Top Tips - Getting the best from your refractometer

Bellingham + Stanley

a xylem brand

Bellingham + Stanley

Application Note DRAFT2017-5-12

The importance of good Quality Control, whether in food, beverage, pharmaceutical or chemical manufacture, is to ensure finished product is not only consistent, it is also to make sure it meets the required, possibly regulated, specification.

Good QC has an impact on profits too. Most people define QC as quality control but it can also be interpreted as quantity control, where quantity relates to the dilution or blend of, say, an expensive raw material such as concentrated apple pulp used to make juice. Over dilute and you're simply giving money away. Under dilute and you run the risk of breaching specification limits that may even result in a lost supply contract or an unhappy customer not coming back for more.

So, refractometers are scientific instruments commonly used as a quantity control tool in the factory as well as a final quality control in the laboratory, the latter to protect the customer. Investing in a good refractometer is therefore essential but you may as well buy a random number generator if other contributory factors are not considered.

So here's what's needed to ensure reliable results when taking refractometric measurements, whether they be Brix, RI, Urea, or many of the other application specific scale derivatives that have evolved over the 150 years refractometers have been in use.

1. Choose the right instrument for the job

With access to a whole world of models and suppliers and prices ranging from as low as £50 right up to £10,000; start by writing down your measurement needs and the environment in which the reading is to be taken. Only then start looking for the right instrument for the job in hand.

A simple, low cost handheld refractometer is fine for field testing before fruit harvest or for checking chemical dilution in the automotive industry but if you're controlling expensive raw materials or a controlling a high speed bottling line in a beverage factory that needs tighter control to avoid even the smallest amount of waste, then a more sophisticated instrument suitable for a factory environment and that eliminates the factors affecting refractometric measurement should be chosen.
Understand the effects of temperature.

Refractive index changes significantly with temperature and so this is a very important consideration if you want to achieve reliable measurements. Sugar based foodstuffs including beverages, sauces, confectionery etc. are specified at 20 °C and have the same temperature characteristics so can be treated together but organics such as oils and aromas differ widely with temperature change and so must be considered independently.

2. Speak to the experts

Instrument manufacturers are a great source of advice so be sure to speak with them. Once you've chosen your refractometer, think about in-country support by looking for a local supplier of the model you have identified as the right instrument for you.

3. Think about the user

It's no benefit having a most sophisticated refractometer if you don't think about the people that are expected to use it. Proper consideration must be given to what the instrument is to achieve vs. the skill-set of the people expected to achieve it.

Top Tips - Getting the best from your refractometer

Bellingham + Stanley
a xylem brand

4. Clear operating procedures and proper training

No matter what the application, good operating procedures and proper training in the use of the instrument, is essential if you are to get the best from your refractometer.

Latest digital refractometers may include operating assistance that takes care of the many known limiting factors with on-screen prompts that guide the operator to take precise measurements with little thought.
Password protection, some using RFID tags, ensures low-level operators will not be able to access to sensitive configuration menus so that instrument integrity is protected throughout is working day.

If available, use the instrument's on-board audit trail that logs who has done what so that any unauthorised changes to the instrument can be easily traced.

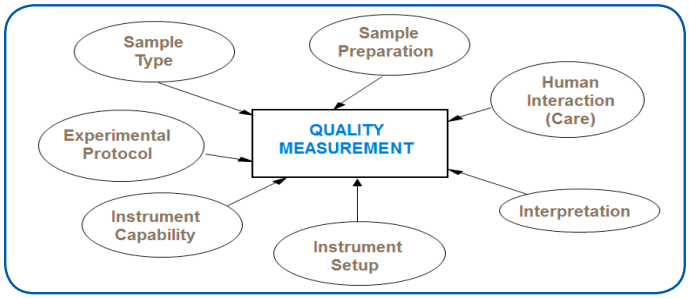
5. Sample preparation is the key to good measurement

For handheld refractometers, this may be simply by degassing soda from canned drinks using cups or crushing fruit in to a nice juicy sample that doesn't include pips or fleshy pulp. For fibrous product like carrot, potato, turnip or swede, use a grater to break down the fibres and then squeeze the juice from a handful of the shreds before taking a measurement. And in the field, make sure you take a representative sample and not just from the sunny side of the tree!

Other methods that should be considered when reading more challenging samples in the lab or factory include:

- Degassing
- Filtering
- Stirring
- Blending
- Centrifuging
- Clarifying

It sounds simple but of neglected, results will suffer!



6. Apply the right amount of sample

Too much and it will take longer to stabilize. Too little and the interface between the prism and sample will not refract properly. Use the presser, plate or flap if fitted.

7. Watch out for highly concentrated layers or "skins"

Make sure you stir sugar syrups properly and avoid the highly consternated, unrepresentative skin that forms on the top.

8. Some like it hot!

Heat up viscous, semi-solid and solid samples like waxes, fats, edible oils & butter to take a reading.
When measuring hot samples next to the production line, reduce stabilisation times by elevating the instrument's temperature to that of the sample. Then use temperature compensation to give the result as if it was at 20 °C. This technique also applies to refractometers measuring the total solids of instant coffee prior to freeze drying so that sediment doesn't form on the prism whilst waiting for equilibrium.

9. Manage the effects of temperature

Optical handheld refractometers offer limited correction using a manual offset or bimetallic strip to compensate; adequate for the typical measurement offered from such an instrument. Better still, digital handheld refractometers use sugar compensation or for other nonsugar samples, high grade digital handhelds use application specific compensation to provide a more accurate result

For convenience, laboratory or factory refractometers adopt electronic/mathematical temperature compensation for sugar based products but for ultimate performance, most nowadays use electronic devices to control the prism and surrounding plate so that the sample is controlled to the desired measurement temperature.

Top Tips - Getting the best from your refractometer

Bellingham + Stanley
a xylem brand

10. Wait for temperature stability to avoid moving targets

Always give the sample time to stabilise to the temperature of the instrument, otherwise the borderline and hence reading will literally be moving! Modern laboratory instruments offer stability checks so that the reading is only given after a set time or better still, when the instrument detects both sample and temperature readings have stabilized – SMART!

11. Keep it Clean

Remember to clean the prism and plate afterwards as well as dry it properly. Cross-contamination between samples and cleaning materials will create erroneous results for the next user. This is critical when using reference materials to verify the instrument

12. Sanity Check

If the reading isn't what you expected or the borderline doesn't look as sharp as it normally does for that sample on an optical handheld refractometer, start again!

For digital refractometers that feature a quality indictor, check to see if the number is correct for the sample being measured? Some "methods based" refractometers with limit function also allow you to set a threshold for each sample so that anything untoward shows up as an error message.

13. Treat handhelds with respect, they're not just another tool in the box!

Handheld refractometers require little maintenance, typically only requiring a zero calibration with water or for high range instruments that don't have a zero point, with a sugar sample or for optical instruments with a solid test plate. Some digital handheld refractometers also allow verification of the upper scale using long-life, certified sample.

Keep them clean, remove sample from the prism once it has been read and keep it in a safe place; after all, a refractometer is an optical instrument.

14. Consider installation and training as a start-up package

For regulated environments such as within the pharmaceutical industry, get the instrument manufacturer, their local agent or even an independent validation contractor to perform a validation (IQ/OQ/PQ) using traceable standards prior to use. Configuration and start-up training can then be done in one go!

15. Verify performance regularly

Verify and if necessary calibrate the instrument on a regular basis. Typically, a ZERO verification should be performed daily. SPAN, a validation of the upper part of the scale or in the area where you normally take measurements, should be done weekly and only after a zero validation.

Always squeeze some sample to waste to ensure no crystals have formed in the nozzle Only adjust the instrument if it falls out of specification and make sure samples are left long enough for the temperature to stabilise. Clean and dry carefully between each verification and if in doubt of the reading, do it again to ensure you don't calibrate in any errors! Always consult with the instrument instructions the guidelines of the standard being used.

16. Schedule regular maintenance within your operating procedures.

This may include cleaning, changing any consumables such as lamps, flow-through pipes or air filters. Some instruments allow you to program calibration and maintenance due dates so be sure to use these features if they are available.

17. Preventative maintenance contracts are a good idea.

Get your instrument checked out by the supplier or manufacturer on a yearly basis, especially if controlling critical or regulated product. Preventative maintenance not only ensure reliable use and extend the life of the instrument, it may also help to prevent a catastrophic breakdown that may in some cases, leave a production plant without proper control.

Bellingham + Stanley

a xylem brand

For further information, please contact:

Bellingham + Stanley, a Xylem brand
Xylem, Longfield Road, Tunbridge Wells, TN2 3EY, UK
sales.bs.uk@xyleminc.com
Phone: +44 (0) 1892 500400