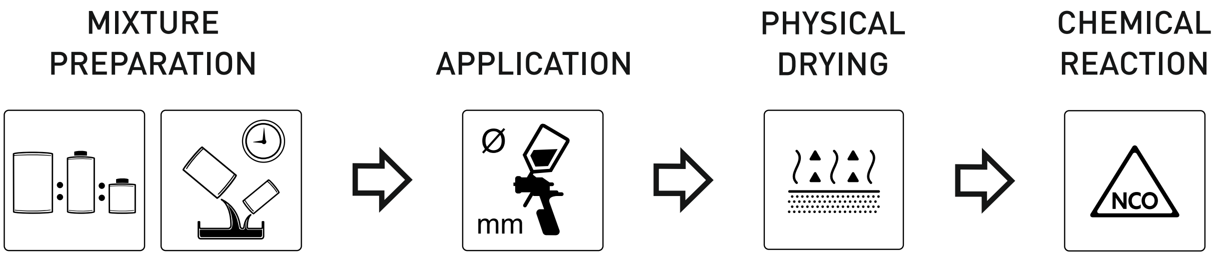
SELECTION PRINCIPLES FOR HARDENERS AND THINNERS – THE EFFECT ON THE FINISH

The correct speed of action for hardeners and thinners is fundamental to the processing of the coating in the prevailing ambient conditions and the refinished area to ensure the best possible finish.



I. Physical drying

This effect is separate from the hardening action: the process begins with physical evaporation of the thinner. During this step of the process, the speed of the thinner (according to the product formula or to thin out the coating mixture) is critical. In the first drying phase of the applied coat, the thinner's speed of action defines the coating product's flowability and minimises the risk of entrapping the thinner which is incompatible with the coating application conditions (which may include high temperature or a thinner which is too fast); this is important for the final quality of the coating.

II. Chemical reaction with the hardener

In 2-component coating products, physical drying progresses virtually simultaneously with the chemical reaction between the resin in component a (the coat or primer) and the resin in component B (the hardener). By selecting the hardener's speed of action (fast, standard, slow, or extra slow), the chemical reaction rate can be controlled, which helps in managing several coating parameters, like dust-free dryness or the coat's open life.

The selection of the hardener and thinner speeds is first determined by the following factors:

- Temperature (generally understood as the temperature of the ambient air, the coated substrate and the coating product),
- Recoated substrate size,
- Ventilation air flow rate in the spray booth.

See Table 1 for the general recommendations in the selection of hardeners and thinners by temperature and size of recoated area.

SURFACE	SMALL, 1-2 PARTS, SMALL REPAIRS	MODERATE, 3-5 PARTS	LARGE, 5+ PARTS
25 ÷ 35°C	STANDARD	SLOW	SLOW / EXTRA SLOW
20 ÷ 25°C	FAST	STANDARD	SLOW
15 ÷ 20°C	FAST	FAST / STANDARD	STANDARD / SLOW

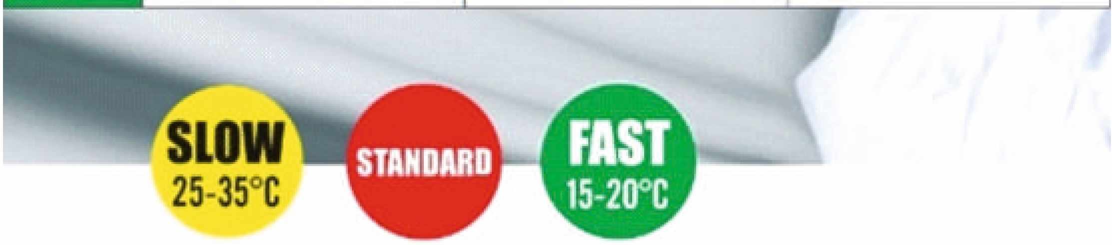


Table 1. Hardener & thinner selection by temperature and the size of the recoated area

Benefits of using various hardener speeds

The correct selection of hardener speed and thinner facilitates optimal coating product performance, depending on the application conditions (temperature and humidity) and recoated surface size.

SLOW/EXTRA SLOW Hardener	**FAST** Hardener
- allows the coating of large surfaces and/or processing at high temperatures, - ensures correct flowability, - reduces overspraying.	- ensures efficient recoating, even from low temperatures, - reduces the drying and curing time, - ensures correct sanding.

FAQ (FREQUENTLY ASKED QUESTIONS):

What does the selection of the hardener and thinner speeds depend on?

As shown in the table above, the speed of a hardener or a thinner depends on the temperature and the recoated substrate size. The prevailing temperature range and substrate size govern the optimum combination.

How does the speed of action work with hardeners and thinners?

The speed of a hardener (fast, standard, slow, and extra slow) is the result of the type and quantity of the inhibitor (retardant) or the catalyst (accelerant) of the chemical reaction contained in the hardener's formula.

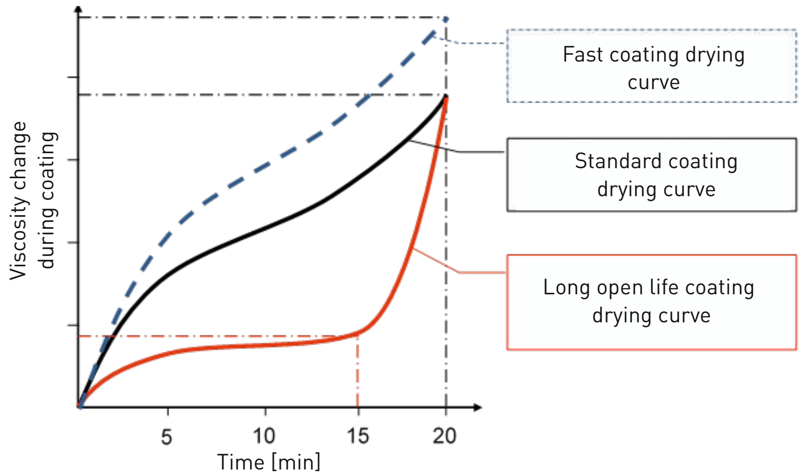


Fig. 1. Change of viscosity during coating by coats which vary in open life.

This is best explained by specific practical examples:

- **High temperature with a large recoated substrate area** – application demands good flowability and a long open life (the capacity to absorb overspray from the process), despite working at an elevated temperature. This process is facilitated by inhibitors, chemicals which reduce the rate of viscosity increase during initial hardening (curing) – a slow or extra slow hardener is recommended in this case. If feasible to do so, hardening can be inhibited using thinners with a longer flash-off time (slow or extra slow thinners may be used).

- **Low temperature with a small recoated substrate area** – when applying a coat at a low temperature, the flash-off time between the layers, the dust-free dryness, the touch dryness, and the working hardness are expected to be not unlike those during coating at 20-25°C. This process is facilitated at low temperatures by catalysts, which accelerate the initial hardening. If feasible to do so, hardening can be accelerated using thinners with a shorter flash-off time (fast thinners).

Can you freely combine the speeds of hardeners and thinners (e.g., a slow hardener with a fast thinner)?

Generally, **they cannot be combined arbitrarily**, otherwise there is a high risk of coating defects. The risk increases the more the products vary in their speed of action in the combination. For example, the combination of a fast hardener with an extra slow thinner would risk entrapping the thinner in the coating.

The safest choice is to use the same speed of hardener and thinner. The safe combinations include a standard hardener with a fast or a slow thinner.

Note that VHS coating products usually do not need the addition of any thinners, as the hardener speed is specified according to the temperature and the recoated substrate size.

What is the risk of using fast or standard hardeners at high temperatures?

Using a fast or a standard hardener at a temperature higher than normal makes application of the coating difficult through the formation of overspray or poor flowability, especially when coating large surfaces. a faster chemical reaction at elevated temperatures may result in sealing of the top layer and pinholes in the primer/coat, caused by the release of the thinners after prolonged time. Entrapment of part of the thinners inside the coating layer most often causes 'sagging' of the coat and loss of gloss.

When should fast hardeners and thinners be used?

Fast hardeners are designed for achieving the cure in an acceptable time when accelerated curing by use of heat is not feasible (there is no heated chamber or the heating costs are prohibitive). If curing by heat is planned, it is always safer to use a standard hardener. A coating system with a curing accelerated using a fast hardener usually achieves a lower final hardness than with a standard hardener. The acceleration generally reduces the final gloss achieved.

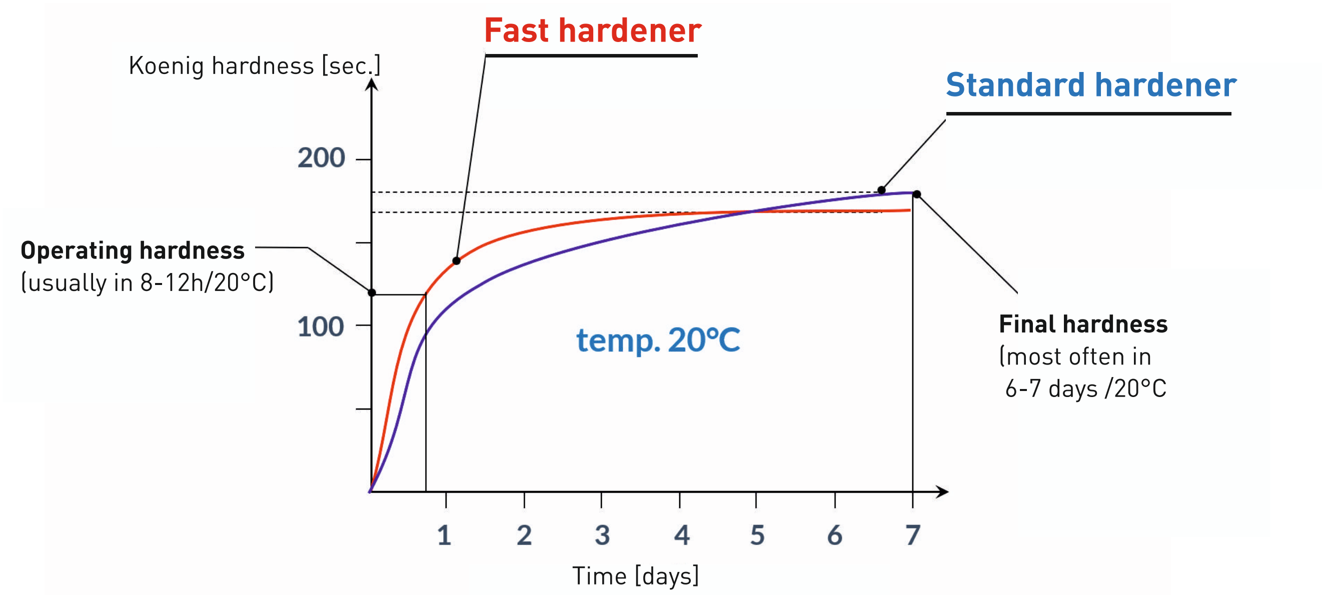


Fig. 2. Effect of hardener speed on the final hardness

When should fast hardeners and thinners be used?

An insufficient amount of a hardener leaves some of the active bonds of the component a resin uncured by the hardener. Poor saturation with the hardener extends the hardening time (the evaporation of the thinners leads to an incomplete chemical reaction), which leaves the coating system below the final performance values designed for the product (which means insufficient final hardness, chemical resistance, sandability, level of gloss, etc.). a hardener amount below that specified may change the coating viscosity and make application difficult (by streaking, for example).

When should fast hardeners and thinners be used?

Contrary to what may be believed, an excessive amount of a hardener will not significantly reduce the chemical reaction time, nor will it markedly affect the final hardness of the coating. If there is way too much a hardener, a part of it will not be bound with the Component a resin and compromise the coating product's performance by, for example, reducing the sandability of the primer or resulting in a lower gloss of the clearcoat.