RAW MATERIALS

Method to measure the concentration profile during destabilization

Introduction

The study of the concentration profile of a suspension or emulsion is of great interest for various fields like coating, inks, pharmaceutical applications, cosmetic...In fact, those profiles allow the users to assess information regarding their products like the capability to deliver the same quantity of an active ingredient over time (i.e. pharmaceutical application) or to avoid the creation of a highly concentrated sediment in ink industries. Using a calibration curve, the Turbiscan® technology gives access to a concentration profile versus the height of the samples over time.

KEY **BENEFITS**

FAST

NO DILUTION

SENSITIVE

In this note, we propose a method to generate this concentration profile for nano-silver ink.
(Reference: "Particle Inks for Inkjet Printing of Electronic Components", U. Currle, International conference on digital Printing Technologies, 2008, 702-706).

Reminder of the technique

Turbiscan® technology is based on Static Multiple Light Scattering which consists of sending a light source (880 nm) into a sample and acquiring a backscattered (BS) and transmitted (T) signal over the height of a sample. Combining both detectors enables analysis of samples over a wide concentration range.
The signal is directly linked to the particle concentration (φ) according to the Mie theory:

$$\varphi = f(BS, d, n_p, n_f)$$

Concentration profile method

The concentration profile can be displayed on a graph where the weight percentage (wt%) is plotted against the percentage of sample height as shown in Figure 1 for a creaming sample.

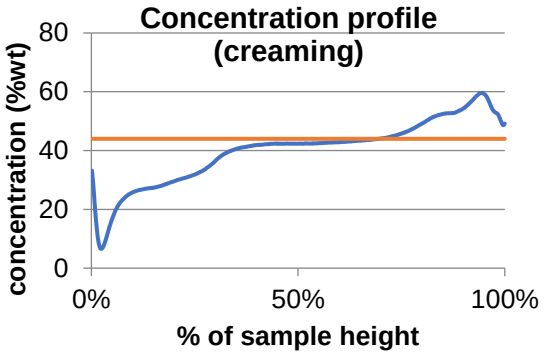


Figure 1: Concentration profile versus sample height

For both case studies, the same protocol was used to generate the concentration profile:
1. Calibration curve: Using known calibration standards, a graph of backscattering intensity versus concentration was generated
2. Turbiscan® measurement: Unknown samples are analyzed using the Turbiscan® technology
3. Concentration profile: Using the calibration curve and the measurement of the unknown sample, the concentration of active ingredient versus the sample height was generated.

Concentration profile calculation for nano-silver ink

The use of nanosized metallic particles allows the formation of the highly conductive patterns to be made using inkjet printing. Due to the high density of the metal particles, sedimentation occurs to be the major challenge.

Calibration curve

The intensity of light in transmission and backscattering was measured for a formulation of glass powder in terpineol with a concentration range from 0.1% to 80% wt of glass powder.

Figure 2 shows Backscattering and Transmission intensity versus the concentration of glass powder in terpinol.

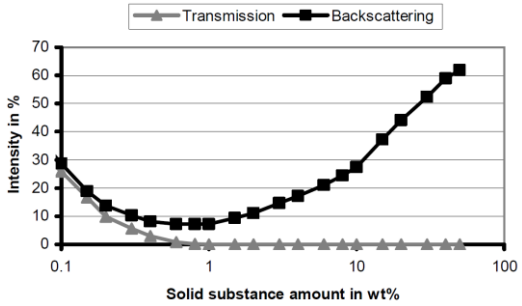
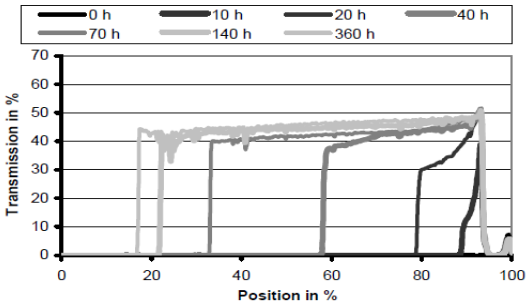


Figure 2: Relation between intensity and concentration for glass in terpineol

Turbiscan Measurement

The sample was analyzed using the Turbiscan® Technology by scanning the sample during a period of 15 days.



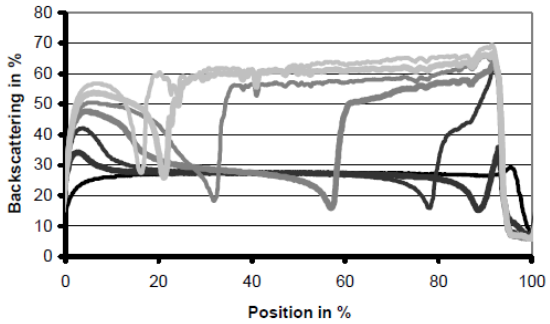


Figure3.Transmission(top) and Backscattering (bottom) signal versus sample height

Concentration profile

Combining the measured signals in Figure 3 and the calibration curve in Figure 2, the concentration profile of this sample is generated in Figure 4.

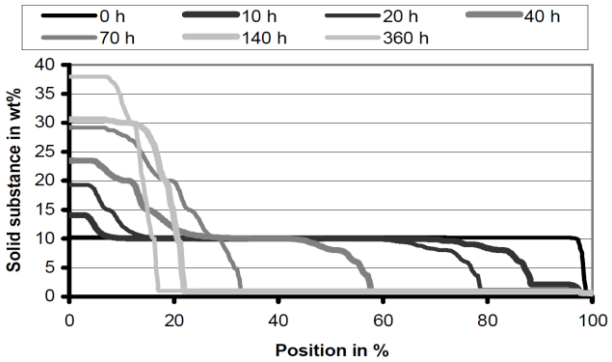


Figure 4. Concentration profile of nanosilver ink over time

CONCLUSION

Turbiscan LAB technology is based on Static Multiple Light Scattering (SMLS), it can monitor the concentration profile of concentrated dispersions over time. As seen in the example presented in this note, the intensity of the light could be converted into the concentration of the dispersion using calibration curve. The advantage of this technique is that the concentration profile of a concentrated emulsion or dispersion can be determined without sample preparation or dilution.