Refractometer – Brix measurement in the juice and beverage industry

Introduction
In beverage industry practice, refractometers are used to measure precise concentrations. Refractometers allow precise definition of the total extract and it is given in °Brix.

Background
The measurement principle is based on the refraction of light (Latin fractus = broken) that occurs due to the type and concentration of the dissolved substances. Therefore, a refractometer indirectly measures the density of liquids. The measurement unit °Brix is named after Adolf F. Brix, a 19th-century scientist. According to this, 1 °Brix corresponds to the refraction index of a 1 % sucrose solution in water.

1 °Brix ≈ 1.3345 nD ≈ 1.0039 SG20/20

However, fruit juices contain other sugars besides sucrose, acids such as ascorbic acid or citric acid, and minerals. Additional substances such as vitamins, iron (II) gluconate, calcium compounds and pectins, used to give juices the desired viscosity, also influence the refraction index.

Because fruit acids have a significantly lower refraction index than sucrose, their concentration is often measured titrimetrically (by titration) and the °Brix value corrected using tables. In commercial trade, the measurement is therefore also described as follows:
°Brix ref. = uncorrected measurement result
°Brix corr. = measurement result after correction for acids

Which devices should be used?
Digital table refractometers from the series DR6000-T are highly precise and available in two levels of precision (DR6000-T: 0.1°Brix and DR6200-T: 0.01°Brix). They are compact, very easy to use, and almost completely maintenance-free.

Advantages
• The instruments in the DR6000-T series are equipped with their own solid state thermostat, i.e. the temperature of hot or cold samples is automatically controlled to 20 °C, for example.
• The conversion of the refraction index to °Brix is saved in the device. If so desired, you can read both scales.
• A typical measurement takes just 30 seconds (approx.).
• The prism is easy to clean, taking just a few seconds.
• All values are documented and can be transferred to a printer or PC.
• Results can be quickly sorted according to sample name, date or user.
• Product-specific correction of acids or conversion to the extract content can be programmed.
• The measurement results cannot be manipulated, and the user administration function enables clear user assignment.

Implementation
To carry out the measurement, a small amount of juice or syrup extract is deposited on the prism with a pipette, or in the case of highly viscous extracts, with a spatula. Start the measurement by operating the touchscreen. This opens an optional window that can be used to enter a sample name via touchscreen, keypad or barcode scanner. After the temperature has been controlled, the measurement is completed within approx. 2 seconds. Double or multiple measurements can be easily preconfigured for the device.

We recommend that a test measurement be carried out using water at the start of each series of measurements (target: 1.33299 nD or 0.00 °Brix, at 20 °C).

Cleaning
Remove the sample from the prism using a soft cellulose cloth and then rinse with a little water. The use of solvents is not required. However, ethanol can be used to speed up the drying process. The measuring prism is made of sapphire and is therefore particularly resistant to scratching.

Area of application
Refractometers are indispensable in the beverage industry. They are used in checking incoming and outgoing goods, e.g. for raw products such as...
concentrated direct mother (direct) juice, syrup or liquid sugar. It is also essential to accompany the manufacturing process with checking and the precise adjustment of the mixing ratio using °Brix is essential.

From practice
Apple juice made by Möller in Recklinghausen has a measured value of 12.6 °Brix. After conversion (using a density table), which can be saved in the device, this corresponds to \( \approx 1.0505 \text{ g/cm}^3 \approx 50.5 \) ° „Oechsle” (an archaic concentration value for the extract content). Correction of acids can also be done in the refractometer.

Direct apple juices should have a Brix value of > 30 °Brix. However, apple juice concentrates (thickened direct juice) can also reach extract values of approx. 70 °Brix. These concentrates have a viscosity and colour similar to honey. This means the simple cleaning of the DR6000-T is an advantage.

Cloudy or particularly dark extracts can also be measured with the DR6000-T, including direct blueberry and cranberry juices. The DR6000-T determines the measured values quickly and with a high level of repeatability.

For example, banana puree, concentrated 2:1 (approx. 39 °Brix), is delivered as a frozen product. After a gentle thawing process, it is measured at the incoming goods check, and here the fast Peltier temperature control is very helpful for cold samples.

Reliable temperature control, simple operation and cleaning even for untrained staff, and easy data processing are important for all measurements.

Autosampler
When there are many samples to process each day, it is helpful to use an autosampler. Therefore, A.KRÜSS Optronic GmbH offers the Autosampler AS80 for fully automatic filling and cleaning. The sample plate holds up to 89 samples of 8ml each (other container sizes are available). Suction time or cleaning procedures can be defined and assigned specifically to each method and therefore to each product.

If there is enough of a sample, and if viscosity is low and/or there are similar samples, it can be filled without being cleaned in between. In this case the measuring cell is rinsed with fresh sample fluid. Highly viscous samples should only be inserted into a clean measuring cell. Cleaning can be done automatically in this case, most often with distilled water.

The regular test measurement with distilled water can also be automated in this way. For this purpose, at the beginning of the series of measurements, sample lists are created in the DR6000-TF via barcodes, keyboard or display, giving the method and sample name. All results are saved in the device and can be printed out either directly after each measurement or at the end of a complete measuring order.

Things to note
Refractometers and density measurement devices determine °Brix by different physical methods. A conversion of °Brix (determined by refraction) to density is possible using tables, but strictly speaking it is only precisely valid for a pure water/sucrose solution. In cases of high acid content, a °Brix measurement using a refractometer will give somewhat lower values than °Brix using a density measurement device. The difference can be several tenths of a °Brix.

Further uses
Other uses beyond beverage testing or wine production include determining salt content or liquid mixture ratios in the chemical industry, e.g. lubricants.