



**Beer force-ageing tests for precise prediction of the shelf life of beer are commonplace in every brewery. Herrenhausen private brewery performs these tests using an opacimeter to measure scattered light and a Memmert cooled incubator ICP110.**

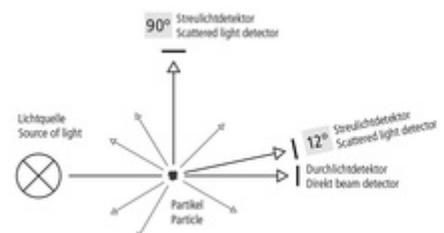
Before refrigeration technology was invented in the second half of the 19th century, brewing beer in the summer was illegal in Germany. This was because, on the one hand, fermentation requires temperatures of between 4 and 9 °C and, on the other hand, beer spoils quickly if it is not kept chilled. Ensuring that neither the appearance nor the taste of beer changes before its best-before date is still one of the greatest challenges that brewers face.

**Opacimeter measures particles down to a size of 0.001 µm**

The first impression a beer makes depends on its taste, freshness, clarity, formation of head, and aromas. When undesirable “off-flavours” like blackcurrant, butter or



Memmert cooled incubator ICP for beer-force-ageing test



cardboard creep in and impurities cause turbidity, producing haze and ruining the clarity, at the latest, even the most inexperienced beer drinker knows that their beer isn't fresh any more.

Turbidity measurement according to the scattered light method

Experts examine how beer ages on the basis of three factors and characteristics: microbiological, physico-chemical, and flavour stability. A beer's chemical and physical stability is defined by the speed and intensity of hazing, i.e. the formation of protein particles, in particular. Just like many other breweries, the private brewery in Herrenhausen measures even the tiniest particles, down to 0.001  $\mu\text{m}$  in size, using scattered light. Scattered light detectors in an opacimeter, also known as a turbidimeter or turbidity meter, determine the amount of light lost when a beam of light at an angle of  $90^\circ$  is diffracted by the particles, while simultaneously measuring the intensity of the scattered light.

## **Proteins and polyphenols are turbidity formers**

The German beer purity law states that only water, malted barley, hops and yeast may be used in the brewing of beer. But at the end of the fermentation process, during which the malt turns into mellow liquid gold, beer is a complex mixture of over 450 constituents, which can react with each other in the course of a beer's life and may cause flocculation.

Turbidity, and thus haze and cloudiness, is primarily caused by proteins. They are "aided and abetted" in the process of clouding the beer by polysaccharides and small quantities of minerals and metals as well as polyphenols, bioactive secondary substances originating from malt and hops, which influence the taste and colour of food.

## **The beer force-ageing test in practice**

Accelerated ageing, also referred to as beer force-ageing or the beer forcing test, is a well-established method that is used to simulate normal storage, lasting several months, in the course of a few days, by increasing the storage temperature, is used to predict the shelf life of beer. The main factors that influence the stability of beer are temperature and oxygen ingress during production and storage as well as UV light, with elevated temperatures

accelerating the oxidation processes in beer the most. In the most common beer forcing test according to MEBAK® beer bottles are exposed to a temperature of 40 - 60 °C during a warm phase, followed by 0 °C during a cold phase alternately for 24 hours at a time. Due to the reduced solubility of the turbidity formers at temperatures below 0 °C, beer develops a temporary chill haze which reverts on warming. The hazing during the accelerated ageing process provides a kind of blueprint for the irreversible, permanent haze of old beer. The turbidity is measured at the end of each of the cold phases. If a certain degree of difference in turbidity (expressed in EBC units), relative to the initial amount of turbidity, is reached, the brewer can calculate the shelf life of the beer using a formula based on the required number of warm days (warm phase + cold phase). As a rule of thumb, one warm day corresponds to one month of shelf life.

## **Temperature control of beer in a Memmert cooled incubator**

After consulting one of Memmert's trading partners, Omnilab, the Herrenhausen private brewery decided to use a Memmert cooled incubator ICP to control the temperature of the beer samples, instead of a water bath. Although heat transfer is slower in air than in water, studies and practical tests have shown that for the beer forcing test it is the temperature differences, rather than the duration of the heat transfer, that is critical, according to laboratory manager Lars Sauer, who explains the advantages of a cooled incubator as follows: "In a water bath there is a risk of bottles bursting during the heating phase. Not only is this dangerous, it also means additional cleaning. Also, it allows us to remove the bottles from the cooled incubator and put them into the opacimeter dry after the cold phase." Other decisive criteria were the display and documentation of the temperature profiles, the ability to export log files from the device directly to a USB stick, as well as simple programming of individual forcing tests. In addition to this, the quality manager at the Herrenhausen private brewery also appreciates the safety aspects. It is possible to set individual alarm values for temperature deviations, it shuts down automatically at 70 °C

## **Incubation of beer-spoiling bacteria**

The Schönram brewery examines the microbiological safety of its beer using a Memmert incubator and a Memmert hot air steriliser.

[more information](#)

and, last but not least, you can programme the incubator to maximize the fan speed automatically during the heating and cooling phases to minimise the formation of condensation.

This article is based primarily on the information provided by the Herrenhausen private brewery. AtmoSAFE would like to thank the Head of Quality Assurance, Lars Sauer, for his kind support.

#### Overview of the main topics

- Beer brewing, quality assurance
- Beer force-ageing test, beer forcing test, accelerated ageing
- MEBAK
- Shelf life of beer
- Polyphenols, protein in beer
- Opacimeter, turbidimeter, turbidity meter, scattered light measurement, turbidity measurement
- Herrenhausen private brewery
- Memmert cooled incubator

#### Laboratory equipment for incubation

[Incubator I](#)

[Cooled incubator ICP](#)

[Peltier-cooled incubator IPP](#)

[CO<sub>2</sub> incubator ICO](#)

[CO<sub>2</sub> incubator INCOmed](#)

[Cooled storage incubator IPS](#)

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