MultiScan MS 20

Stability Analysis of Seasoning Oil Mixtures with DataPhysics Instruments MS 20

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Understanding Interfaces

Seasoning oil (Fig. 1) is popular worldwide and plays an essential role in cooking, due to its enhancement of flavour in various foods. These oils are often dispersions with multiple components for which a homogeneous distribution needs to be assured in order to accieve a good taste and cooking quality. To study the stability of seasoning oil formulations and modify them towards a better processability and performace is therefore of high importnace. With the MultiScan 20 (MS 20) (Fig. 2) dispersion stability analysis system form DataPhysics Instruments stability changes can be detected and evalauted in a quantitative way much faster than any traditional shelflife test would permit. The stability study of three seasoning oil formulations will be presented throughout this application note .



Fig. 1: One example of seasoning oil

Keywords: MultiScan 20 (MS 20) ▪ Stability Analysis ▪ Seasoning Oil ▪ Food Product

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 (-10 °C to 80 °C).

With its matching software MSC, 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 Scan Towers.

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 intensity is represented in an intensity-position diagram. The sample was scanned at regular time intervals. Changes in the detected measuring signal can provide explanations on the stability properties of the sample.

Around 20 ml of each seasoning oil formulation (seasoning oil 1, seasoning oil 2, seasoning oil 3) were poured in a transparent glass vial and measured at T = 40 °C every 5 s for 2 hours 45 minutes. The measured zone is between 0 mm (bottom of the via) and 57 mm (upper level of the vial). Fig. 3 shows the samples’ vials at the end of the measurement.

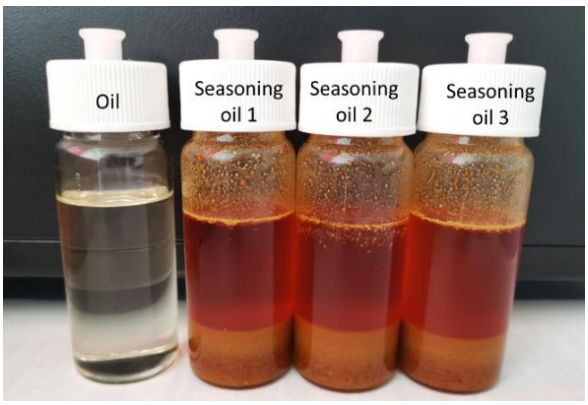


Fig. 3: Seasoning oil samples show an inhomogeneous particle distribution after 2 hours 50 minutes measurement time.

Results

The three samples showed similar change of backscattering intensities over time. Fig. 4 shows the plot of the relative transmission & backscattering intensities against the position for seasoning oil 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 = 2 hours 45 minutes). Every curve represents one individual measurement. The transmission intensity increases over time in the top and middle layer. And the backscattering diagram also shows a clearly time-dependent as well as position-dependent change of the signal, which increased between 4 mm and 15 mm while decreasing between 18 mm and 40 mm, indicating a typical sedimentation process.

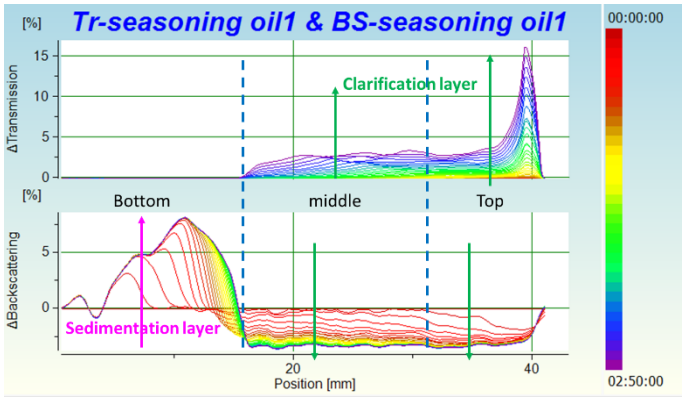


Fig. 4: Backscattering intensity diagram of seasoning oil 1

Fig. 4 shows a strong increase in backscattering intensity, leading to the formation of a peak between 4 and 15.5 mm, corresponding to the sedimentation layer, which can be evaluated using the Peak Width method. As shown in Fig. 5, the three seasoning oils are highly unstable, with most particles migrating to the bottom layer within the first 1.5 hours. By the end of the measurement, the sedimentation layer thicknesses for Seasoning 1, 2, and 3 are approximately 10.8 mm, 11.6 mm, and 11.6 mm, respectively.

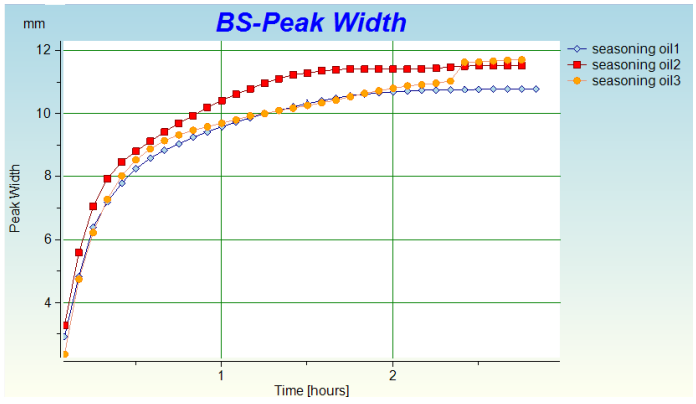


Fig. 5: Changes in peak width of samples over time

Thanks to the MSI function, the global sample stability can be ranked with a single number. The higher the MSI value is, the less stable the sample is. It is important to note that the MSI accounts for all potential destabilising factors present within a sample. Furthermore, the MSI scale, which correlates with the visual variation of the sample, has been provided. The bars are coloured in accordance with the scale presented below the graph, which utilises a colour code and a grade to indicate the level of destabilisation.

Fig. 6 shows that all three samples exhibit a similar and rapid increase in MSI during the first 1.5 hours, indicating fast variations. After this period, most particles have already sedimented, and only smaller particles continue to migrate, which explains the continued MSI increase observed for seasoning oils 1 and 2. Fig. 7 further shows that the MSI values for all three samples at the end of the measurment remain well between 3 and 10, confirming that all samples undergo significant and clearly visible changes. This is consistent with the oberservations in Fig. 3.

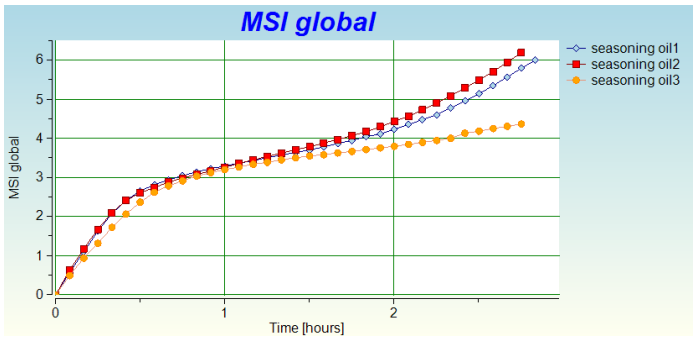


Fig. 6: MSI global vs. time for samples

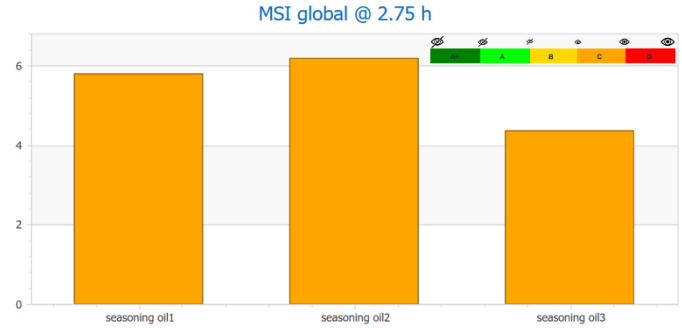


Fig. 7: MSI global values of samples at the end measurement in histogram

Summary

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

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