MultiScan MS 20

Evaluation of Beer Foam Stability

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Understanding Interfaces

Foam stability is an important parameter of a beer's quality. A stable and rich foam can enhance the subtle flavour and mouthfeel of beer. To provide beers with a stable foam, extensive research has been done on chemical compounds like proteins. Added to a beer they can improve the stability of the foam. Thus, it is of great significance to provide an ***easy*** *and* ***fast technique*** *for the evaluation of foam stability to ease the research and development of such formulations. With the* ***MultiScan 20 (MS 20)*** *(Fig. 2) dispersion stability analysis system from DataPhysics Instruments stability changes can be detected and evaluated in a* ***quantitative way much faster*** *than any traditional shelflife test would permit. The foam stability study of two types of beer will be presented throughout this application note.*

Fig. 1: Various types of beer and foam.

Keywords: MultiScan 20 (MS 20) ▪ Stability Analysis ▪ Beer Foam ▪ Foam Evaluation

Technique and Method

The MultiScan MS 20 (Fig. 2) from DataPhysics Instruments is the measuring device for an 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

10 ml of each type of beer (light beer, pils beer) were carefully poured in a transparent glass vial, shaken to create a foam, and immediately measured every 13 s for 10 min. The measured zone is between 0 mm (bottom of the glass) and 57 mm (fill level of the vial). Fig. 3 shows the sample vials at the beginning and end of the measurement.

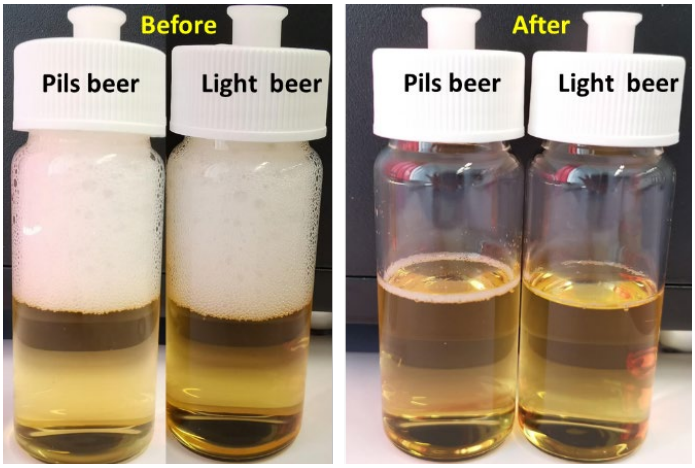

Fig. 3: Two types of beer before and after measurement.

Results

Since the transmission signal showed a significant change during the measurement period the signal was further analysed to study the stability of the beer foam.

The two samples showed similar change of transmission intensities over time. Fig. 4 shows the relative transmission intensities against the position for light beer. 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 = 10 min 45 s). Every curve represents one individual measurement. The transmission diagram shows a clearly time-dependent as well as position-dependent change of the signal, which increases between 25 mm and 32 mm as well as between 33 mm and 56 mm, indicating the foam area above 33 mm. The area between 25 mm and 32 mm is a drainage phase, where liquid is released as the foam collapses.

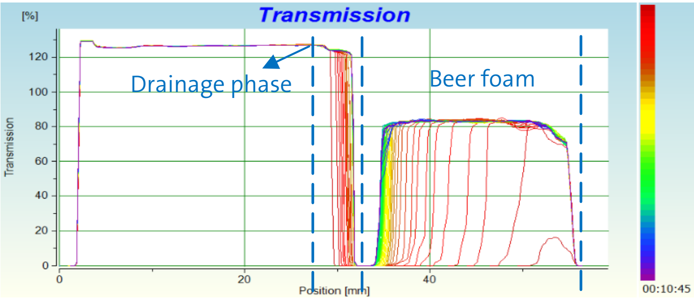

Fig. 4: Transmission intensity diagram of light beer.

Drainage phase

In order to better understand the kinetics of the liquid drainage phase, the rate and thickness of the liquid drainage were calculated. Fig. 5 shows the liquid drainage rate and thickness for pils beer are larger than for light beer, indicating that the foam formed in pils beer is less stable than the one in light beer.

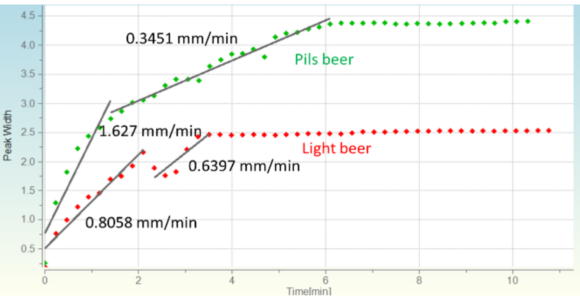

Fig. 5: Kinetics of liquid drainage.

Beer foam phase

As the collapse of a foam is comparable to a semdimentation process, the transmission intensities increased inside the foam zone between 33 mm and 54 mm over time. The change of the migration front is being analysed resulting in an average migration rate of 9.34 mm/min in around 3 min (Fig. 6). After the initial migration the rate becomes much smaller, indicating that most of the foam of light beer has collapsed in the first 3 minutes.

Accordingly, the second sample was analyzed leading to the change rates in Fig. 7. Notably, the changes in transmission intensity of pils beer foam started from 1 min 56s, which means that the foam is very stable with little change in the first 2 minutes. However, pils beer foam was found to be

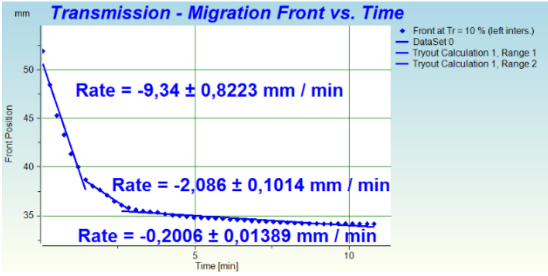

Fig. 6: Migration front vs. time (position 32 mm – 54 mm) of light beer.

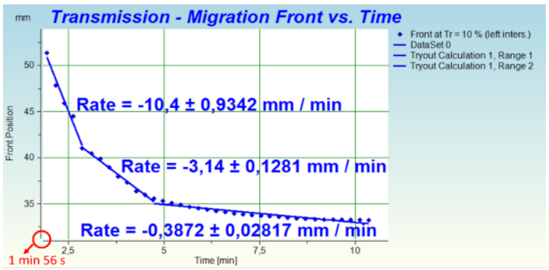

Fig. 7: Migration front vs. time (position 32 mm – 54 mm) of pils beer.

very unstable between 2 min and 3 min with a change rate of 10.4 mm/min. After this fast destabilisation the foam continues to drain at a slower rate.

Global stability

Using the **stabilty index (SI)** function provided by the MSC software, an overall stablity can be evaluate and represented by a single value (see Fig. 8). In consitency with the previous results, the stability index analysis supports that freshly opened light beer destabilises much faster in the first minutes after beeing filled into a test vial while the pils beer is more stable at least in the first 4 min. The final SI in the pils beer is however higher which correlates well to the thicker drainage layer as illustrated in Fig. 5.

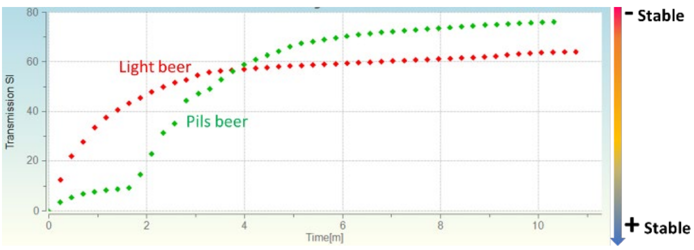

Fig. 8: Transmission stability index of pils and light beer vs. time.

Summary

Using the MS 20 stability analysis system and its corresponding MSC software, an **easy and fast way** to study the stability of beer foam could be demonstrated. **Changes can be detected sensitively, easily, fast 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