POLYVINE®
TRADE VARNISH EXPERTS

A self-crosslinking water-based polyurethane varnish that remains uncured, and porous

A self-crosslinking water-based polyurethane varnish that remains uncured, and porous is likely suffering from incomplete coalescence, where the resin particles did not fuse together, or a failure of the crosslinking reaction itself. This results in a film that acts more like a sponge than a protective barrier.

This is Incomplete film formation (Coalescence Failure)

Water-based polyurethanes rely on polymer particles fusing as water evaporates. If that process is disrupted: the cured film will be porous.

Primary Causes of Failure

Too High Humidity/Too Low Temperature: Water-based polyurethane requires the water to evaporate to bring the resin particles together for crosslinking. If the humidity is above 60–70% or the temperature is below 60°F (15°C), the water cannot escape, preventing the chemical reaction.

Contamination: Residue from oil, grease, wax, or silicone (furniture polish) on the surface prevents adhesion and curing, leading to soft, porous spots.

Recoating Too Fast: Applying new layers before the previous coat is fully dry traps moisture underneath. This is common with fast-drying water-based products that feel dry in 30 minutes but are not ready for a second coat.

Improper Mixing/Shelf Life: Over-shaking the can introduces microscopic air bubbles that remain in the dry film, making it porous. Furthermore, expired varnish (after 9-12 months) loses its crosslinking ability.

Surface Porosity: If applied to highly absorbent wood without a sealer coat, the resin can sink into the wood, leaving a thin, weak, and porous finish on top.

Crosslinking Reaction Not Triggering Properly

Self-crosslinking systems (often carbodiimide, aziridine, or NCO-based blocked systems) require specific conditions:

Do Not Shake: Stir the varnish slowly to avoid air bubbles, which can create a porous, matte, or weak finish.
Use High-Quality Brushes: Synthetic bristles are best for water-based varnishes.
Use a Dehumidifier: If you must apply in a humid environment, run a dehumidifier or a fan, as moisture in the air prevents the varnish from curing properly.

Likely Root Causes

Temperature below minimum film formation temperature (MFFT)
Rapid drying (surface skins before bulk coalesces)
You get microvoids → porosity → liquid ingress
pH drift (too acidic/basic)
Expired material (crosslinker deactivated)
Incorrect storage (moisture/heat exposure)
Film applied too thin or too thick
High Ambient Humidity During Cure
Water cannot evaporate efficiently
Crosslinking is delayed or incomplete
Leads to a soft, permeable film

Substrate or Contamination Issues
If the substrate interferes with the cure because of contamination
Residual oils, wax, old coatings
High moisture content (especially wood)
Alkaline surfaces (can destabilise dispersion) prevent adhesion

Film Thickness
Too thick → traps water → incomplete cure inside
Insufficient Cure Time

Microvoids between polymer particles
Incomplete coalescence
Low crosslink density
This creates capillary pathways → liquids penetrate instead of beading.

Practical Fixes

Immediate Remediation
Unfortunately, once porous, you cannot “fix” the film in place
You’ll need to:
Sand back to a sound layer
Reapply under controlled conditions
Reapplication Conditions (Critical)
Temperature: 15–25°C minimum, ideally ~20°C
Humidity: <65% RH
Air movement: moderate (not forced drying)
Apply thin, even coats
Improve Film Formation
Avoid over-thinning
Don’t force dry with heat guns or strong airflow
Verify product shelf life
Mix thoroughly (if 2K or additive-based)
Respect pot life if applicable
Substrate Preparation
Sand properly (e.g., 180–220 grit for wood)
Remove all contaminants from the substate.
Ensure substrate moisture is controlled
Always apply a test patch, when cured, allow 5-7 days, test with a small amount of water.

by Peter Wells, Polyvine Technical Director.