

Novel Silane Resins Tool Box for Ambient Temperature Curable and Scratch Resistant Coatings

VESTANAT® EP-MF 201 is a solvent-free, ready-to-use self-crosslinking binder. It can be used either as a single binder or in combination with appropriate co-binders. Such low VOC formulations show outstanding scratch and chemical resistance. VESTANAT® EP-M 222 is a resin which is used to modify flexibility while maintaining excellent drying performance and hardness development.

Aliphatic PUR coatings are known for their high chemical resistances, good flexibility, good adhesion and overall weathering properties, yet handling of isocyanates can be an issue, if applicators are not trained and protected properly. Hence expertise and training is needed for proper handling of isocyanates and DIY use of isocyanates in of 2K PUR coating systems is not supported e.g. under REACH.

Two new alkoxy silane-resins, VESTANAT® EP-MF 201, based on a short-chain backbone, and VESTANAT® EP-M 222, which contains a higher molecular weight backbone for flexibility reasons. These NISO crosslinkers include urethane linkages that give chemical resistances and adhesion properties typical to polyurethanes, but without the isocyanate functionality.

There are two primary routes of silane crosslinking: the first route involves a condensation reaction between two silanol groups. The other crosslinking mechanism is a transesterification reaction with a polyol.

These two types of reactions allow for either a two component (2K) coating formulating a NISO cross linker with a polyol, or a one-component (1K) moisture cure coating where the NISO cross linker is the sole component of the binder matrix.

Ambient cure 1K NISO coatings based on VESTANAT® EP-MF 201 and VESTANAT® EP-M 222 for wood, metal and plastic substrates

While two-component coatings are quite useful in order to build hardness and other properties fairly quickly, there are many applications where a one-component (1K) non-isocyanate curing coating is desired. These include wood coatings where significant improvements, especially with regard to scratch resistance, are observed, as shown in the pictures above. Even the pure VESTANAT® EP-MF 201 can be used as a single binder to formulate NISO ultra high solid, scratch resistant coatings for wooden substrates, as well as others.

Table 1 shows the properties of a 1K NISO coating based solely on VESTANAT® EP-MF 201 and applied and cured at ambient temperature for seven days. The initial hardness and chemical resistance of this coating is high. To improve the mechanical properties and increase flexibility of the 1K NISO coating, VESTANAT® EP-M 222 was substituted for VESTANAT® EP-MF 201 at three different levels: 70:30, 50:50 and 30:70 pbw, cured at room temperature and periodically tested for pendulum hardness and for full properties after the seven days of curing had elapsed (Table 1). As the M 222 was added to the MF 201 formulations, both the impact resistance and Erichsen cupping values increased as expected. Despite the reduction of crosslink density, the MEK resistance was maintained and higher pendulum hardness was achieved. The only deficit observed was an increase in the VOC content from 0.9 lb/gal to 3.0 lb/gal. Furthermore, the coatings were tested for 20° gloss and loss of gloss after a modified Crockmeter test (wet abrasion) was applied, showing outstanding scratch resistance.

1K moisture cure NISO system for clear coat applications

Excellent scratch resistance can be combined with high flexibility, good chemical resistance and



Clear Coat
Standard 2K PUR



Clear Coat
Acrylic Polyol (of comparative example) + VESTANAT® EP-MF 201
(No isocyanate hardener included.)

Table 1. 1K NISO coatings using VESTANAT® EP-MF 201 / M 222 mixtures

	MF 201	MF 201: M 222		
	-	70:30	50:50	30:70
Hardness [König] 1d/7d	72/132	56/158	36/164	15/168
Impact, direct [inch lbs]	30	40	50	50
Erichsen cupping [mm]	1.5	3.0	3.5	6
MEK resistance [DR]	150++	150++	150++	150++
VOC [lb/gal]	0.9	1.9	2.7	3.0
Gloss/loss of gloss [20°]	78/1	78/2	77/1	74/0
Touch dry [23 °C]	1.25 h	2.0 h	3.0 h	5 h

The chemical resistance of the 50:50 blend of MF 201 and M 222 shown below in table 2 was tested in reference to a 2K polyurethane coating against the six liquids, and found to be superior in the case of the NISO coating compared to the 2K PUR coating (0 = no changes / 6 = clearcoat destroyed).

Table 2. Chemical resistance of a 1K moisture-cured VESTANAT® EP-MF 201 / M 222 mixtures

		MF 201 : M 222	2K PUR
		50:50	
Acetic Acid, 20%	1 h	0	0
	4 d	1	5
Sodium Hydroxide, 20%	1 h	0	0
	4 d	2	0
Distilled Water	1 h	0	0
	4 d	0	0
Ethanol/Distilled Water (1:1)	1 h	0	4
	4 d	3	6
Brake Fluid	1 h	0	1
	4 d	1	6
Gasoline	1 h	0	2
	4 d	1	2

good weathering durability of these NISO coatings. First results indicate that also pigmented systems exhibit a good storage stability as formulated

paints. More detailed studies are ongoing to support these promising results.

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