



Precise Control Benefits Beverage Producers Profitability

USING REFRACTOMETERS, TITRATORS & ANALYSERS TO CONTROL YIELD

Application Note

XAUK LAB202-01 0517



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As commodity prices continue to rise and in an age of cost control awareness, manufacturers look to technology to help increase profits by cutting down waste and increasing plant productivity.

Quality control was once perceived as an overhead but now that it has moved away from the lab and into the production hall, instruments commonly used to check final product for compliance are now playing a vital role in controlling the product line. Whether it be a laboratory style instrument wrapped up in an industrial package that makes it suitable for use in harsh environments, like the RFM700 Series refractometer with simple user controls designed for factory operation or one of the most recognisable RFM340 refractometer derivatives, many beverage packers throughout the world rely on Xylem's Bellingham + Stanley brand as their main quality control tool.

When it comes to selecting the right instrument for the job, beverage packing houses need to consider the environment as well as the reliability and complexity of measurement before they make their choice. "Reliability is paramount," says Kevin Chapman, Product Manager of Bellingham + Stanley. "Not just physical reliability but also in terms of the measurement. Calibration is important too. It's no good having a really precise instrument if the operators cannot use it or even worse, the instrument isn't kept in good working order."

Bellingham + Stanley supply a number of long-life Brix solutions that are ideal for verifying the performance of any make of refractometer. "Our AG Fluids are particularly useful in the beverage arena as they are available in the low end of the Brix range, right where beverage packers operate," Chapman continues.

AG Fluids are calibrated in Bellingham + Stanley's UKAS accredited laboratory in accordance with EN ISO/IEC 17025:2005 and are supplied with a certificate showing traceability to ICUMSA (International Commission for Uniform Methods of Sugar Analysis) and importantly for the American marketplace, to NIST. AG Fluid certificates also bear the ILAC-MRA logo that is recognised



Fig. 1: The popular RFM340+ Series Peltier temperature controlled refractometer (left) used to control Brix in the factory or laboratory next to a TitroLine 7000 auto-titrator (right) for controlling acids and diet beverage concentrations

"Without good calibration, you may as well use a random number generator to control Brix..."



internationally by participating local accreditation boards. Refractometers can be found throughout the packing process, from goods inwards for checking incoming Brix of sugar syrups and concentrates right through production and of course in final quality control applications.

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Production line efficiency:

Although full automation in some applications is practical, semi-automatic systems using simple funnel flow cells can prove beneficial. For example, use of such an instrument will not only make reading times more efficient, they will also help reduce the amount of cleaning waste when compared to a standard refractometer, providing for a safer workspace and better practise all round.

RFM-Flow refractometers fitted with XyCone flowcells cleverly use vortex technology to sweep away the previous sample without leaving entrapped air so that only minimal flushing is required to achieve results as accurate as $\pm 0.01^{\circ}\text{Brix}$.

There are two types of RFM-Flow refractometer, the RFM300-Flow with Peltier temperature control and RFM700-Flow Series that uses temperature compensation; the latter being one of the most viable factory or field instruments on the market. Additionally, horizontal prisms facilitate easy cleaning and of course, simple calibration.

Temperature plays an important role when measuring Brix, particularly if adopting the density method, as density meters are affected to a greater degree than refractometers. This is why many beverage producers employ refractometers without temperature control in the production environment as readings may be electronically compensated for temperature differentials rather than go through a process of temperature control.

Although hand held refractometers like the OPTi digital refractometer may be used they are generally not accurate enough as the lack of mass reduces their ability to influence sample temperature effectively, however bench-top instruments like the RFM742-M refractometer can provide reliable results in a matter of seconds compared to more complex models that employ electronic Peltier temperature control systems to temperate the sample prior to the Brix measurement being made.

Having no Peltier and simple iconographic button makes instruments such as the RFM742 an ideal contender for factory use as part of product start-up.



Fig. 5: RFM300-Flow refractometer for factory line Brix control improves sampling time to get the line up-and-running faster after product changeover

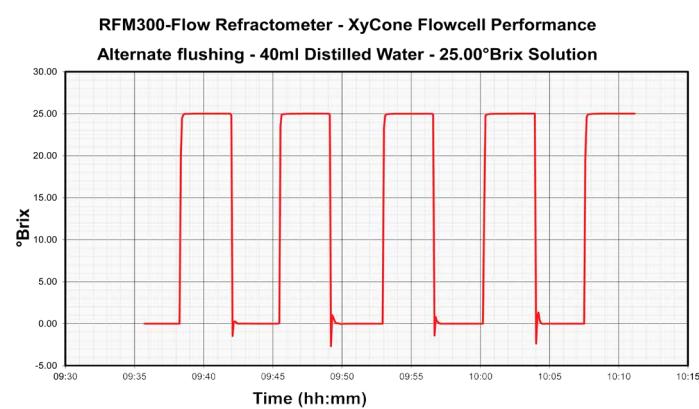


Fig. 6: Graph showing cleaning performance and reading reproducibility of XyCone flowcell fitted to RFM refractometer.

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Easy to take readings, no matter what the skill level of the operator:

Refractometers are often chosen in front of density meters for use in the factory as they require less skill to operate, are simple to calibrate and sample preparation time is less specific, for example, degassing for a refractometer may be simply achieved by using two cups.

However, as instrument suppliers quote so many different types of specification, it is sometimes difficult to understand or compare which refractometer is most suitable for the application. If we consider what the refractometer is really doing, it becomes obvious that the most important specification parameters are accuracy but more so reproducibility, the latter being how repeatable the instrument is when measuring the same known sample time-after-time.

Accuracy and reproducibility will affect yield so what beverage packers should look for is an accurate, repeatable Brix result. But when it comes to accuracy, there needs to be an understanding of what Brix means in the concept of beverage production. TRUE Brix is a real representation of pure sucrose in water but APPARENT Brix is what a refractometer, or density meter for that matter, will show when a beverage made up of sugar and other components is applied.

To that effect there is little difference when comparing accuracy of refractometers against density meters as it is an apparent Brix reading that is achieved and regardless of methodology, some kind of data manipulation is required to correct for the non-sugar components. So as we stated earlier, when it comes to instrument selection, accuracy is important but above all, reproducibility should be considered for the skill level and working environment desired and based on these four important factors, Bellingham + Stanley's RFM340+ refractometer has become one of the instruments of choice for primary Brix measurement by many of the World's leading beverage brands.



Fig. 7: OPTi digital handheld refractometers have temperature compensation so that Brix readings are consistent in the factory, laboratory or in the field.



Fig. 7b: Latest RFM340-T refractometers are capable of measuring to 3 decimal places Brix and can measure the total dissolved solids of nonhomogeneous samples such as yoghurt drinks with ease. The new touchscreen interface and clever software takes refractometry to a new level unsurpassed by other manufacturers.

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Carbonated beverages or sodas are generally easy to control using a refractometer as they normally have little if no pulp content. Readers may also recall the article previously published in Soft Drinks International (SDI March 2012) about the Pro-Juice refractometer facilitating highly repeatable Brix measurement of reconstituted orange juice that highlighted not only how the instrument dealt with sedimentation but also how it presents the sample for measurement at exactly the right temperature so there is no time for residue to build-up on the prism. The Pro-Juice is thought to provide a significant opportunity for savings when compared to a standard or vertical mounting refractometer claiming the same effect.

Controlling the acidity of fruit juice and using acidity to control diet beverage concentration:

Diet beverages pose a different problem to producers as the concentrate is often as little as 2 Brix, so when it's diluted target is about 0.2 Brix based on a 10:1 dilution ratio, the use of a refractometer or for that matter many density meters may not be ideal as under perfect conditions, a typically specified accuracy of ± 0.02 Brix would yield a 10% error.

So, although a refractometer can still be used to check whether a beverage is diet or sugar based, producers will look at alternative methods for rapid determination of diet beverage dilution ratio.

Although colour may be used, many producers choose total acidity as the base line because most diet beverages will have an acid content that can be targeted.

SI Analytics TitroLine® 7000 automatic titrator (figure 1) meets this need and conveniently employs a Methods system for easy operation by non-skilled users required to control diet and acid containing beverages in a matter of seconds.



Fig. 8: The Pro-Juice refractometer pre-conditions orange juice samples so that lines can run just above the lower threshold of product filling specification providing optimum yield from concentrates and thus helping to improve profitability from reduced waste or "over Brixing."

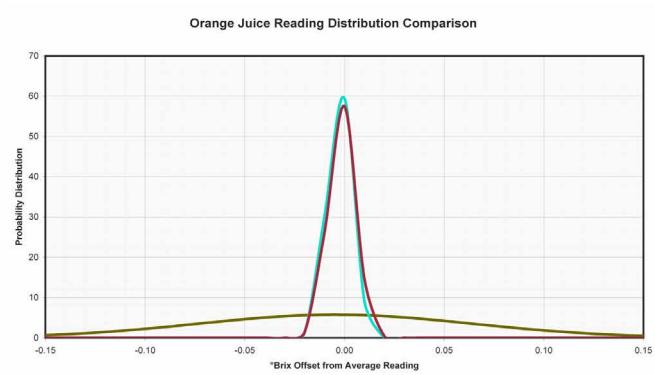


Fig. 9: Comparative deviation from target value, "standard laboratory refractometer vs. Pro-Juice."

Monitoring spoilage through ethanol analysis

One other measurement of interest is naturally occurring alcohol content in fruit juice, which is normally a sign of spoilage. The YSI 2900 biochemistry analyser is a new instrument for testing the alcohol content of low and no-alcohol beverages, whether it is a deliberate addition as part of a fruit based alcoholic drink or for ethanol content of fruit juice, where build-up of CO₂ and ethanol is an indicator of product spoilage.



This article was originally written by Bellingham + Stanley for publication in "Soft Drink International," July/August 2015.

Fig. 9: The YSI 2900 Series Analyser can not only differentiate specific sugars in a diverse foodstuff, it can also be used to monitor ethanol build-up in fruit juices and fresh fruit.

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You can read more about how Xylem's instrumentation can help improve your facilities productivity by visiting their website or by downloading their 32-page Food & Beverage Instrumentation brochure by scanning this QR-Code

