

Bio-based Dual Cure binder for high-quality, solvent-based paints, wood oils and clear coats

Alkyd resins are an important product group that can be used in a wide variety of coating systems. By definition, they are based on high proportions of bio-based raw materials - mostly vegetable oils. However, the growing demands pose some challenges for alkyd resins. For example, the solvent content is to be further reduced and cobalt-containing siccatives and oxime-containing anti-skin agents are to be dispensed with.

Further development of WorléePur Si technology enables significantly wider use

The silane-functional polyurethane-urea binders of the WorléePur Si series achieve exceptional properties, especially in terms of drying speed, hardness and chemical resistance. Before application, a catalyst must be added so that the hydrolysis and polycondensation of the silane groups contained in the binder can take place. Depending on the binder and the coating formulation, these coatings allow a processing time of days or sometimes even weeks and months. Nevertheless, this technology has not yet been able to serve as a substitute for a large part of the high-quality alkyd resin lacquers.

Most of the paint systems to be applied by hand with brush and roller use 1K systems. The consumer often expects an infinite working time without the addition of a separate hardener or catalyst. On the other hand, these types of paints are often subject to the Decopaint Directive and must therefore comply with applicable VOC limits.

Both points could not be achieved with the previous WorléePur Si technology, which limited the possible applications. Furthermore, the current WorléePur Si products contain only small proportions of bio-based raw materials.

In the WorléePur VP Si 1031 T, the above mentioned technology has been significantly further developed to also meet the needs of modern 1K systems. The basis is a polyol which consists of 100% bio-based raw materials. The tall oil fatty acid used is a by-product of paper and pulp production. No additional arable land is used for its production and it is not suitable for human or animal consumption.

In further production, this bio-polyol is reacted with an aliphatic isocyanate monomer and a suitable silane. The product obtained has a bio-based content of about 78% on solid resin and was dissolved 85% in dearomatised KW 180-220 and dipropylene glycol monomethyl ether.

The product cross-links both oxidatively, like common alkyd resins, via the double bonds of the fatty acid and via the silane groups present (hydrolysis, polycondensation). Only known siccatives are necessary for the catalysis. A specific catalyst for the cross-linking of the silane groups is not required. To improve storage stability, the use of known anti-skinning agents is recommended. The lacquers produced in this way can be regarded as 1K lacquers and can thus be stored like known alkyd resin lacquers.



The prototype is suitable for many applications and for getting to know the technology

The WorléePur VP Si 1031 T represents the first prototype of this technology. It is primarily suitable for formulating a wide range of VOC-compliant paint systems for craft application, especially for categories A/d and A/e of the Decopaint Directive. The limit values for VOCs here are 300 and 400 g/l respectively.

WorléePur VP Si 1031 T	
Binder type	Silane-functional polyurethane-urea binder on the basis of a bio-based polyol
Fatty acid type	Tall oil fatty acid
Bio-based share	78% on solid resin content
Delivery form	85% Shellsol D60 / Dowanol DPM
Crosslinking	Moisture curing via the silane groups Oxidative drying via the vegetable fatty acid
Catalyst	Siccative
Processing time	Infinite / 1K System

It is suitable for the formulation of high gloss, silk gloss and matt clear and top coats. The formulations contain conventional raw materials and can be produced using standard manufacturing processes.

Compared to conventional coating systems, many properties are improved

Compared to conventional VOC-compliant paint systems, there are several advantages. For example, coatings based on WorléePur VP Si 1031 T usually achieve better drying properties, significantly higher pendulum hardnesses and chemically and mechanically resilient films after only a short time. Table 1 shows some of these properties of a VOC-compliant and high-gloss topcoat as an example. In particular, a very high MEK resistance is achieved, which is on the same level as e.g. isocyanate-curing 2K coatings. The drying speed can be further optimised by using suitable siccatives and quantities.

Property	
Non-volatile content	75,50%
Density, 20°C	1,21 g/cm ³
VOC content	296 g/l
Drying 100 µm wet film on glass	
Dust dry	1 h 55 min
Tack-free	6 h
Drying stage 4	6 h
Drying stage 6	7 h
MEK Resistance	
after 24 h	> 200 double strokes
after 1 week	> 200 double strokes
Gloss 20°/60°	> 80 GE / > 90 GE

Table 1: Properties of a high-gloss painter's lacquer

Cobalt-free formulated and VOC compliant alkyd resin based top-coats show a lower development of hardness over time. Figure 1 clearly shows the differences to WorléePur VP Si 1031 T. The hardness development is on a completely different level. Due to the higher film shrinkage of the long oil

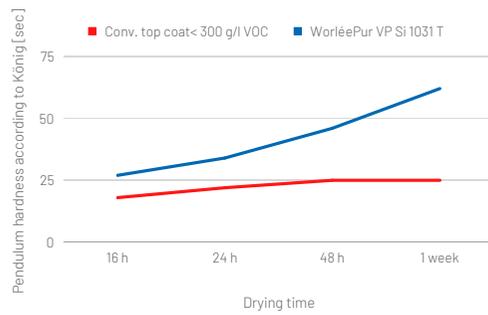


Figure 1: Hardness development of silk gloss topcoat in comparison

alkyd resin contained in the lacquer, conventional silk gloss lacquer systems take a relatively long time to reach their final and desired gloss level. Comparable varnishes based on WorléePur VP Si 1031 T7 are much easier to matt. Figure 2 shows that the desired gloss level is achieved after a short drying time, which makes the formulation of such varnish systems much easier. Clear lacquers or parquet oils can also be formulated on the basis of WorléePur VP Si 1031 T.

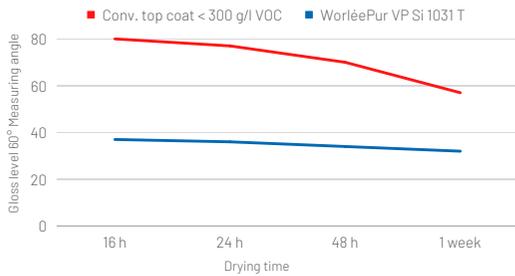


Figure 2: Gloss Silk gloss coating after drying in comparison

Common parquet oils with a high solids content do not allow a layer-forming application and are rather designed for a strong penetration. In addition, with these systems, the excess coating material should be removed after sufficient exposure time.

If too much coating material is applied, the drying times of these very low-viscosity systems would be too long. The new technology, on the other hand, allows the formulation of very high solids systems using reactive diluents.

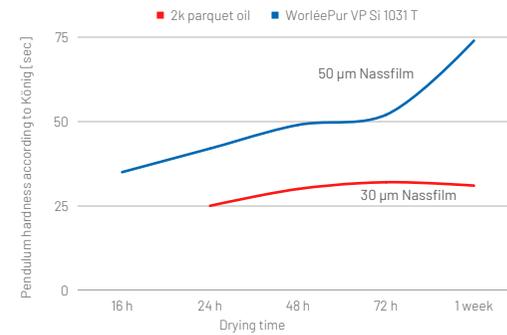


Figure 3: Hardness development of a parquet oil in comparison

These systems dry faster than 2K parquet oils and, as shown in figure 3, even achieve higher hardnesses with larger application quantities. A layer-forming application is thus possible.

Such a system is also chemically resistant to common substances, such as red wine, coffee or even mustard, as can be seen in figure 4. Paint systems based on WorléePur VP Si 1031 T are easy to apply by brush and roller and provide excellent flow.



Figure 4: Evaluation chemical resistance on oak

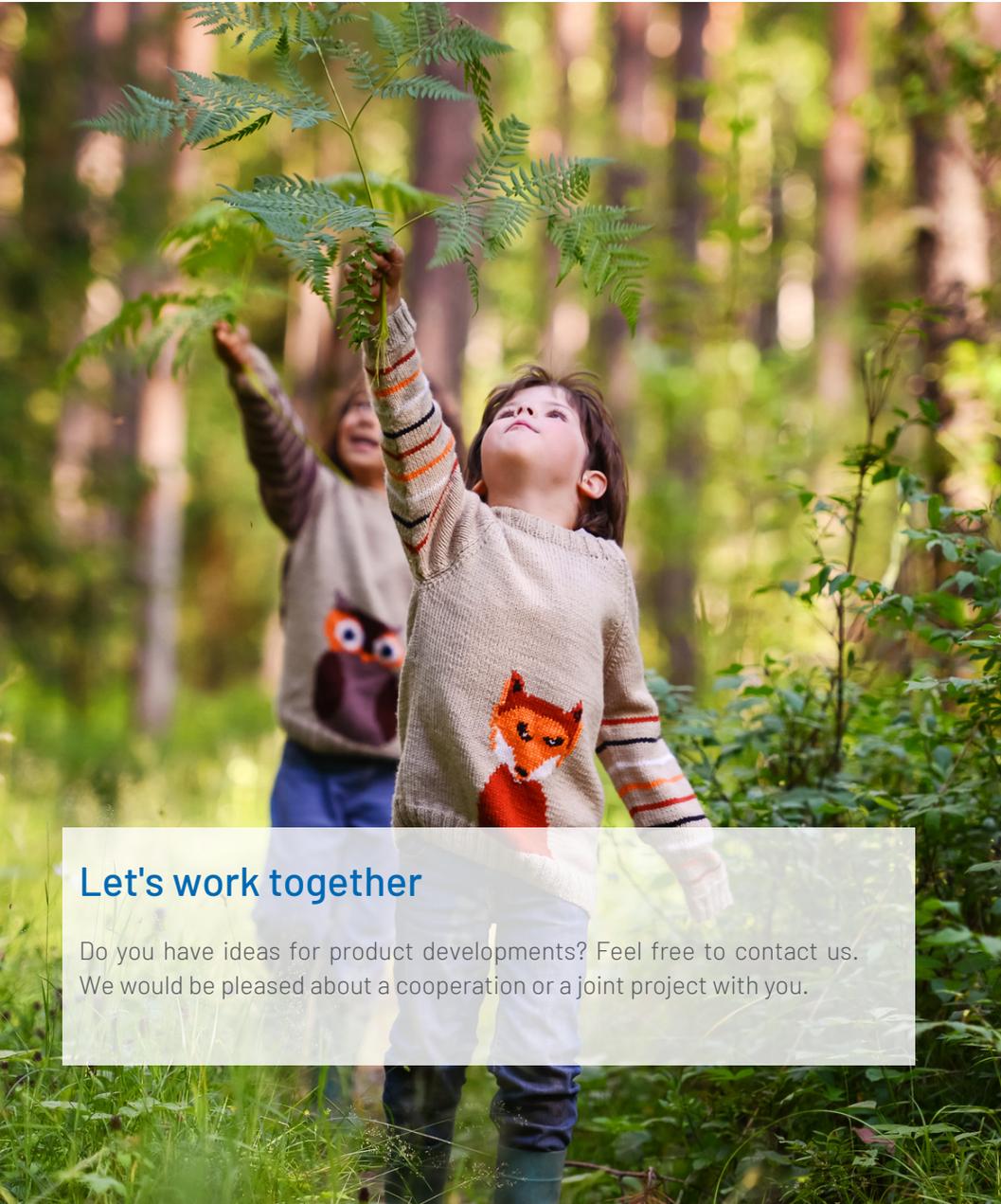


In summary, the WorléePur VP Si 1031 T offers several advantages over conventional VOC compliant alkyd resin systems:

- Dual Cure binder: oxidative drying and additionally moisture curing
- The drying and especially the hardness development is clearly better compared to alkyd resins with a high solids content
- The chemical resistance is at a very high level, similar to that of 2K systems
- The formulation of high-gloss and silk-gloss, as well as matt topcoats and clearcoats is possible
- Due to the lower film shrinkage over time, silk-gloss lacquers achieve the desired gloss level significantly earlier
- The use of bio-based components is possible

The product is the first binder in this product range. The adapted technology allows the development of binders for high-quality and modern coating systems. It combines the advantages of alkyd resins with those of modern moisture-curing binders, and does so on the basis of high bio-based content. It thus also contributes to the solution of existing and future requirements.





Let's work together

Do you have ideas for product developments? Feel free to contact us.
We would be pleased about a cooperation or a joint project with you.

Sustainable product development

The development of sustainable products has accompanied us for a very long time. Even without legal or societal pressure, it has always been our ambition to offer better and more durable products and solutions for a wide range of applications. Developing high quality products in collaboration with our customers remains our primary focus.

Over the decades, we have gained a lot of experience in developing various resin technologies based on different raw materials to make products more sustainable from different perspectives. Sustainable product development must ultimately benefit the environment and society, but also take into account economic aspects.

The entire supply chain must benefit. Already in our proven developments, we can take many of these different aspects into account and make resins and additives ever more sustainable. For example, we can determine factors such as the proportion of renewable and renewable raw materials, the proportion of secondary raw materials, regionality and longevity, the hazard potential of our products, and the competition of our raw materials with the food industry.

Technologically, we are well positioned with our creative departments in research, development and application technology to continue to move toward sustainable products in collaboration with our customers and partners. Every new development is related to sustainability factors such as climate change and resource conservation.

Our corporate values by which we act

Since the founding year of 1851, the principle of sustainability with its three core themes of economy, ecology and social issues has been at the heart of our corporate philosophy. As a family business, Worlée-Chemie is committed to social responsibility and fair dealings with business partners and employees. We are committed to forward-looking and prudent environmental protection as well as preventive and comprehensive occupational health and safety as a corporate goal.

We are convinced that the natural resources of water, air and soil must be treated with care as part of our responsible actions. In this way, the ecosystem of which we are a part can be preserved as the basis of our living conditions for future generations. This also applies in particular to the economical and efficient use of energy and natural resources.

We stand by our responsibility for safety in production, storage and transport. We ensure that our products are handled conscientiously along the entire value chain.

Compliance with human rights due diligence is part of our company's self-image. Integrity, fairness, responsibility and a high degree of transparency are the basis for a trusting and long-term business relationship. We expect our suppliers to adhere to these principles in the wider supply chain and to recognize our Supplier Code of Conduct or provide an equivalent guideline.

Solvent-based binders

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