Study of the stability of a ceramic ink

Application
Paint & Ink

Objective
Study the effect of serigraphic liquid on pigment stability

Device
TURBISCAN® Classic

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

A good stability of ink, at rest or in use, is essential because pigments tend to settle and to 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 liquid available in the market.

The Turbiscan Classic enables to study the stability of formulated inks and compare their stabilities :

- If the pigment settles quickly it is not redispersible, 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.

METHOD
We have analysed three inks with the same pigment and dispersed in three different serigraphic liquid :

Samples quantity: 3
Analysed volume: 6 mL
Temperature of analysis: 20°C
Duration of analysis: 18 hours

We analyse only the backscattering variations (%, ordinate axis) on the tube height (mm, abscises axis) as a function of time (last curved displayed in red).

RESULTS

1. Migration profiles and sedimentation kinetics

In the profiles we see a big decrease of the backscattering signal at the top of the sample over time. This is due to a clarification of the product at the top of the product (Figure 1).
This clarification is due to sedimentation of the pigment in the ink. Therefore, we calculate the kinetics of sedimentation for each of the three inks (Figure 2). Comparing the sedimentation rate of the three inks, we can deduce that the sedimentation of the pigment is less important in sample 2.

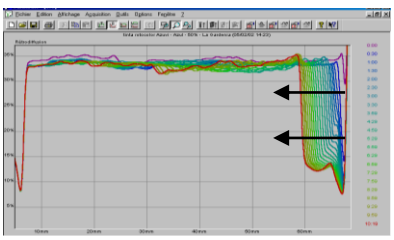

Figure 1. Raw data.

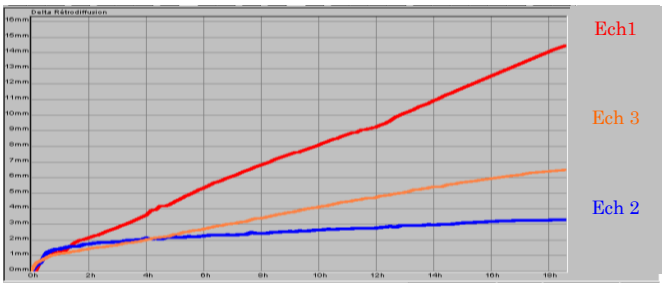

Figure 2. Sedimentation kinetics.

2. Sample stability as a function of ink viscosity :

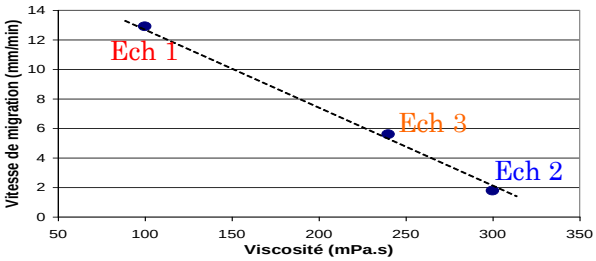

Figure 3. Sedimentation is function of the viscosity.

At $10s^{-1}$ we can see that 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 in an irreversible way.

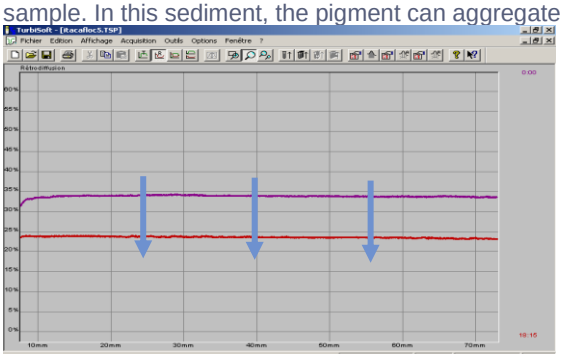

Figure 4: Comparison of the backscattered level after 18 hours

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 than t_0: the pigment is redispersible.
If the level is lower at the end of the experiment the pigment is not redispersible. See example obtained with the sample 1 (Figure 4). The level is lower: the pigment is not redispersible.

SUMMARY

The Turbiscan Classic allows detection of migration phenomena in a few hours and enables 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 kind of pigment dispersions (paints, ink jet…).