

How to make a successful waterborne wood impregnation & saturator



Hereafter is a mean to make a waterborne wood impregnation paint based on alkyd technology.

- Good penetration and wood fiber saturation
- Good stain and chemical resistance
- Good wood firing
- VOC < 25 g/L to 0 g/L & biobased content 69% to 99%
- Limited grain raising

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 and biobased** resins through the development of water-based alkyd resins: Inokem UR 3308 and Secoia 4487 (Table 1).

Table 1: Impregnation alkyd emulsions.

Ref.	Oil length (%)	Biobased content (%)	VOC content (%)	Positioning and use
Secoia 4487	87	99	0	Deep impregnation
Inokem UR 3308	57	69	<2,5	Penetrating hybrid resin for primer and impregnation

Inokem UR 3308 is an internally emulsified alkyd emulsion, where the alkyd resin is modified with polyurethane chemistry.

Secoia 4487 is a surfactant free alkyd emulsion based on a patented technology using solid particles

absorbed irreversibly at the resin/water interface and stabilizing the alkyd emulsion (Figure 1). This technology removes all the drawbacks of conventional surfactants: adhesion, water sensitivity, VOC, plasticizing effect, cost impact and reactivity with associative thickeners.



Figure 1: Conventional alkyd emulsion vs Pickering technology used in the Secoia 4487.

Paint formulation

Here below are starting wood impregnation formulations based on customer feedbacks and Ecoat's experience (Figure 2).

Ingredients	Weight (g)	Weight (g)	Chemical function
<i>Prepare the millbase</i>			
Water	9,93	8,20	Water
Disperbyk 190	0,15	0,15	Dispersing agent
Tego Dispers 750W	0,00	0,00	Dispersing agent
AMP 95	0,00	0,00	Neutralizing agent
Byk 024	0,30	0,30	Defoamer
Butyl glycol	1,00	1,00	Butyl glycol
Durcal 2	0,00	0,00	CaCO ₃
Deuteron MK	4,00	4,00	Matting agent
Acrysol RM 5000	0,54	0,20	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	17,26	32,66	Water
Inokem UR 3308 (39%)	64,29	0,00	Alkyd-PU emulsion
Secoia 4487 (46,1%)	0,00	49,89	Alkyd Emulsion
Byk 3455	0,30	0,30	Leveling agent
Borch Oxycocat 1101	0,16	0,16	Iron based drier
Acrysol RM 5000	0,27	0,34	Rheology modifier
Acrysol RM 8W	1,80	2,80	Rheology modifier
<i>Mix 5mn at maximum 1000-1400 rpm</i>			
Total	100,00	100,00	

Impregnation characteristics:

Theoretical values		
Density (g/cm ³)	1,06	1,06
Solids in weight (%)	27,92	27,92
Solids in volume (%)	23,5	23,5
Binder content (%)	23	23
PVC (%)	11%	11%
PVC/CPVC	0,648	0,648

Figure 2: Wood impregnation formulation based on Inokem UR 3308 and Secoia 4487.

A transparent iron oxide or an UV-absorber (such as the Tinuvin 5333-DW) can be added into this starting mat paint formulation to improve the UV protection and weathering (1,5-3 wt.%).

The application

A light ginning (sanding paper > 80), brushing and dusting before the first layer will improve the penetration and the general aspect of the wood.

The first layer should be applied generously, while the second and third layers are often applied wet on wet until wood fiber saturation. The surface can be smoothed with a dry spalter after application.

General rules are that the wood to be painted should be dry and clean, and the application temperature of at least 5°C and maximum 35°C, in order to allow proper water evaporation.

Key results

Secoia 4487, Inokem UR 3308 and a waterborne alkyd impregnation from the market are compared and down below are their drying performances on pine wood substrates.

The water drop test achieved after each layer highlights the **better penetration** properties of the Secoia 4487 and to a less extent of the Inokem UR 3308 compared to the benchmark (Table 2). This property can be linked to their long oil lengths. Three layers of Ecoat's products enable to saturate the wood fibers leading to a **hydrophobic surface**.

Benchmarking Ecoat's products

- Secoia 4487
- Inokem UR 3308
- Waterborne alkyd paint benchmark

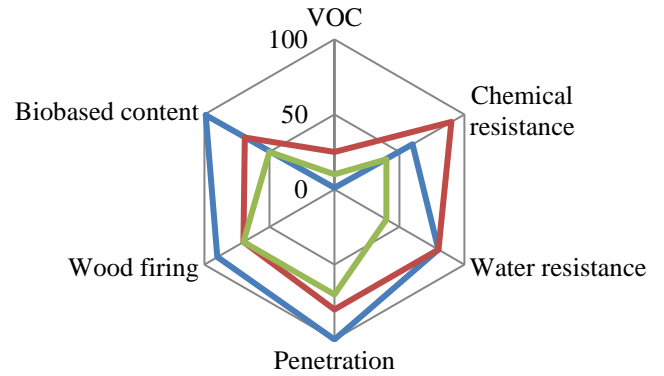











Table 2: Water drop test on pine wood substrates.

Layer	Loading (g.m ⁻²)	Inokem UR 3308	Secoia 4487	Waterborne alkyd impregnation from the market
1 st layer	66,7			
2 nd layer	66,7			
3 rd layer	66,7			

Compared to conventional alkyd emulsions, the Inokem UR 3308 will outperform in chemical and water resistances, film forming balance and **penetration**. As Secoia 4487 will exhibit improved **wood firing, penetration, water and chemical resistances**, while being **99% biobased**.

Table 3: Chemical resistances after 3 layers of 66,7 g.m² each.

Chemical resistance	Inokem UR 3308	Secoia 4487	Waterborne alkyd impregnation from the market
Oil	1	1	1
Hand care	1	1	1-2
Salt water (5wt.%)	1	1-2	3
Water	1	1	3
Acid H ₂ SO ₄ 50%	2	5	1-2
Chlorinated water (0,2g.L ⁻¹)	1	1-2	3