

How to make a successful waterborne wood top coat



Hereafter is a mean to make a waterborne wood top coat based on alkyd technology.

- Producing a water based wood top coat with biobased content around 50%
- Hardness at B after 24h, stabilizing at H-3H after 1 week
- VOC < 25 g/L
- Hardness can reach 2H within 24h in 2K

Binder characteristics

Ecoat, has developed water-based cost competitive and high quality binders that can meet today's requirements by shifting towards **VOC < 25 g/L** resins through the development of water-based alkyd resins: Inokem UR range (Table 1). They are internally emulsified alkyd emulsion, where the alkyd resin is modified with polyurethane chemistry.



Table 1: Internally emulsified alkyd emulsions.

Ref.	Oil length (%)	Biobased content (%)	VOC content (%)	Positioning and use
Inokem UR 3304	36	50%	< 2,5%	Colorless hybrid resin for indoor/outdoor top coat
Inokem UR 3309	33	47	< 2,5%	Colorless hybrid resin for top coat

Paint formulation

Here below is a starting wood top coat formulation based on customer feedbacks and Ecoat's experience (Figure 1).

Ingredients	Weight (g)	Weight (g)	Chemical function
<i>Prepare the millbase</i>			
Water	3,91	3,91	Water
Tego Dispers 750W	1,00	1,00	Dispersing agent
AMP 95	0,16	0,16	Neutralizing agent
Byk 024	0,20	0,20	Defoamer
Acticide MBS	0,20	0,20	Biocide
Butyl glycol	1,00	1,00	Butyl glycol
Sillitin Z89	10,00	10,00	Filler
Acrysol RM 5000	0,10	0,10	Rheology modifier
<i>Disperse at high speed during 30 minutes with a cover. Then cool down the mixture by decreasing the agitation between 500 and 700rpm. Keep the cover during this step. Then add:</i>			
Water	30,56	30,50	Water
Inokem UR 3309 (40%)	48,25	0,00	Alkyd-PU emulsion
Inokem UR 3304 (40%)	0,00	48,25	Alkyd-PU emulsion
Byk 3455	0,30	0,30	Leveling agent
Borchi oxycoat 1101	0,14	0,14	Iron based drier
Aquacer 513	3,00	3,00	Wax
Acrysol RM 5000	0,44	0,44	Rheology modifier
Acrysol RM 8W	0,74	0,80	Rheology modifier
<i>Mix 5mn at maximum 1000-1400 rpm</i>			
Total	100,00	100,00	

Paint Characteristics:		
Theoretical values		
Density (g/cm ³)	1,14	1,14
Solids in weight (%)	30	30
Solids in volume (%)	20,1	20,1
Binder content (%)	19,3	19,3
PVC (%)	16,6%	16,6%
PVC/CPVC	0,166	0,166

Figure 1: Wood top coat formulation based on Inokem UR 3304 and Inokem UR 3309.

Key success factor is to use hydrophobic and hard ingredients.

The application

Alkyd binders dry through an oxidative mechanism, in which the surface drying is to be balanced with the core drying. The thicker the film, the longer it will take to reach a full drying.

The film will perform only if the drying is completed, either by applying multiple thin layer, or by giving drying time. At least 7 days are used to reach the best performances in Europe. Air force drying (80-140°C) might also be used and will help with the film build-up.

Therefore the recommendation is to apply layers of **20-25µm DFT/layer** (DFT = Dry Film Thickness).

Benchmarking the APU from Ecoat

Key results

Down below are the paint performances according to European mostly used standards (Table 2).

Table 2: Paint performances of Inokem UR 3304 and 3309.

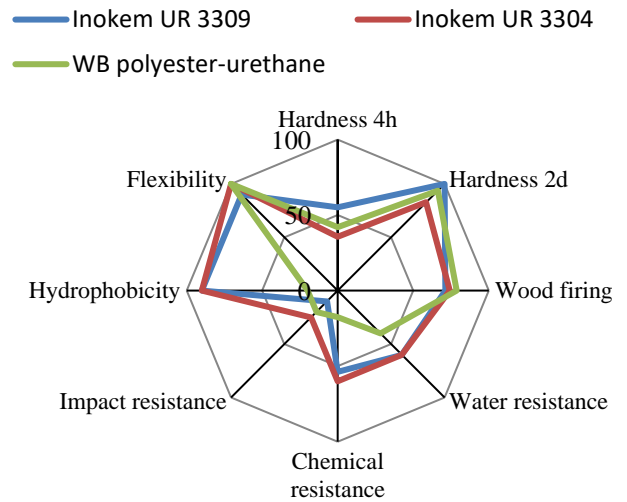
Item	DFT (µm)	Drying time	Inokem UR 3304	Inokem UR 3309
Gloss 60°	20±3	72h	36	25
Surface Drying Time (h) - Touch Dry	20±3	—	<1h	<1h
Hard Drying Time (h) (Cotton ball method)	20±3	—	<2h	<2h
Pencil hardness	20±3	24h	B	B
Pencil hardness	20±3	168h	H	3H
Resistance to yellowing after 14 days in dark (Δb*)	25±3	14 days	0,436	0,332
Water Resistance (Immersion)	20±3	48h	>24h	>24h



Figure 2: Pine wood panel coated with Inokem UR 3304 as a top coat.

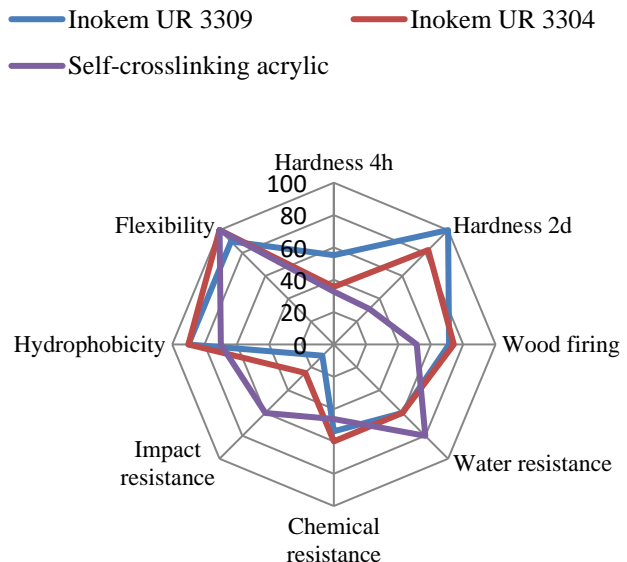
Inokem UR alkyd dispersions present residual hydroxyl value (around 1%) and can therefore be blended with water soluble isocyanate, such as Easaqua XD 803, to improve the overall drying performances. This blend works then as a 2K technology **and can reach a pencil harness of 2H within 24h.**

Inokem UR vs self-crosslinking waterborne polyester-urethane



Compared to a self-crosslinking waterborne aliphatic polyester-urethane, the Inokem UR will outperform in hardness, water & chemical resistances, hydrophobicity, and last but not least in **wood firing and price competitiveness vs polyester-urethane.**

Inokem UR vs self-crosslinking waterborne acrylic



Compared to a self-crosslinking waterborne acrylic, the Inokem UR will outperform in hardness, chemical resistance, hydrophobicity, and last but not least in wood firing and **ease of application.** Moreover, the Inokem UR range **doesn't require any coalescing agent reducing the VOC and the price of the overall paint formulation.**