Determination of alcohol content in Hard Seltzers

Relevant for: Manufacturers of Hard Seltzer, Taxation offices

Hard seltzer, a low-calorie and low-carbohydrate alcoholic drink, currently represents one of the trendiest alternatives in the beverage industry. In order to ensure that the alcohol content is correctly deducted from the tax, an accurate measurement is required. This document informs you about proven instruments that are capable of meeting this challenge.

1 Legal requirements

Since the alcohol content of hard seltzers is always above 0.5 % v/v, the product is considered as an alcoholic beverage and therefore subject to different laws and regulations. This makes an accurate alcohol and extract determination necessary.

Hard seltzer producers need to be compliant to national authorities before sending their products to market. It is of utmost importance to avoid false label declarations with subsequent heavy fines.

2 Alcohol measurement in Hard Seltzers

There is a choice of different methods to determine the ethanol content in beverages such as hard seltzers. Official acknowledged reference methods are represented either by a head space gas chromatography or classic distillation. Such methods are time consuming and require skilled personnel. The aim of this study was to investigate whether other analytical methods are equally suitable for a reliable measurement of the ethanol content in hard seltzers.

For this purpose, a total of 16 different hard seltzer samples from various producers in several different countries were analyzed. The verification test was performed using the following three methods:

- Distillation followed by density measurement,
- Beer Analyzing System
- PBA 5001 Beer

2.1 Sample preparation

Samples which have been determined by distillation or by the Beer Analyzing System have been degassed first. To avoid possible influences of variations on the alcohol results caused by different batch productions, two bottles of each of the 16 hard seltzers were mixed together and homogenized. On PBA 5001 Beer, in contrast, the samples were filled directly from the container. In this way, the automatic CO_2 correction which is required for correct density and alcohol readings could be tested.

3 Comparative test of analytical methods

3.1 Distillation

The distillation was performed according to the TTB proofing regulations using two Erlenmeyer flasks with attached distilling column, condenser and adapter tip. The distillate was collected in two 100 mL volumetric flasks which were placed in an ice bath. The density of the distillate was then analyzed using a DMA 4501 density meter. The alcohol content (in % v/v) was calculated according to the Ethanol AOAC Association of Official Agricultural Chemists 60 °F.

Tip: According to TTB's procedure (Gauging Manual, 27 CFR Part 30 and https://www.ttb.gov/distilled-spirits/proofing-tutorial), the sample is not neutralized prior to distillation.

3.2 Beer Analyzing System

The Anton Paar Beer Analyzing System (figure 1) is a combination of a DMA 4501 density meter, Alcolyzer 3001 and a Xsample 520 sample changer. The degassed and unfiltered samples were directly placed into the 24-position magazine and measured without any other sample pre-treatments. The previously defined sample list allowed a fully automatic measuring routine without any user interactions. The obtained measuring results were automatically stored in the system and used for the comparison in chapter 4.

Figure 1: Beer Analyzing System

3.3 PBA 5001 Beer, the fastest way

The **P**ackaged **B**everage **A**nalyzer for Beer (PBA 5001 Beer) consists of a DMA 4501, Alcolyzer 3001, CarboQC ME and a PFD in its minimum configuration. The 16 different hard seltzer samples were packed partly in cans and partly in glass bottles. However, the packaging type was not a problem, because the **P**iercing- and **F**illing **D**evice (PFD) is able to handle all typical beverage containers such as cans, glass and PET bottles. Due to the reason that the system is operated at a relative pressure of 6 ±0.5 bar (87 ±7 psi), it allowed the measurement directly out of each beverage container without any sample preparations. The applied overpressure keeps the CO_2 in the liquid phase and thus avoids bubbles that could lead to subsequent filling errors.

Figure 2: PBA 5001 Beer

Tip: For samples that are colder than 15 °C (59 °F), a sample conditioner between DMA 4501 and Alcolyzer 3001 ensures sample pre-heating in real time, allows quicker measurement results and avoids condensation on the instruments' measuring cells.

4 Results and discussion

The measuring results obtained by the different methods are summarized in **Table 1**. A graphical overview is shown in Figure 3. The ethanol content of all analyzed samples ranged widely, from 2,8 %v/v up to 6,9 %v/v. As it can be seen, the ethanol readings of all three methods are very close to each other and the minor deviation is within a few hundredths.

Table 1: Obtained ethanol results of different methods

Sample	EtOH [% v/v] (by means of distillation and density measurement)	*EtOH [% v/v] (with PBA 5001 Beer)*	*EtOH [% v/v] (with Beer Analyzing System)*
Sample 1	4,99	4,98	4,97
Sample 2	5,89	5,97	5,96
Sample 3	4,49	4,51	4,5
Sample 4	4,89	4,91	4,92
Sample 5	6,92	6,94	6,94
Sample 6	4,83	4,82	4,79
Sample 7	4,98	4,93	4,92
Sample 8	4,60	4,57	4,58
Sample 9	4,58	4,64	4,61
Sample 10	4,72	4,76	4,75
Sample 11	2,84	2,79	2,77
Sample 12	2,81	2,77	2,75
Sample 13	4,97	4,99	5,00
Sample 14	4,71	4,79	4,71
Sample 15	4,89	4,94	4,86
Sample 16	5,08	5,14	5,06

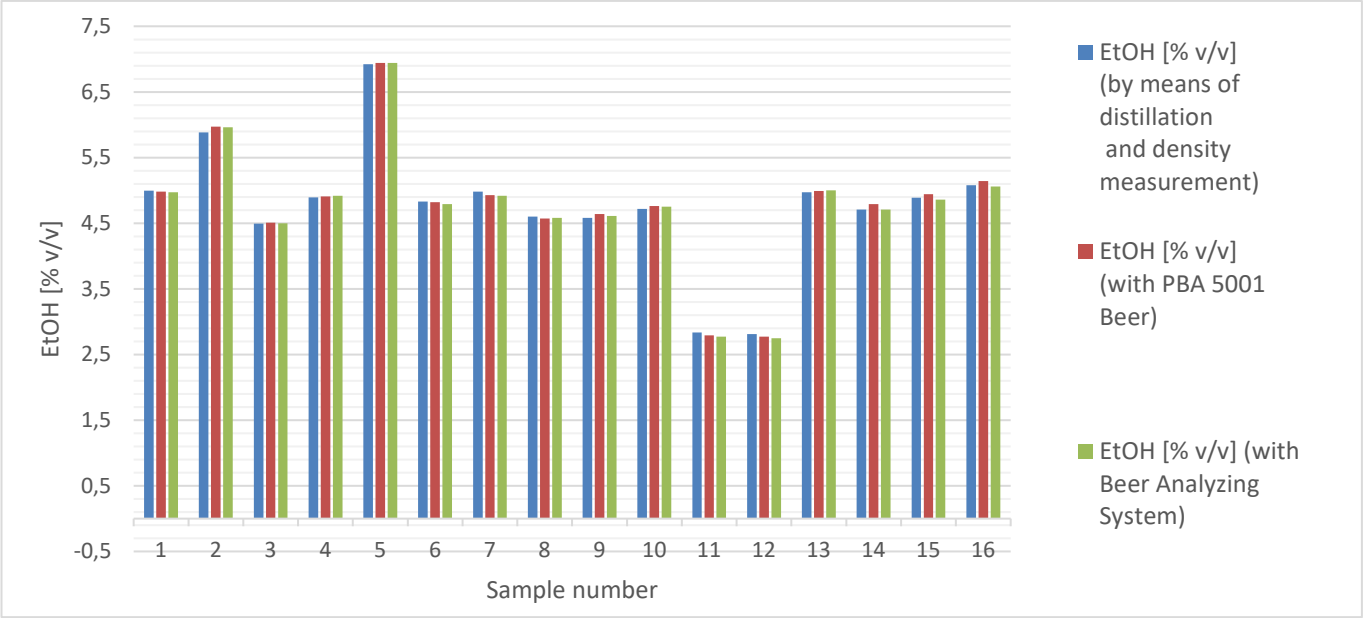

Figure 3: Obtained measuring results based on three different methods

The Beer Analyzing system as well as the PBA 5001 Beer determine the ethanol content based on an optical principle. For that reason, highly turbid samples have to be filtered prior to analysis. Also, samples with pulp or solid particles have to be filtered before being investigated with a Beer Analyzing System and a PBA 5001 Beer (Packaged Beverage Analyzer for Beer). As it is typical for Hard Seltzers, all samples analyzed were clear and free of pulp.

5 Alcohol Measurement directly in the production line

For over 30 years, inline alcohol and extract content determination has been used in the process using a density and sound velocity measurement. Over the years, the measurement has been further improved so that even the very low alcohol content from so called non-alcoholic beers can be determined.

Samples, analyzed in the laboratory, were also measured with the inline beverage analyzer “Beer Monitor” to prove that the Anton Paar inline solution is capable to determine the alcohol content during production and before filling.

The Anton Paar **Beer Monitor** is your inline solution for highly accurate and real-time measurement during Hard Seltzer production.

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Figure 4: Beer Monitor

6 Conclusion

The results indicate that all three laboratory methods as well as the inline solution are suitable for alcohol determination of hard seltzers.

Comparison of three analysis methods showed that Anton Paar Beer Analyzing Systems and PBA 5001 Beer systems provide a fast and reliable way of alcohol determination on hard seltzer samples. The pressurized as well as the non-pressurized system allow the simultaneous determination of other important parameters in the sample such as pH or extract.

In total the analysis of up to 7 quality parameters within 4 minutes in one measuring cycle is possible with **PBA 5001 Beer.** Thus, Anton Paar offers a method which is much faster and more convenient for the operator.