C15 - Charge titration – a fast alternative to the forciertest

Introduction

The stability of filtered beer is a main attribute for the brewing industry. To analyze the stability of beer the physical-chemical properties are important. One of the quality problems is the early haze of filtered beers. To analyze this haze the very long forciertest must be done. If you look at beer as a colloidal dispersion, the colloid-chemical methods like Dynamic Light Scattering (DLS) or the streaming potential in assembly with a charge titration can be used.[1,2]

Streaming potential and charge titration

Whether, a flat interface, a particle or a molecule surface for all applies the same rules.

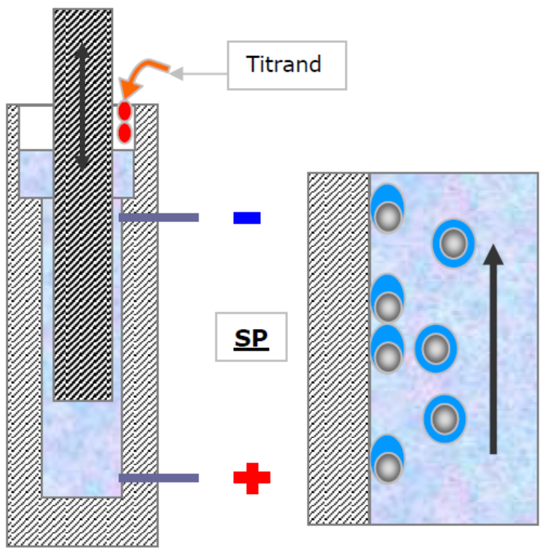

Figure 1: Basic setup of a streaming potential monitor. The ion cloud around the particles, which adhere to the porous walls of the PTFE sample container and pistons, will be changed. The so-called streaming potential is taken from the electrodes.

The ions of the charge cloud (double layer) can be shared by an electrified or by mechanical work (flow). The potential which is generated at the shear plane can with StabiSizer® be measured. There the sample will be in a type of capillary in motion and the charge cloud will be directed to the flow. There from the streaming potential (zeta potential) will be measured.

At the charge titration with polyelectrolytes, the charge of the particles is neutralized and the total charge can be measured. The zeta potential or streaming potential is a property of the dispersion stability. That means that much higher or lower the potential or the titrated amount of charge is such more or less stable will be the dispersion. **Figure 1** shows the principal setup of the Stabino®.

Measurement

To determine the hazing and colloidal stability of filtered beers, charge titration were carried out with the calibrated polyelectrolyte 0,001 N P-DADMAC (poly-diallyldimethylammonium chloride). To get a comparison to the forciertest the titrations will be done at every warm day. The haze was measured at 90 degree angle in EBC formazin units.[3, 4]

Results

In **Figure 2A** is shown the titration curve from the measured streaming (ψ) as shown in **Figure 2B** approximated by a mathematical function. By calculating the first and second derivative of this function a local minimum from -284 mV and 0.43 mL can be calculated.[3]

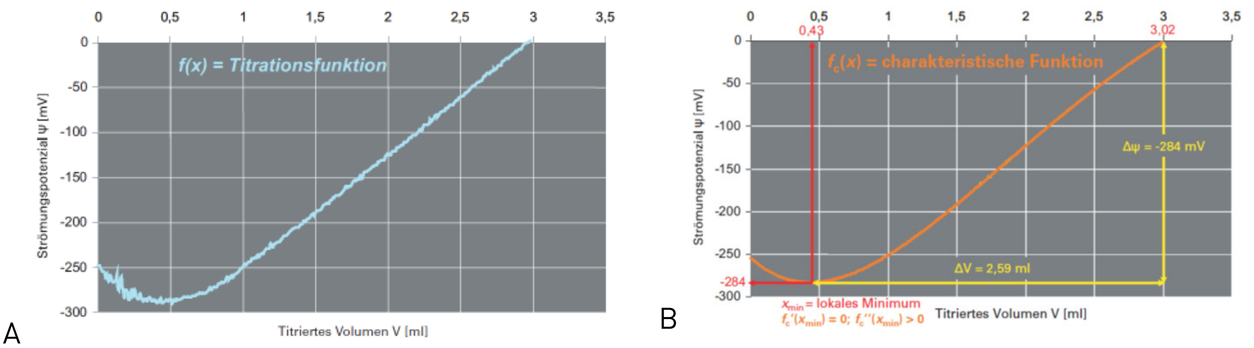

Figure 2: A) titration of filtered beer **B)** Function of the titration curve with a local minimum an a zero point at 3.03 mL of 0.001 N P-DADMAC (taken from:[3])

As described in the implementation a forciertest parallel to the streaming potential charge titration of every warm day were done. **Figure 3** shows the titration curves from every warm day. [3]

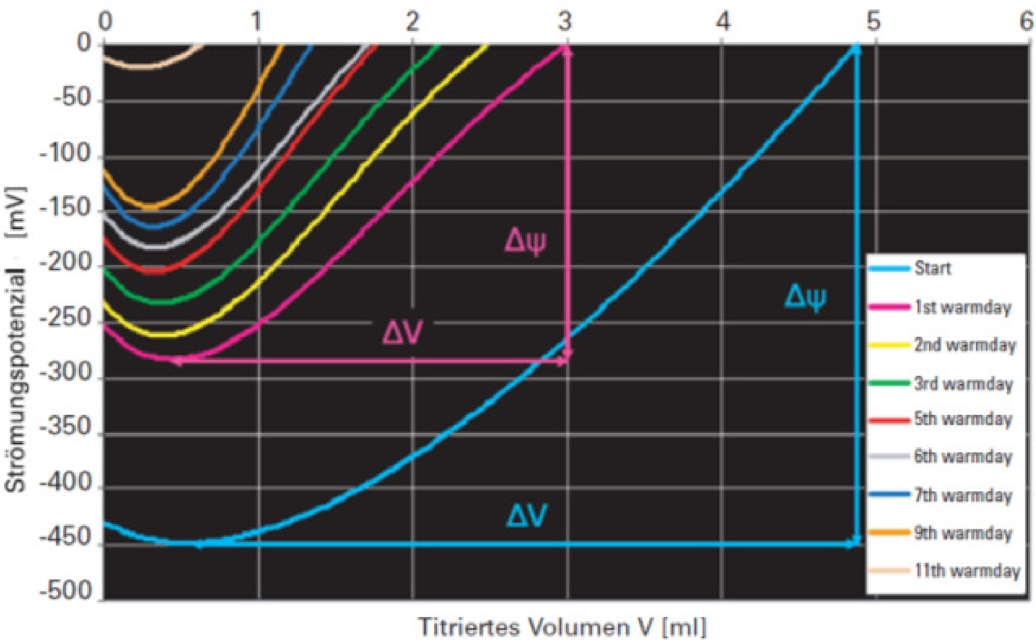

Figure 3: Titration curves of charge titration of every warm day. (taken from:[3])

The measurement show the typical titration curves as the fresh beer sample. By calculating Δψ and ΔV for each titration curve a significantly decreased from the streaming potential and the volume of P-DADMAC were obtained. For better comparison **Figure 4** shows the hazing curve of filtered beer. Here is clearly seen, especially in the first interval of the hazing curve, that there were only minor changes at the curve. [3]

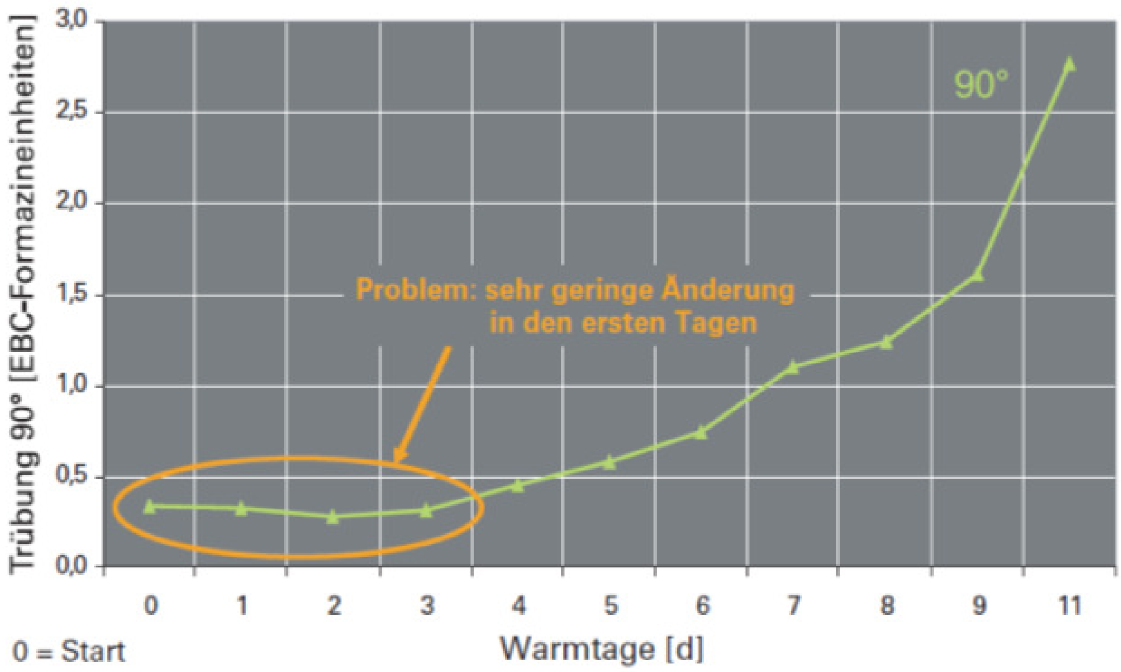

Figure 4: Hazing curve of filtered beer dependent to warm days under 90 degree. (taken from:[3])

Figure 5A shows the titrated difference volume ΔV and the hazing dependent to the time. In this graphs it is clearly seen, that the biggest change of the volume is at the beginning of the measurement. This is a clear benefit to the forciertest.[3]

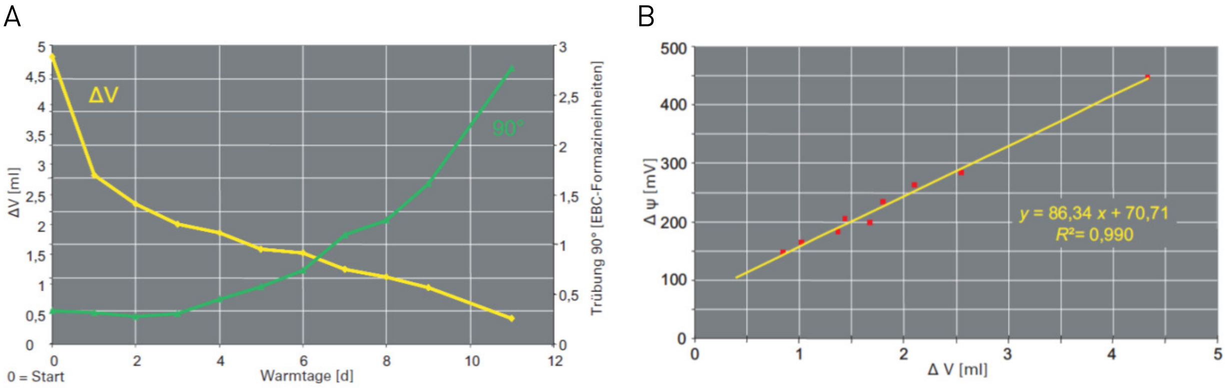

Figure 5: A) Decrease of ΔV and increase of hazing dependent to warm days. **B)** Relationship of ΔV and Δψ dependent to warm days. (taken from:[3])

Substituting the calculated differences in the ratio to each warm day a linear relationship with $R^2 = 0.990$. **Figure 5B** shows the relationship graphically.[3]

The charge titration method produce in one single measurement assess of the stability of filtered beer.

Summary

The charge titration, in contrast to the forciertest gives very quickly information to the stability of beer. A single measurement (5-10 min) may be still assessed prior stability before storage. Furthermore, there are other interesting applications of the streaming potential and charge titration. These applications were the predictability of gushing and the rapid determination of nitrogen compounds during the wort boiling.

Literature

[1] TITZE, J., CHRISTIAN, M. 2010: *Combined Particle Analysis – Eine neuartige Methode in der Brau- und Getränkeanalytik.* Getränkeindustrie **64** Nr. 10, S. 52-55

[2] TITZE, J., ILBERG, V., JACOB, F., PARLAR, H., 2008: *Einsatzmöglichkeiten der Ladungstitrationsmethode zur Beurteilung der chemisch-physikalischen Bierstabilität, Teil 1.* Brauwelt **148**, Nr. 18/19, S. 506-509.

[3] TITZE, J., ILBERG, V., JACOB, F., PARLAR, H., 2008: *Einsatzmöglichkeiten der Ladungstitrationsmethode zur Beurteilung der chemisch-physikalischen Bierstabilität, Teil 2.* Brauwelt **148**, Nr. 23, S. 624-527.

[4] TITZE, J., CHRISTIAN, M., ILBERG, V., JACOB, F., 2010: *Particle analysis – A combined method to analyze the colloidal characteristics of particles*. BrewingScience **63**, Nr. 5/6, S. 62-71.

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