RHEOLASER MASTER

Pot-life determination of 2K-paints

Clean and simple

INTRODUCTION

Commercial resin paints are two-component systems of a solvent-based resin and cross-linker, which is added to cure right before utilization. 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, making its application impossible. The pot's life is usually determined by viscosity measurements. Due to the curing, samples get sticky, render the pot-life determination a "dirty" experiment. This application note shows, how easy and fast pot-life determination is with Rheolaser Master, providing disposable measurement cells and 6 independent measurement positions.

Pot life | 2K Paints | Resin

HOW IT WORKS

Rheolaser Master is based on Diffusing Wave Spectroscopy (DWS), a multiple light scattering technique. Light is backscattered by scatterers in the sample. The microstructure motion inside the sample (droplets, crystallites, etc.), creates an interference pattern (Speckle Image). Variation of this image in time is directly related to the mobility of the scatterers. (Figure 1a). The faster the Speckle Image changes in time, the higher the mobility of the microstructure.

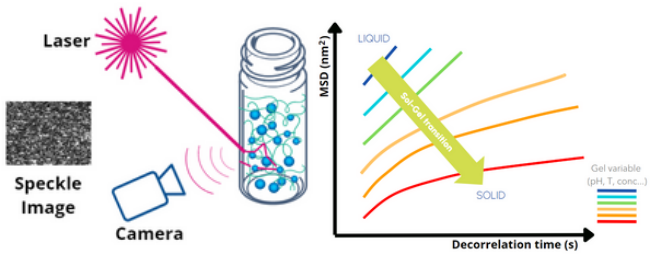

Figure 1. Schematical representation of the measurement set-up.

By mathematical treatment, Mean Square Displacement (MSD) curves are obtained (Figure 1b), which contain the viscoelastic information. Straight lines (blue) indicate a purely viscous behavior of the sample. Curves with a plateau (red) indicate gel-like or solid-like behavior. The macroscopic Viscosity Index (MVI) is the reverse of the slope in a double-linear scale. The higher this index, the higher the viscosity of the sample.

SAMPLES

A commercial paint based on the 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.

RESULTS

Figure 2 shows a schematical representation of how pot-life time is determined by viscosity measurement. It is the cross-over of two fitted straight lines.

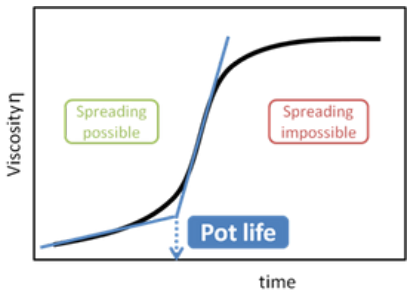

Figure 2: Schematical representation of the pot-life determination.

Figure 3 shows the evolution of the Macroscopic Viscosity Index (MVI) of both mixtures measured with Rheolaser. The higher this index, the higher the MVI. In the beginning (right after mixing with the cross-linker), the MVI of both mixtures does not change significantly. During this time, the paint can be applied easily. Mixture 1 increases significantly at 1h32, whereas the MVI of Mixture 2 does so at 1h50 (Mix 2).

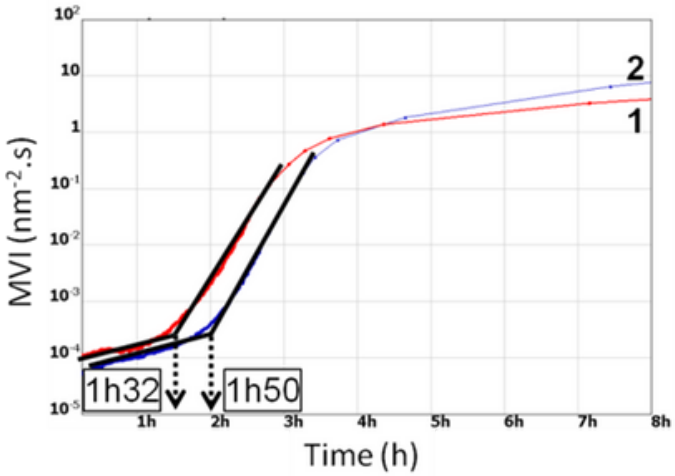

Figure 3: Evolution of MVI as a funciton of time for two mixtures of resin and cross-linker. The black arrows indicate the pot-life

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Table 1 shows the composition of both mixtures and the pot-life time given by the manufacturer, as well as those measured with Rheolaser Master. The measured pot-life time for mixture 1 is in good agreement with that of the manufacturer. Mixture 2 is not proposed by the manufacturer.

Table 1. Composition of mixtures 1 and 2. Theoretical and measured pot-life times.

	Mixture 1	Mixture 2
Resin	75.7%	63.7%
Cross-linker	19.0%	31.8%
Water	5.3%	4.5%
Pot-life (producer)	1h30	N/A*
Pot-life (measured)	1h32	1h50

A main advantage of Rheolaser is the optical measurement technique without physical contact between the instrument and the 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 the sample until full binding of the resin, which simple viscosimeters cannot provide. The higher the Elasticity Index EI is, the higher the elasticity of the sample. One can see that after binding of the resin paint, the Mixture 2 possesses a higher elasticity due to higher cross-linking between the resin molecules as shown in Figure 4.

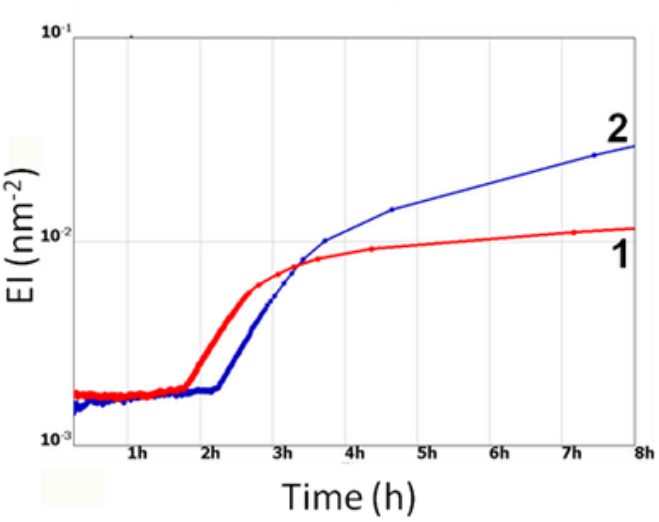

Figure 4. Influence of (a) formulation and (b) temperature on SLB to improve printability.

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 operator time and accelerate product development. In particular, the impact of new hardening retarders can be studied, not only in epoxy resin paints but also in glues, and building materials such as concrete or other composite materials.

CONCLUSION

Rheolaser Master provides a clean and simple way to study the pot life of 2K paints. Reformulation of these systems is necessary due to the use of solvent-free formulation. 6 independent measurement positions combined with disposable measurement cells decrease development time and make development more efficient.

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