



ARE WATER-BASED LACQUERS MORE HARMFUL THAN SOLVENT-BASED SYSTEMS?

This is a widespread misconception

Even though the advantages of water-based lacquers are obvious, there is still some uncertainty among many processors of solvent-based coatings regarding the hazards of waterborne materials. It is often asserted that water-based lacquers are more harmful to health when inhaled and are more easily absorbed, or penetrate the skin when in contact.

Yet these concerns are unfounded. Especially when the guidelines relating to the processing and handling of lacquers are observed. These are the same for both lacquer systems (solvent-based and water-based) and largely exclude any health effects.

We also commissioned the Fraunhofer Institute for Manufacturing Engineering and Automation (Fraunhofer-Institut für Produktionstechnik und Automatisierung IPA) to conduct a scientific study comparing the particle size distribution during application via cup gun and via AirMix unit.

Experimental setup:



(Source: Fraunhofer IPA)

In each case the study examined one version of

- **typical 1C Hydro lacquers**
(such as COOL-TOP HE 6509x(gloss level))
- **genuine 2C Hydro lacquers**
(such as PERFECT-TOP HDE 5400x (gloss level), (mixing ratio: 10 : 1 with HDR 5091))
- **solvent-based 2C PU lacquers**
(such as: FANTASTIC-CLEAR DE 4877x gloss level), (mixing ratio: 10 : 1 with DR 4071))

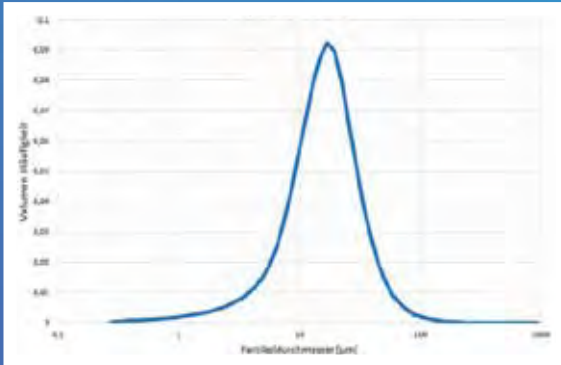


Here is a rough summary of the findings:

Characteristic parameters

- Characteristic parameters for a particle size distribution include $Dv(10)$, $Dv(50)$ and $Dv(90)$; ($Dv(x)$: x % of the measured particle volume is less than $Dv(x)$ μm).
- A cumulative curve is created by summing up the distribution function. This curve enables the above-mentioned parameters to be read.

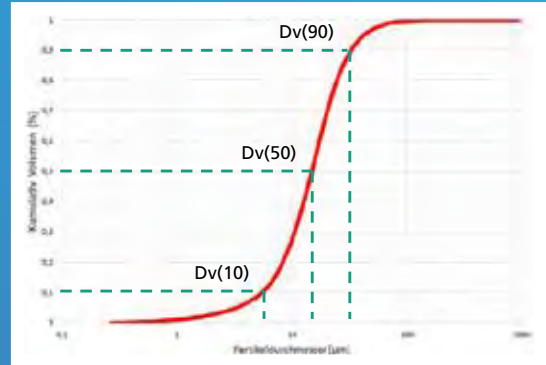
Particle size distribution



sum up

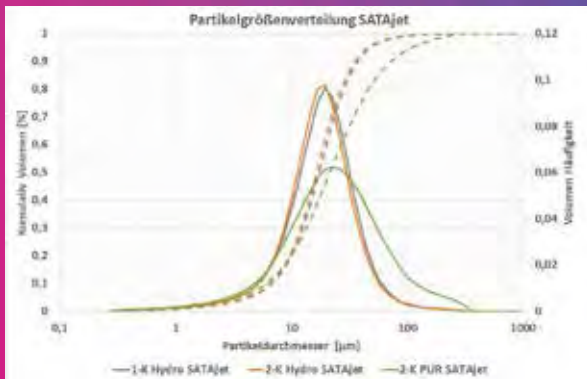


Particle size distribution



(Source: Fraunhofer IPA)

(Source: Fraunhofer IPA)



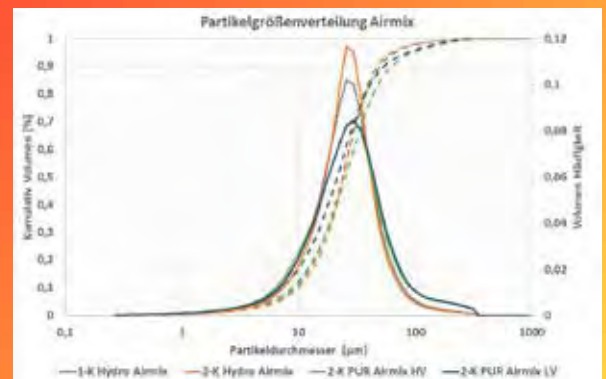
In the case of **Airmix** the **2C PU lacquer** with a $Dv(10)$ of 8.9 μm (9.3 μm) has the highest and the **2C Hydro lacquer** with a $Dv(10)$ of 10.6 μm has the lowest fine fraction in spray.

All 3 lacquer systems are very close together in terms of mean droplet diameter. The 1C Hydro shows the lowest value here with 25.3 μm and the 2C PU has a value of 26.8 μm which is the largest $Dv(50)$.



In the case of a **cup gun** the **2C PU lacquer** with a $Dv(10)$ of 6.5 μm has the highest and the **1C Hydro lacquer** with a $Dv(10)$ of 7.2 μm has the lowest fine fraction in spray.

The 2C Hydro lacquer features the smallest mean droplet diameter with a $Dv(50)$ of 17.7 μm . The 1C Hydro lacquer sits at around 18.6 μm and the 2C PU at 23 μm .



(Source: Fraunhofer IPA)

These findings were obtained by Mr Christian Heinen, occupational physician and medical director at Werkarztzentrum Westfalen Mitte e.V.

His assessment confirms that water-based lacquers are no more harmful to health than solvent-based lacquers.

Here is an extract of his assessment:

"The Fraunhofer Institute's study does not in my opinion provide any evidence of a higher health risk from water-based lacquer aerosols.

The argument for a so-called enhanced 'respirable' nature of waterborne lacquer aerosols is refuted by the measurement results.

Particularly in the so-called alveolar fraction (part of the inhalable aerosol that is so fine that it can penetrate into the smallest branches of the lungs - the alveoli), the hydro lacquers are even confirmed to have a smaller fraction for this section compared to the solvent-based lacquers.

From a statistical perspective, I don't see any significant difference in the depositions of the different lacquer fractions in any of the breath sections when I observe the individual bar charts. There are only minor percentage differences after all. The lung permeability of the lacquer types is therefore equivalent in practice."

Against the background of the disproven higher hazard potential, there is therefore no reason not to use water-based lacquers and benefit from their many advantages!

Albeit a careful working method, wearing the prescribed protective equipment and a functioning extraction system are indispensable during (spray) application of both lacquer systems.

These include:

(abridged excerpts from documentation issued by the Berufsgenossenschaft Holz und Metall – BGHM)

Before commencing work:

- Check whether less hazardous working substances can be used – a substitute substance review
- Follow the skin protection plan (skin protection, skin cleansing, skin care). Apply skin protection to uncovered body parts if damage to the workpiece due to the skin protection agent (greasy fingers on untreated wood) can be excluded
- Check extraction for effectiveness
- Check the respirator filter, replace the filter or mask as necessary

Whilst working:

- Avoid contact with eyes, skin and clothing
- Wear protective goggles and gloves (such as nitrile)
- Only use lacquers in well-ventilated areas (such as a lacquering booth (Fig. 1)) or at workplaces with extraction (e.g. point extraction, extraction wall/spray wall)
- Use respiratory protection if ventilation measures cannot be adequately implemented:
 - An A2 gas filter during spray processing
 - Half/quarter mask with combination A2/P2 filter (Fig. 2) when processing nitro lacquers, PU lacquers and water-based lacquers using the airless system and during replenishment and cleaning processes at a UV system

Abb. 1



Abb. 2





DGVU Information 209-014 "Lacquering and coating"
(<https://publikationen.dguv.de/widgets/pdf/download/article/322>)

And let's take a closer look at the point

"Check whether less hazardous working substances can be used – a substitute substance review" mentioned above.

Because, in addition to the other protective measures already outlined, it is also mentioned in documentation issued by the DGVU (Deutsche Gesetzliche Unfallversicherung) (even from 2019!):

This states on page 36 under 3.3.2. Protective measures as a recommendation for substitution: **"Use less hazardous products whenever possible, such as water-based products rather than solvent-based products"**

3.3.2 Schutzmaßnahmen

Tabelle 22 Schutzmaßnahmen beim Spritzlackieren

Schutzmaßnahmen	Zusätzliche Schutzmaßnahmen
Substitution	
Wenn möglich, Produkte mit geringerer Gefährdung verwenden. Beispiele:	
• Wasserbasierte Produkte statt lösemittelhaltiger Produkte • Produkte mit hohem Flammpunkt, möglichst nicht entzündbar • Keine sensibilisierenden Produkte	
Technische	
• Technische Lüftung verwenden. • Bei Spritzständen und Spritzkabinen: Die Spritzpistole darf	• Bei Arbeiten mit geringem Umfang und ohne stationärer Absaugung sind mobile Absaugwände zu verwenden oder zusätzl.

And substitution with water-based lacquers is also recommended in a special guide on the topic of skin protection:



DGVU Information 212-017 "Selection, provision and use of occupational skin products"
<https://publikationen.dguv.de/widgets/pdf/download/article/853>

Beispiele für eine Substitution sind:

- Ersatz von wassergemischten Kühlschmierstoffen (Feuchtarbeit) durch Minimalmengenschmierung bei der mechanischen Bearbeitung (Sägen, Bohren, Drehen, Fräsen)
- Ersatz von lösemittelhaltigen Lacken durch Wasserlacke oder Pulverlacke
- Ersatz flusssäurehaltiger durch säurefreier Felgenreiniger
- Ersatz eines „unnötig aggressiven“ durch ein milderes Hautreinigungsmittel

Auszug S. 18 / 3.3.1. Substitution



Hamm, 21 June 2023 U. Abdinghoff

Conclusion:

The studies reveal that water-based lacquers are in part significantly less harmful to health compared to solvent-based lacquers. Unlike solvent-based lacquers, they generally contain only small amounts of volatile organic compounds (VOCs), which are released during evaporation and are responsible for damage to health. That's why many sectors are already recommending water-based lacquers as substitution alternatives to solvent-based products.

Although water-based lacquers don't just offer advantages from a health perspective. They're also characterised by higher environmental compatibility and sustainability and often meet stricter environmental requirements. And they're also even easier to dispose of in many cases.

In summary, therefore, the statement that water-based lacquers are more harmful to health than solvent-based lacquers is simply incorrect.

On the contrary – water-based lacquers are a good alternative in many sectors and offer numerous advantages in terms of health, environment and processing.