STABILITY AND REDISPERSIBILITY OF CERAMIC INK

FORMULATIONS COMPARISON

Context

Printing inks used in ceramics are constituted of inorganic pigments dispersed in a serigraphic liquid. This liquid gives the ink some rheological properties necessary for the printing process (with a screen or a flexographic roll).

Good stability of the ink, at rest or in use, is essential because pigments tend to settle and aggregate. The aggregation can be reversible or not because of chemical interactions between the pigment and the serigraphic liquid. This instability leads to evolutions of the rheological properties of the product, which can make the application difficult or even impossible, and provoke defects in the printing. For a given pigment, it is necessary to study the stability of the ink as a function of the different serigraphic liquids available in the market.

The TURBISCAN instruments enable to study of the stability of formulated inks and compare their stabilities:

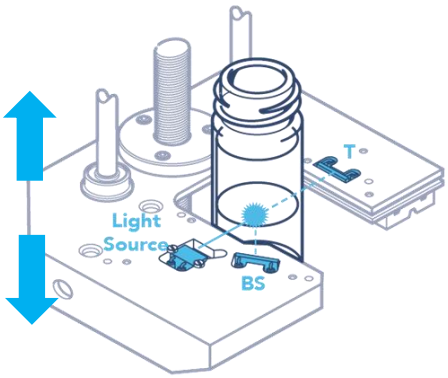
- If the pigment settles quickly, it is not dispersible, the use of the ink is not recommended.
- If the migration rate of the pigment is low but the sediment is not redispersible, the ink as to be used quickly.
- Finally, if the sedimentation is low and the pigment is redispersible, the using time is long enough and the product can be stored for the future.

Reminder of the technique

TURBISCAN technology, based on Static Multiple Light Scattering, consists of sending a light source (880nm) on a sample and acquiring backscattered (BS) and transmitted (T) signals over the whole sample height. By repeating this measurement over time with adapted frequency, the instrument enables monitoring physical stability.

The signal is directly linked to the particle concentration (φ) and size (d) by the Mie theory

knowing the refractive index of continuous (n_f) and dispersed phase (n_p):



BS and T = f(φ, d, np, nf)

Method

Three inks with the same pigment and dispersed in three different serigraphic liquids were analyzed:

Analysis conditions	
Sample number	3
Temperature	20°C
Duration	18 hours

Only the backscattering variations (%, ordinate axis) on the tube height (mm, abscises axis) as a function of time (last curved displayed in red) were retained for the study.

Results

1. Migration profiles and sedimentation kinetics

In Figure 1, a big decrease in the backscattering signal at the top of the sample over time is visible. This is due to a clarification of the product at the top of the product.

This clarification is due to the sedimentation of the pigment in the ink. Therefore, the kinetics of sedimentation for each of the three inks has been calculated (Figure 2). By comparison of the sedimentation rate of the three inks, the sedimentation of the pigment seems less important in sample 2.

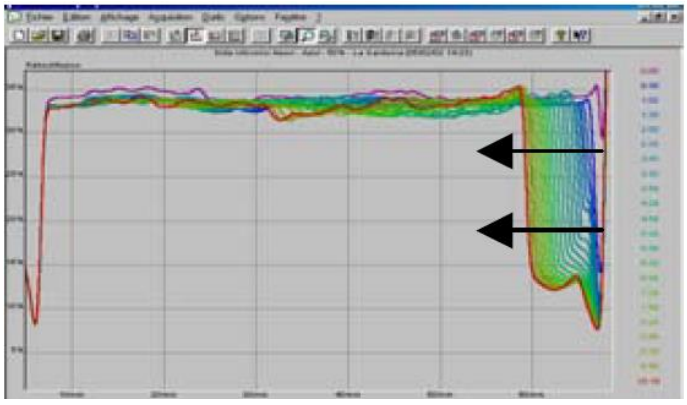


Figure 1. Ink backscattering profile

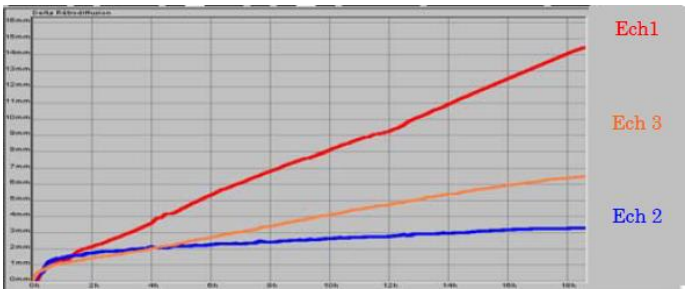


Figure 2. Comparison of sedimentation kinetics between samples

2. Sample stability as a function of ink viscosity

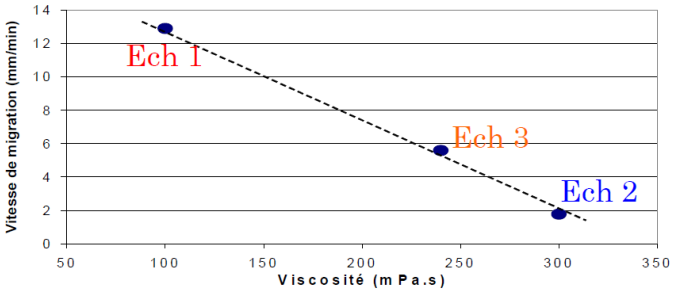


Figure 3. Sedimentation in function of the viscosity

At 10 s^{-1}, there is a link between the ink viscosity and the migration rate of the pigment. The more viscous the ink is, the slower the sedimentation (Figure 3).

3. Study of ink redispersibility

Generally, pigments are of a high density and form a sediment at the bottom of the sample. In this sediment, the pigment can aggregate irreversibly.

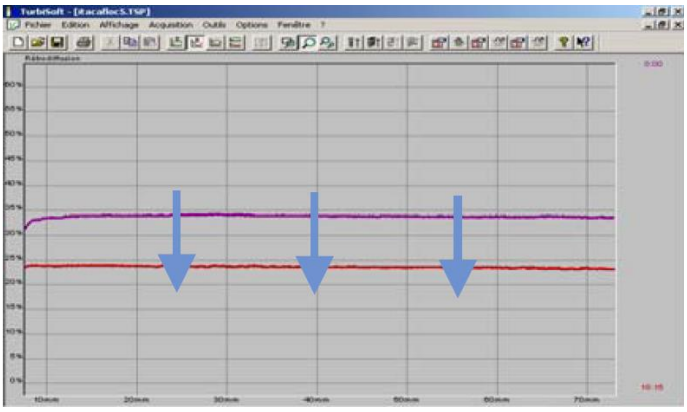


Figure 4. Comparison of the backscattered level after 18 hours

With a simple experiment, we can determine the redispersibility of these pigments in the sediment: we compare the backscattering level at the beginning and at the end of the experiment after shaking the sample.

If the final level is the same as t0: the pigment is redispersible.

If the level is lower at the end of the experiment the pigment is not redispersible. See the example obtained with the sample 1 (Figure 4). The level is lower: the pigment is not redispersible.

Conclusion

TURBISCAN technology based on Static Multiple Light Scattering (SMLS) is the leading technology since 1994 to measure the stability of formulations and dispersions. This Application Note shows a quick and simple method to compare the formulation stability in the function of the serigraphic liquid selected.

The TURBISCAN instruments allow the detection of migration phenomena in a few hours and enable to compare the stability of different formulations. Moreover, we can determine the redispersibility of pigment sediment and see if shaking the ink will redisperse the pigment or not. The same study can be made with all kinds of pigment dispersions (paints, ink jet…).

The world leader in Stability & Dispersibility Analysis