

Pot-life determination of epoxy resin paints in disposable measurement cells

Application

Resins
Glues
Building materials

Device

Rheolaser® Master

Commercial resin paints are two-component systems of a solvent based resin and a cross-linker, which is added to cure. The characteristic time during which resin paints are applicable after adding the cross-linker is called “pot-life”. At longer times the cross-linking of the resin increases the paint viscosity and spreading is not possible. The pot-life is usually determined by viscosity measurements.



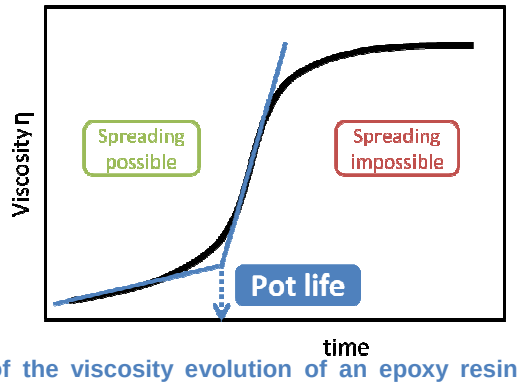
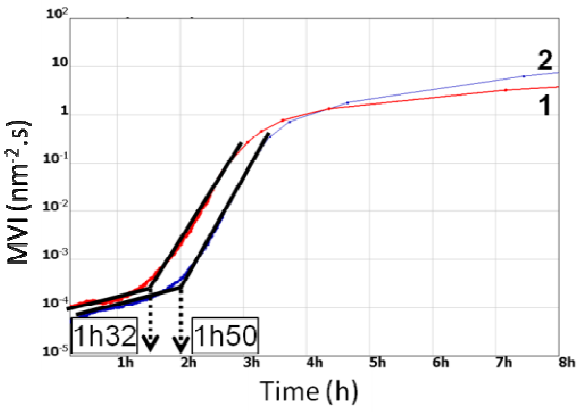


Figure 1: Schematic representation of the viscosity evolution of an epoxy resin paint after addition of the cross-linker.

A commercial paint based on epoxy resin used for coatings of ceramics or wood was studied. It is a two component system of water soluble colored resin and a cross-linker. For this experiment, we studied two ratios of resin and cross-linker. Mixture 1 is composed as indicated on the commercial paint, whereas Mixture 2 contains less resin and higher cross-linker concentrations. Figure 2 shows the evolution of the Macroscopic Viscosity Index (MVI) of both mixtures measured with Rheolaser. One can observe that the MVI of both mixtures does not change at the beginning of the experiment, but increases significantly at 1h32 (Mix 1) and 1h50 (Mix 2) (cross-over of two fitted straight lines). As shown on the table below, the time of Mixture 1 corresponds very well to the time proposed by the producer (1h30).This measurement was performed at 25℃, but measurements until 90℃ are possible.



	Mixture 1	Mixture 2
Resin	75.7%	63.7%
Cross-linker	19.0%	31.8%
H_2O	5.3%	4.5%
Pot-life (Producer)	1h30	(*)
Pot-life (Measured)	1h32	1h50

Figure 1: Macroscopic Viscosity Index (MVI) of two epoxy resin paints after addition of the cross-linker. The pot-life was determined by fitting two lines. (*) Mixture 2 was not proposed by the producer; therefore no pot-life time was indicated.

Contact free analysis



Figure 3: Rheolaser disposable measurement cell

A main advantage of Rheolaser is the optical measurement technique without physical contact between instrument and sample. While conventional viscosimeters use a rotating spindle probe introduced into the sample, which requires short and spaced measurement cycles, Rheolaser measures viscoelastic properties continuously during curing.
Moreover, conventional viscosimeters stop measuring just after the pot life time to avoid complete sticking of the measurement geometry; Rheolaser can measure until complete cross-linking thanks to disposable measurement cells.
In addition, Rheolaser measures the elastic properties of sample until full binding of the resin, which simple viscosimeters cannot provide. The higher the Elasticity Index EI is, the higher is the elasticity of the sample. One can see that after binding of the resin paint, the Mixture 2possesses a higher elasticity due to higher cross-linking between the resin molecules as shown in Figure 4.

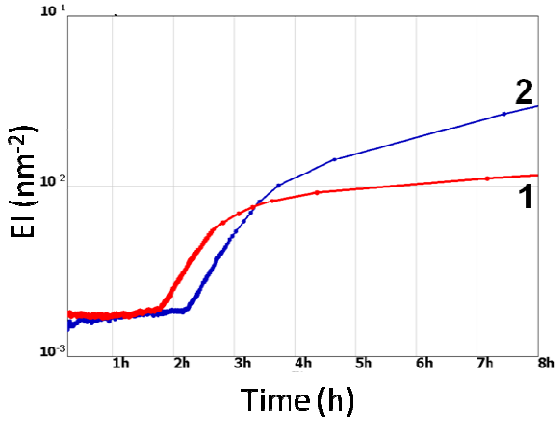


Figure 4: Evolution of the elastic index of epoxy resin paints after addition of the cross-linker. The elasticity of Mixture 2 is far higher than that of Mixture 1, due to higher cross-linker concentration.

Thanks to the 6 measurement positions, 6 formulations can be studied simultaneously without any degradation or cleaning of the instrument. Both factors decrease significantly the user time and accelerate product formulation. In particular, the impact of new hardening retarders can be studied, not only in epoxy resin paints, but also in glues, building materials such as concrete or other composite materials.

Benefits:

- **Easy: Disposable measurement cells.**
- **Reliable: Pot-life determination with a non-contact method.**
- **Fast: 6 measurement positions.**