MultiScan MS 20

Stability Analysis of Ink Formulations

dataphysics
Understanding Interfaces

Ink stability is an essential parameter for the fabrication process, printing performance, transportation and storage time and conditions. However, to meet the complex requirements of a good ink, a large number of components like pigments, binders, chelating agents, humectants, wetting- and dispersing agents, biocides, etc., are present in ink formulations. The type and particle size of the components above can be unfavourable for the ink stability. The ink-jet printing technique involves a jetting process in which the inks are ejected from a small orifice which can be clogged if the the ink is not stable. Thus, stabilising agents are commonly used in inks. It is of great interest to study the effect of stabilisers on the ink stability to achieve an optimal performance and reliability of the ink formulation and printing system. The stability study of two ink formulations containig different stabilisers will be presented throughout this application note using the MultiScan 20 (MS 20).

Fig. 1: Ink cartridges on printer.

Keywords: MultiScan 20 (MS 20) ▪ Stability Analysis ▪ Ink Formulation ▪ Ink Stability ▪ Stabiliser ▪ Stabilising Agent

Technique and Method

The MultiScan MS 20 (Fig. 2) from DataPhysics Instruments is the measuring device for the automatic optical stability and aging analysis of liquid dispersions and the comprehensive characterisation of time- and temperature-dependent destabilisation mechanisms. It consists of a base unit and up to six connected ScanTowers with temperature-controlled sample chambers. The ScanTowers of the MS 20 can be individually controlled and operated **at different temperatures (4 °C to 80 °C)**.

With its matching software MSC the MS 20 is an ideal partner for the stability analysis since **even the slightest changes** within dispersions can be detected and evaluated. The MS 20 enables a fast and objective analysis of the dispersion stability as well as conclusions on possible **destabilisation mechanisms**.

Fig. 2: DataPhysics Instruments stability analysis system MultiScan MS 20 with six independent ScanTower.

Experiment

A small vial filled with the desired dispersion is placed in one of the “Scan Towers” of the MS 20. The scanning system is composed of a transmission and backscattering LED along with a detector. This system moves along the vertical side of the vial (z-axis). The obtained transmission and backscattering intensities are represented in an intensity-position diagram. The sample is scanned at regular time intervals. Changes in the detected measuring signal can provide explanations on the stability properties of the sample.

The formulations of ink 1 and ink 2 contained different stabilizers. 25 ml of each ink formulation (ink 1, ink 2) were poured in a transparent glass vial and measured at T = 30 °C every 6 min for 1 d 3 h. The measured zone was between 0 mm (bottom of the glass) and 57 mm (fill level of the vial). Fig. 3 shows the sample vials at the end of the measurement. No change in the sample vials could be observed by the naked eye.

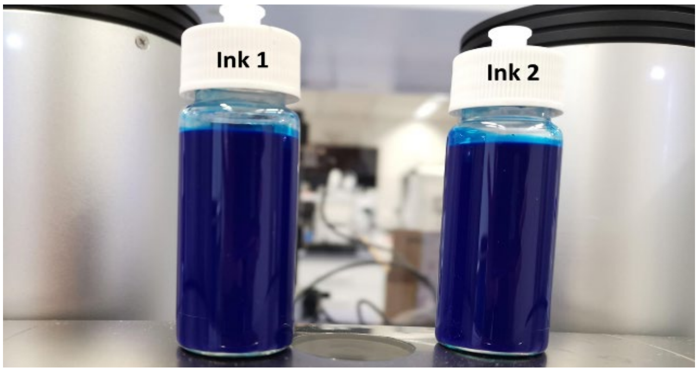

Fig. 3: Ink samples after 1 day and 3 hours measurement time.

Results

As the samples have a significant volume concentration, the transmission signal was too weak and contained very little information throughout the measurement. Therefore the backscattering signal was analysed.

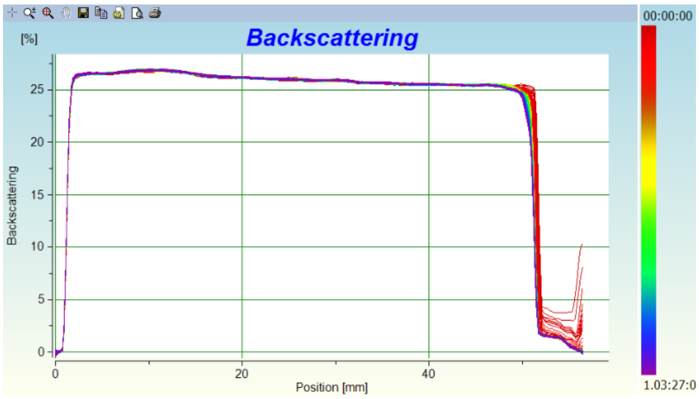

Fig. 4: Backscattering intensity diagram of ink 1.

The two ink samples showed similar change of backscattering intensities over time. Fig. 4 shows the backscattering intensities against the position for ink 1. The colour-coding of the curves indicates the time at which they were recorded, from red (start of the experiment, t = 0 s) to purple (end of experiment, t = 1 d 3 h). Every curve represents one individual measurement. The backscattering diagram shows a clearly time-dependent as well as position-dependent change of the signal, which decreased between 48 mm and 52 mm, indicating a typical sedimentation process. Calculated with the respective function of the MSC software, the change of the migration front can be analysed resulting in an average sedimentation rate.

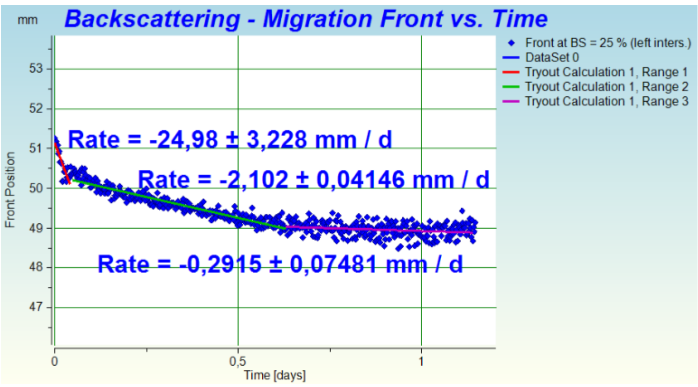

Fig. 5: Change of the migration front (position range 48 – 52 mm) of ink 1 vs. time.

The sedimentation rate analysis of ink 1 in Fig. 5 shows that the observable change in the migration front of ink 1 is very fast in the first hour with a sedimentation rate of 24.98 mm/d, whereas the migration front changes slow down with a change rate of 2.201 mm/d and 0.2915 mm/d afterwards. It can be concluded that ink 1 is quite unstable and most of the paticles sedimented in the first half day.

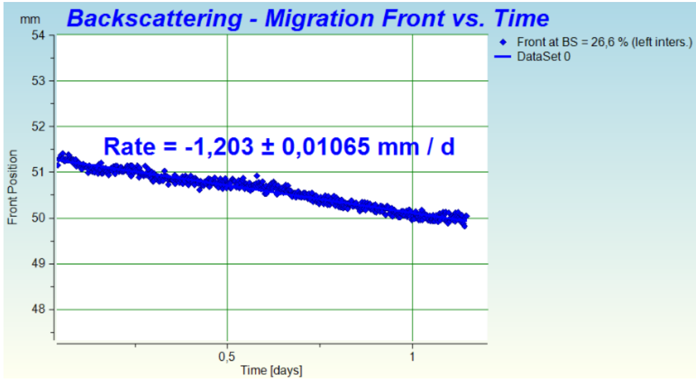

Fig. 6: Change of the migration front (position range 48 – 52 mm) of ink 2 vs. time.

Ink 2 was analysed accordingly, resulting in the sedimentation rate as shown in Fig. 6. Compared to ink 1, ink 2 is a much more stable formulation with a lower sedimentation rate of 1.203 mm/d thoughout the measurement interval.

Thus we can conlcude that the stabiliser used in ink 2 exhibits a much better performance for stabilising the dispersed paticles in the tested inks. This simple and fast measurement can help formulation chemists decide on the right stabiliser based on a quantitative evaluation.

Summary

Using the MS 20 stability analysis system and its corresponding MSC software, an **easy and fast way** to study the stability of ink formulations could be demonstrated. **Changes can be detected readily and reliably** which enables the producer to anticipate and quantify **stability issues** and thus **guarantee time and cost** optimal product development.

DataPhysics Instruments GmbH • Raiffeisenstraße 34 • 70794 Filderstadt, Germany
phone +49 (0)711 770556-0 • fax +49 (0)711 770556-99
sales@dataphysics-instruments.com • www.dataphysics-instruments.com