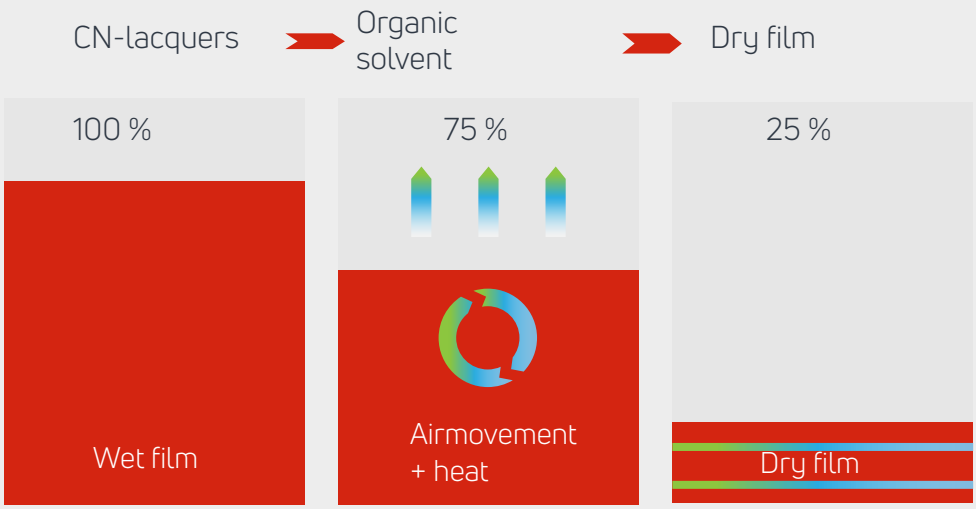
On beech

On MDF

Differences: various MDF qualities after 1 h of exposure to water in the lower section:

- Other (and slower) evaporation/drying; depending on the ambient humidity In comparison with a solvent-based system (true binding solutions) water-based lacquers (dispersions) dry completely differently and absolutely require a certain solvent content in order to form a film; a so-called coalescence solvent.

Various drying solvents/water-based lacquers
Drying CN lacquers

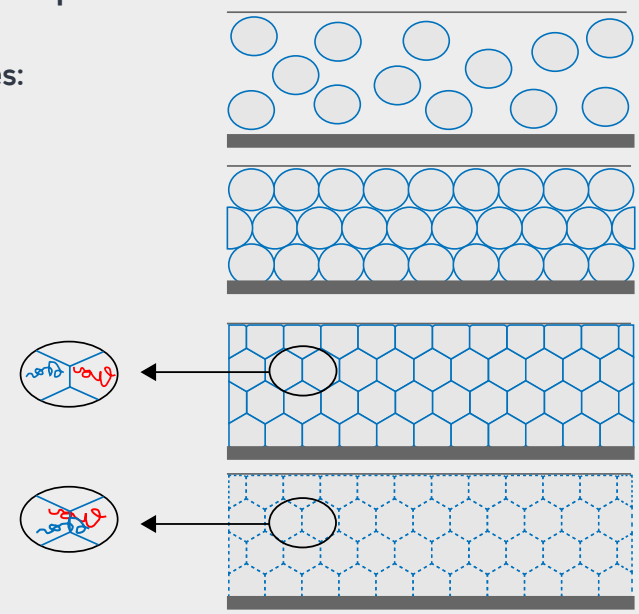


Drying water-based lacquers:

Filming process in stages:

1. **Approach**
2. **Contact**
3. **Fusion = coalescence**

The process is temperature-dependent!

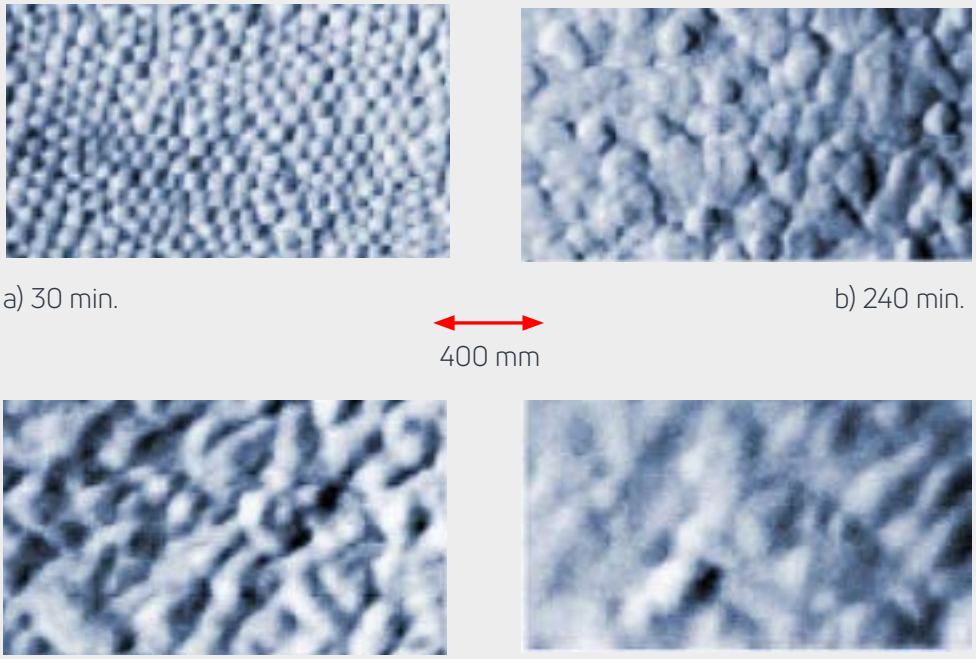


1. In wet films, the polymer particles move around freely and barely touch (various electrically-loaded particles)
2. Upon commencing the drying process, the polymer particles approach each other and then take on a mostly cubic structure.
3. Continued drying and shrinking completes the transformation into a dense spherical pa-ckage. The polymer particles are no longer moving and coalescence begins (aided by the coalescence solvent in the lacquer = very long solvent).
4. The filming process is complete. For 2C systems, this is followed by further cross-linking.

>>> 03

Drying water-based lacquers:

Electron microscope: Filming a dispersion



a) 30 min.

b) 240 min.

c) 660 min.

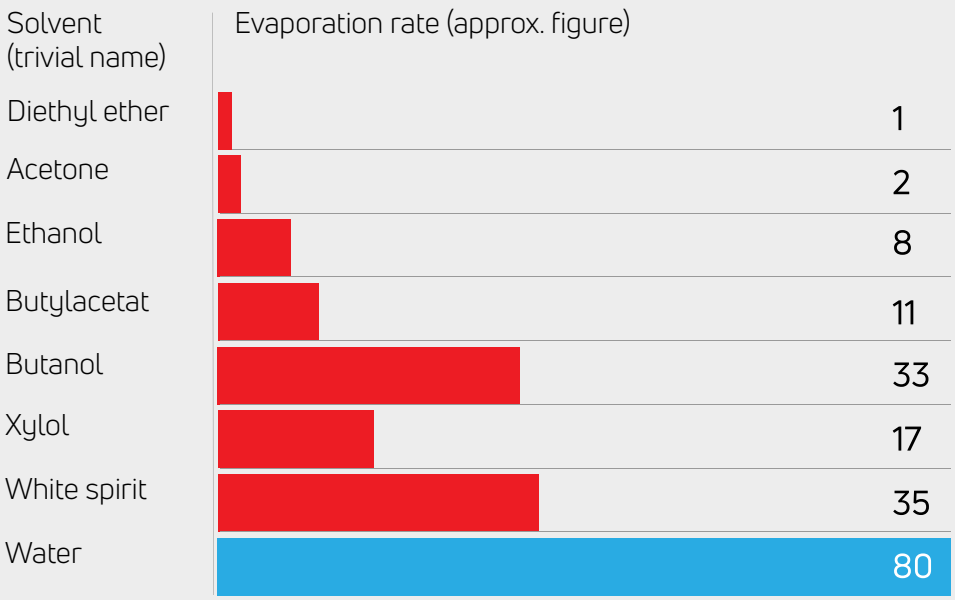
d) 1440 min.

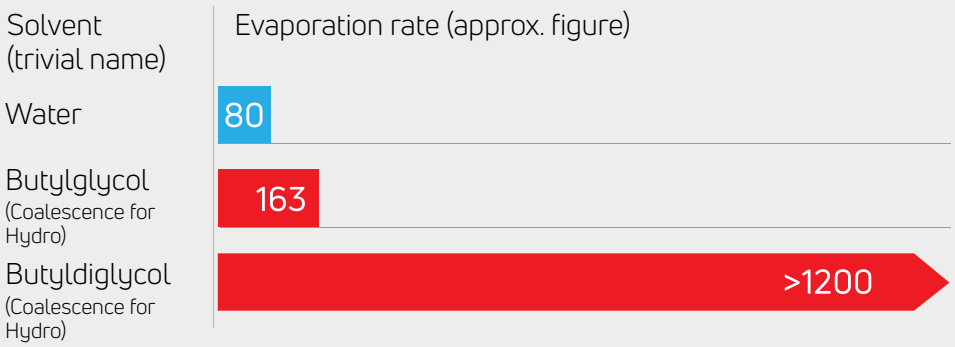
- Water evaporates significantly slower than the majority of the remaining solvents in a solvent-based lacquer. Through a combination of solvent systems (there are up to 35 different solvents that can be used here!), it is possible to control targeted drying and complete drying processes. For HYDRO lacquers, this is only possible to a highly limited extent. There is only one water. And its chemical/physical indicators are simple and can only be influenced very slightly.

Table Evaporation rates for some lacquer solvents

The evaporation rate is the time it takes for a material to completely evaporate in relation to the time the diethyl ether needs to evaporate. This time is denoted as "1". i.e. A solvent with an evaporation rate of 10 evaporates 10x slower than the reference solvent (under the same conditions!).

As a result, in most cases:
The higher the evaporation rate of a solvent and the higher its content proportion in the lacquer, the longer the drying time will be for the lacquer.





- Regarding the dependancy of the air temperature and humidity on drying water based lacquers, the more humid the air is, the less water it can take in. The less water the air can take in, the longer it takes for the water to evaporate from the wet film. The lacquer dries for longer. Because the air temperature has a direct effect on the intake of water into the air, it should also not be too low.

Table Influence of air temperature and humidity on the drying process

Air temperature	100 % Absolute air humidity	55 % Relative air humidity	Difference = possible water intake into the air
10 °C	9,4 g/m³	5,2 g/m³	4,2 g/m³
20 °C	17,3 g/m³	9,5 g/m³	7,8 g/m³
30 °C	30,4 g/m³	16,7 g/m³	13,7 g/m³

Only differential quantities/m³ are available for drying the water-based paint.

Example calculation for a water-based lacquer surface:

- Hydro lacquer, 35 % humidity; 65 % water
- Application quantity of lacquer: 100 g/m²
- 65 g water/m² coated surface!
- Air required to dry this quantity:
  - at 10 °C: 15.5 m³
  - **at 20 °C: 8.3 m³**
  - at 30 °C: 4.7 m³ => per square metre of coated surface!

In comparison:

Example calculation for a surface with solvent-based PU lacquer:
Calculation basis: Solvent saturation of the air at 20 °C:

Butylacetat	approx.	500 g/m³
Acetone	approx.	600 g/m³
Diethyl ether	approx.	1900 g/m³

- solvent-based 2C PU lacquer, 25 % humidity; 75 % VOC (Buac)
- Application quantity of lacquer: 100 g / m²
- 75 g solvent / m2 coated surface!
- Air required to take in this quantity of solvent:
  - **at 20 °C: approx. 0.15 m³** => per square metre of coated surface!

Context: These calculations only serve to provide a rough guideline!

Only approx. 2 % of the air quantity is required to dry the solvent-based lacquers, hence why it "smells" stronger.

- Other optics / transparency: The binder dispersions of water-based lacquers already discussed are more coarse than the binders for solvent-based systems. Therefore, the dry water-based lacquer films have a different optical effect. Even the haptics are slightly different. Some woods look more natural and sophisticated after coating with water-based lacquers. As such, this special optical effect underlines their exclusivity.

Photo Comparison of finishes: Solvent lacquer / HYDRO lacquer

PU HYDRO CN

Beech

Oak

Ash

Walnut

You can clearly see that the lacquers behave differently on different woods. It is also possible to see, however, that no "obfuscations" occur on dark woods such as walnut. Oak gains more colour because it contains water-soluble substances.

Photo Comparison of finishes: Solvent lacquer / HYDRO lacquer

Comparison with rosewood (Bahia Rosewood);
both 2 x basecoat and each 1 x topcoat.

PU finish HYDRO finish

Conclusion: Accentuating using Hesse HYDRO PU BRILLIANT PRIMER HDG 5407 (mixing ratio: 10 : 1 with HDR 5091) is identical to a solvent-based PU primer.

- In rare cases, the pore pattern on special wood types is not quite as sophisticated and accentuated as with solvent-based lacquers. In most cases, however, this effect can generally be corrected using the right application method, e.g. by adding optimizer.

- Hydro lacquer surfaces are often more thermoplastic than solvent-based system surfaces. As such, lacquer sanding will not result in too much heat. Therefore, pay attention to ensure a balance between cutting speed and pressure.

- Water affects the corrosion of various metals, hence why stainless steel or plastic materials are preferential

- Water freezes at approx. 0 °C

- Water-based lacquer materials must be stored, processed and dried frost-free. It is necessary to maintain the minimum film binding temperature (MFT).

- Preserving water-based lacquers. Recently, this issue has become increasingly important. Why do water-based lacquers need to be preserved?
  Can water rot or develop mould?

No, pure water on its own cannot go off. Only when "external" substances are added can this result in a build-up of algae, mould and bacteria among others.

Because the raw materials and production of water-based lacquers is not absolutely germ-free, it is not possible to prevent a certain number of germs from entering the lacquer during the production process. This is, however, generally significantly lower than the germ load present during application, i.e. by the applicator (germs from clothing, gloves, in the air, on the stirrer, in the spray gun's lacquer container etc.). In order to significantly reduce these naturally-occurring germs and ensure a proper shelf life of the water-based lacquer systems (usually several months), certain preservatives are added. In most cases, the sub-supplier will add the raw materials during the manufacturing process. These mostly unavoidable preservatives must be listed on the label, according to the applicable laws and the specific and (unfortunately) ever-changing limit value.

As a manufacturer of lacquers, we only use preservatives in very exceptional cases. And where possible, we use non-classified preservatives. Moreover, we already aim to achieve a professional compromise between storage stability and non-classification, in cooperation with our sub-suppliers. Our objective is to produce water-based lacquers in accordance with the applicable statutory provisions and in a non-classified manner; and all this whilst maintaining a professional storage stability of several months. Nevertheless, there is a constant competition between proper storage stability and ever-changing statutory provisions.

However, we have been able to weaken many of the described effects of the "water" on the HYDRO lacquer system, so that they are not as significant as they were several years ago.

But as an applicator, you should know these effects and prepare accordingly. Only a little effort is required to further weaken these effects. And in most cases, this will achieve the desired result. The Hesse sales representatives will, of course, assist you to ensure seamless implementation.

>>> 04

What does that mean for you as an applicator?

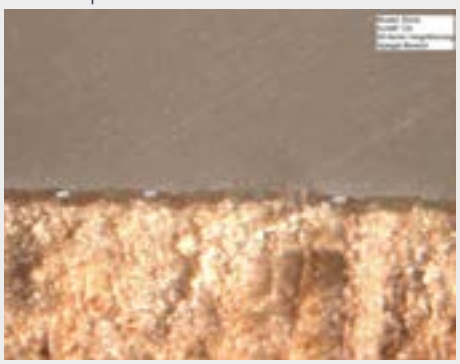
What does that mean for you as an applicator?

Substrate and preparation

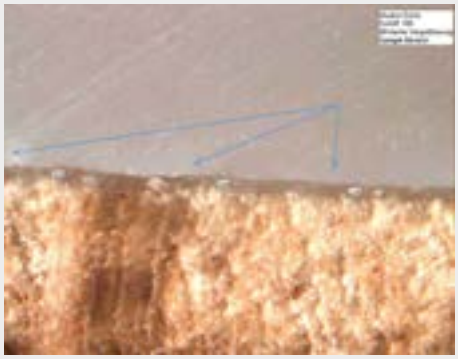
- Use of "water-based lacquer-appropriate" substrate materials, e.g. MDF
- Wood moisture; ideally between 8 - 12 %
- Ideal ambient humidity 55 - 65 %
- Remove the sawdust and clean the substrate material well: Under certain conditions, the substrate may be sub-optimal (greasy impurities, sweat from hands, hand creme, unsuitable gloves etc.) and this can result in wetting issues.
- Temperature: Lacquer and substrate material, at least 15 °C; ideally 18 - 20 °C - otherwise issues may occur in the film-binding or complete hardening process; this is also the case for solvent-based.
- excessively rough wood sanding should be avoided. Better/other raw-wood sanding (e.g. staged along/crosswise sanding). The old rule of thumb applies in connection with water-based lacquers: "Well-sanded means half-coated."

Influence of raw-wood sanding on the size of the wood fibres:

120 Raw-wood sanding of oak:
21 - 29 µm



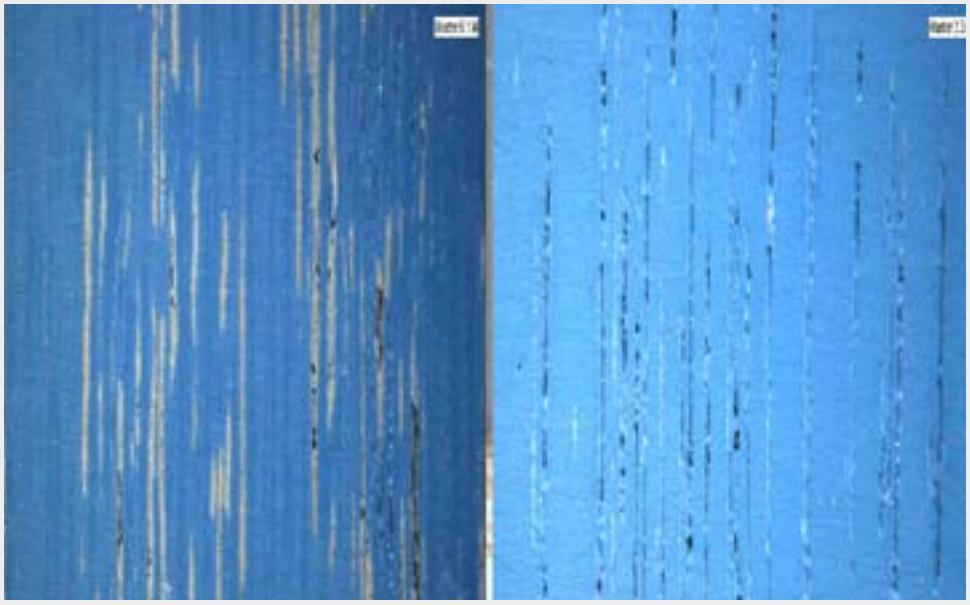
180 Raw-wood sanding of oak:
11 - 19 µm



For 180 sanding, the fibres are significantly shorter: 11- 19 µm. They are generally completely embedded in the lacquer film. The dry lacquer surface is much smoother as a result.

Further ways to optimise raw-wood sanding:

For solid wood, in particular oak, crosswise sanding is the best solution:
Left photo: Sanding 120/120 along
Right photo: Sanding 120 along/ 150 crosswise/ 180 along



Sanding 120/120 along

Sanding 120 along/ 150 crosswise/ 180 along

For the trials, we used blue water-based lacquer to better illustrate the relaxation.

You can see the setup of the wood fibres at the relaxation points during sanding.

You will see that crosswise sanding sets up significantly fewer fibres because the fibres are actually capped during a crosswise sanding.

- The lifetime of a sanding belt for raw-wood sanding is generally many times longer than for a belt used for lacquer sanding.
- Check that stains and other pre-treatment materials are suitable for use with/in conjunction with water-based lacquers. If in doubt, contact the manufacturer.

Application

In addition to the "standard" provisions that also apply to solvent-based lacquers

- Stir well before use
- Take measures to ensure that neither wood nor (lacquer) dust enters into the containers
- Always seal the containers carefully after use and store appropriately
- Clean tools appropriately as soon as possible after use
- Do not eat or drink during application
- Wear personal protective equipment etc.

Furthermore, the following should be adhered to:

- Only use rust-free tools
- Ideal working temperature: 18 - 20 °C
- In the event of several open lacquer containers: carefully remove any dried lacquer particles (clumps at the edge of the container or on the surface of the lacquer) from the liquid lacquer prior to application. They must not be simply stirred in. This is because they do not dissolve in the water-based lacquer and will result in a raw lacquer surface. Ideally, sieve the lacquer directly before application.
- Water-based lacquers are more prone to foaming than solvent-based lacquers. Therefore, you should stir the material well before application. However, stir as slowly as possible by hand or using a suitable agitator so that little or no air is stirred into the lacquer.
- Due to their special properties, water-based lacquers require different sprayers, i.e. generally those with smaller spray-hole diameters and higher material or spray air pressures. The corresponding recommendations can be found in the technical information for the respective lacquer system.
- Water-based lacquers are generally applied in slightly lower quantities.
- They have a different flow behaviour and are not sprayed through levelling but they level anyway.

- The first layer of water-based lacquer should be applied more thinly than the following layer(s). This involves less water coming into direct contact with the wood and it does not swell as much. A positive side-effect is that the thinner hydro-lacquer layer will dry faster and can be sanded and top-coated sooner.

- For 2C systems, always begin by slowly stirring in the hardener and then, depending on the details in the technical information sheet, dilute with up to 5 % water.

- Never mix water-based lacquers with organic solvents. They flake and become unusable. This means that combined application of water-based and solvent-based systems with, for example, a spray gun, is a risk.

Drying

- Room temperature of at least 16 °C (ideally 18 - 20 °C) and constant, but not too intense, air circulation, so that the room air can constantly take in and transport the water that has evaporated during the drying process.

In addition: This minimum temperature also applies to solvent-based PU systems. They also take longer to dry at temperatures < 15 °C and will not cure properly. They will also require much longer to form their normal properties. It is just not as clear to see this as it is with water-based lacquers.

- Ideally, spraying and drying rooms should be separate in order to optimise the application and drying parameters as required

- A constant, but not too intense, air exchange, in addition to the right drying temperature, is important for enabling the appropriate drying process. Attention: no draught! Often, a simple ventilator will suffice (for exclusively water-based lacquer applications, no special EX protection is usually required!)

- Options for forced drying:
  Advantages of short-wave radiation:
  Only the lacquer layer to be dried is to be heated, not the workpiece (no wood moisture changes)
  Not only is the water/solvent expelled but any required chemical reactions will also be stimulated/fast-tracked.

- For example:
  A dryer set up consisting of 2 mobile, reflective panels, each with 6 built-in short-wave halogen infrared radiators at a distance of 2.80-3 m (space in between for a trolley with 15 cm distance).

Example for halogen IR drying:

Product	Example application quantities	Minutes
COOL-TOP HE 65094	1. Layer 90 g/qm 2. Layer 90 g/qm	3-4 9
COOL-FILL HP 6645-9343	1. Layer 190 g/qm	8
Special adjusted HYDRO-colour lacquers	1. Layer 120 g/qm	15

Lacquer

- As a dried HYDRO lacquer surface can no longer be sufficiently removed from the subsequent lacquer layer, in most cases de nipping will be required. This will create a mechanical bridge for good adhesion of the individual lacquer layers.

- The required de nipping will depend on the application quantity, the application parameters (temperature, air moisture, air circulation etc.) and, of course, the drying time and ambient parameters. Therefore, the times stated in the technical information sheets are to be understood as standard values that should be checked in line with the conditions at your site.

- By using specially recommended sanding tools (bands, open / dense spread, brushes etc.), the result can be further optimised. The sanding tool manufacturer will gladly assist you.

- Always remove the lacquer dust carefully. It cannot be removed from the water-based lacquer anymore and may function as a separating layer, negatively impacting the bond between the lacquer layers. In some cases, it may also result in a raw surface.

Miscellaneous

Cleaning

Dried lacquer residue cannot be removed from the water anymore; to remove it will require a conventional thinner. A combination of water and solvent system applications in one spray gun is prone to risks and costly!

When switching from solvent to water-based systems and vice versa, always use reversing agent:

From solvent to water-based:

- Remove lacquer
- Rinse with thinner
- Rinse with reversing agent
- Rinse well with water
- Fill with water-based lacquer and coat

From water to solvent-based:

- Remove lacquer
- Rinse well with water
- Rinse with reversing agent
- Rinse with solvent
- Fill with solvent-based lacquer and coat

If you forget a step or do not follow the sequence, problems are likely to occur. A separate spray gun should be used immediately after the first "mistake". It is therefore better to use a suitable spray gun for the water-based lacquer system. In spray booths equipped with water curtains, a special coagulation agent is required! (particularly when switching between the use of water-based and solvent-based lacquers in a single booth!).

Workplace protection

Water-based lacquers less damaging to the environment and, at first glance, not as damaging to health. Nevertheless, you should follow standard practices and follow the required workplace protection measures. Just like with solvent-based lacquers, but tailored to the water-based lacquers. Detailed information can be found in the respective material safety data sheets.

Disposal

Unused water-based lacquers, water-based lacquer residue, cleaning/waste water etc. constitutes special waste and may not be flushed into the sewage system without permission from local authorities!
Disposal is not uniformly regulated. There are significant regional differences. Therefore, place pay attention to the various provisions! Contact your relevant authority for more information.

>>> 06

Ulrich Abdinghoff
(Productmanagement)

Conclusion

As you can see, there are some things to note when applying HYDRO lacquers. But often just a small change in the production process is required in order to adapt to the special properties of the system of the future, water-based lacquers.

Changing to an aqueous system is a true advantage, as water is the most important raw material for future-orientated lacquer systems.

It's clear to me: Conversion begins in the mind!

Once that is clear, you can achieve (almost) anything with HYDRO systems that you could with solvent-based systems; as long as you take the special properties of these future-orientated systems into account.

Try it out and you will find yourself pleasantly surprised!

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