LOVIBOND® TINTOMETER® WHITE PAPER

Colour Consistency Across The Supply Chain- Update 2012

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Defining the colour of a product and ensuring colour accuracy every time is critical to long-term success and accurate communication within a supply chain.

Clear and correct description of colour standards and tolerances is critical when:

- Specifying materials when sourcing.
- Communicating colour within the wider supply chain.
- Inspecting incoming materials.
- Conducting continual production Quality Control.
- Inspecting final/outgoing products.
- Guaranteeing compliance with National & International Standards.

Reliable and repeatable colour test results are the key to ensuring final product quality, and also to minimising production costs. Speed of analysis can also be vital for efficient process control. Simplicity of operation helps to reduce error, and increase productivity.

Visual Comparators vs. Automatic Measurements

The fundamental difference between the Lovibond® Tintometer Model F, Comparator 3000, Comparator 2000 and the PFX/PFX*i* range is that the Model F and Comparators are based on subjective, visual comparison methods. Subjective, visual methods rely to a high degree on the judgment and skill of the operator and hence their perspective, feelings, beliefs, and desires. The PFX/PFX*i* range, on the other hand, relies on automatic, non-subjective measurements, and are thus unaffected by the judgment of the operator.

With inexperienced operators, visual comparison can be more time consuming and less precise than the fast automatic readings taken with a PFX/PFX*i*. Visual agreement between operators at one site or multiple sites cannot be guaranteed.

The skill/experience of operators, degree of acceptable error, sample preparation time, choice of scale and required scale resolution should be carefully considered before making your decision on what instrument to purchase.

When comparing visual (subjective) to automatic (non-subjective) colour assessment, the fundamental differences between these methods need to be considered. Visual systems are of a lower initial cost, but their limitations should be taken into account when selecting the correct instrument.

Colour Consistency

Four very basic steps can also be initially taken to reduce colour communication problems;

1) **Cell Path Length:** Is cell path length appropriate and are you using comparable, clean, cells?

   Your choice of path length will impact accuracy. Unless working to a particular specification, the optical path length of the cell used should be related to the colour intensity of the sample.

Image 1- Top view

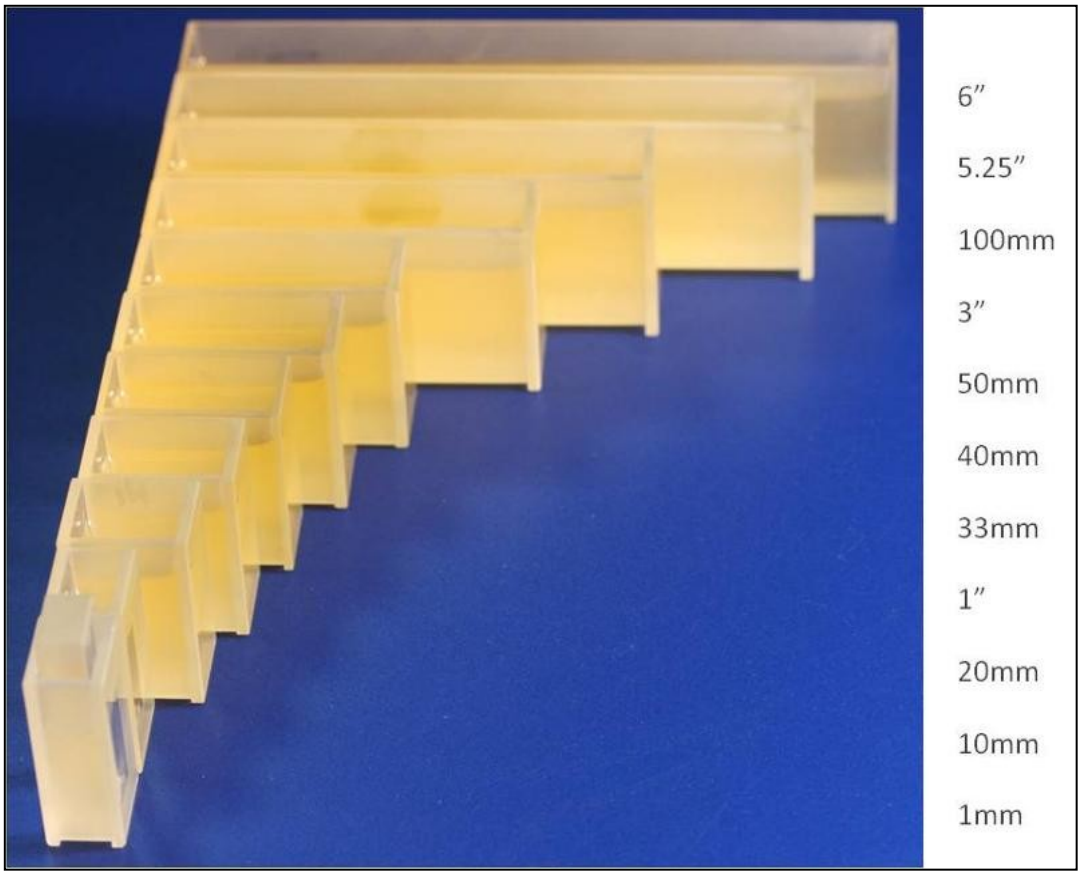

Image 2- Front View

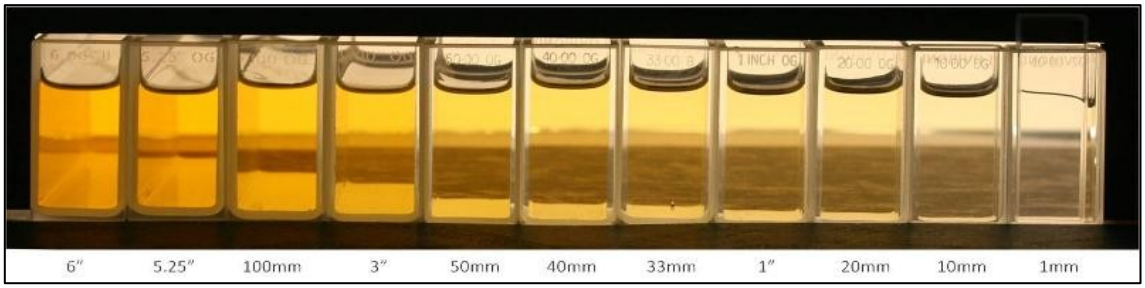

Image 1 shows the same liquid sample viewed across a range of cell path lengths. Image 2 shows that as path length changes the perceived colour of the samples will change significantly. Any visual or automatic methods results would be influenced by this difference.

For example with **Lovibond® RYBN Colour**, it is advisable that the depth of colour should never be greater than that which may be matched by a total of 20 Lovibond® units. This is because slight differences are most easily perceived in intensities ranging between approximately 3 and 10 units of the predominating colour.

For example; (*i) using a 5.25” cell a sample gives **R** 1.7, **Y** 10, **B** 0 and **N** 0.1 = 11.8 in total, the path length used is correct. (ii) using a 5.25” cell a sample gives **R** 5.7, **Y** 31, **B** 0 and **N** 0.1 = 36.8 in total, the **Y** is high, a 1” cell should be considered.*

When comparing with others check that cell path length and type (Optical Glass, Borosilicate or Plastic) are identical and the cells used are clean and undamaged.

2) **Colour Scale:** Confirm that the correct colour scale is selected?

The instrument you are using (visual or automatic) should be compliant with the reference method defining the scale. If this is the case, correct and unambiguous scale selection is easy to achieve when using scales such as Gardner, FAC, Iodine, Platinum-Cobalt/Hazen/APHA Colour etc.

Problems generally arise when Red and Yellow values are required.

Historically a number of scales are available that report Red (R) & Yellow (Y) values. These R & Y values vary from scale to scale and are not compatible. This is a common source of error. The following all describe colour in terms of R & Y;

AOCS-Tintometer® Colour
(AOCS Cc 13b, the Wesson Method; AOCS Cc 13j)
Range: 0 - 20 Red; 0 - 70 Yellow

Lovibond® RYBN Colour
(AOCS Cc 13e, AOCS Cc 13j,ISO 15305, MS 252: Part 16, IP17 Method A)
Range: 0 - 70 Red, 0 - 70 Yellow, 0 - 40 Blue, 0 - 3.9 Neutral

BS684
(BS 684 Section 1.14, ISO 15305 and AOCS Method Cc 13e-92)
Range: 0 - 70 Red, 0 - 70 Yellow, 0 - 40 Blue, 0 - 3.9 Neutral

AF960 *(based on two λ's for pure triglycerides)*
Range: 0 - 20 Red; 0 - 70 Yellow

For Example; a standard Model F reports Lovibond® Red, Yellow, Blue and Neutral units (RYBN). An AF710 reports AOCS-Tintometer® in terms of Red & Yellow (RY). A PFX/PFX*i* (depending on model) may be configured to display either or both RYBN and RY.

Only by being 100% sure that values of Red and Yellow are from the same colour scale, can the user be 100% sure of the accuracy of the results and tolerance levels.

A special note regarding Neutrals and Lovibond® RYBN

It is important to adjust brightness with the Neutral racks when measuring Lovibond® Colour. The eye is more accurate at matching colours when the colours are of similar brightness.

A brightness difference between the sample and the glass standards will introduce an error in the colour match. When measuring Lovibond® RYBN, the Red and Yellow values cannot be treated as independent.

Automatic Lovibond® instruments always include Neutral values in Lovibond® Colour calculations.

However, evidence shows that users of visual Tintometer® Colorimeters routinely fail to adjust for brightness differences.

3) **Instruments and Maintenance.** In addition to ensuring the same Colour Scales are used, close attention should be paid to the instrument itself. Many visual units such as Model D's, E's and F's have been modified over time by users. Neutral racks have been removed, lamps replaced with non-standard lamps, interiors painted...etc.

We strongly advise against on-site modification of any instrument. Effectively any "customized" instrument is operating a "unique" version of the original colour scale. It is unlikely to agree with other instruments.

We advise against the purchase of copies of Lovibond® instruments. Internal tests have shown these units to be inconsistent from batch to batch. They are not manufactured with our approval.

Instruments should be serviced regularly and maintained according to the detailed recommendations found in the manual. Interiors of the instrument should be kept clean and white and sample chamber inserts replaced as recommended in the manual.

4) **Turbidity needs to be eliminated.** Turbidity scatters and blocks light, resulting in incorrect and inconsistent readings. A sample needs to be maintained at a constant temperature +10 °C above the "Cloud Point" of the oil. No Bubbles or Particles should be present in the sample.

Accuracy of Measurements

Once compatibility of instruments has been established, it is critical that the long term accuracy of instruments is monitored and maintained.

Two approaches exist historically:

1) Liquid Reference Standards: High quality liquid samples with known values are used to check that an instrument is reporting the correct figures. The range of Lovibond® colour reference standards includes AOCS-Tintometer®, ASTM, Gardner, Lovibond® RYBN, Pt-Co/Hazen/APHA and Saybolt Colour. Each standard is shipped with a 12-month guarantee of colour stability.

2) Glass Filters: Conformance filter sets allow quick and simple conformance checks on Lovibond® instruments. Each filter set is supplied with a Certificate of Conformity that confirms that they have been manufactured under the control of an ISO 9001: 2000 Quality Management System.

Remote Calibration & Maintenance Service via internet

With the launch of the Automatic PFX*i* range of instruments, a new 3rd option exists:

3) The PFX*i* series of instruments is installed with a NEW technology from Lovibond Tintometer: **RCMSi** (Remote Calibration & Maintenance Service via internet.)

   RCMSi is the process by which a number of tightly controlled calibration liquids are measured in a 50 mm cell via the Calibration function of a PFX*i*. The data is communicated via the internet to a secure server and compared to Master Data. *No other data is sent, only calibration data.* If the data passes within tolerance, then a Certificate of Calibration can be downloaded by the user by logging into the Lovibond® website.

   This allows Lovibond Tintometer to ensure a PFX*i* instrument is operating correctly and is traceable to ISO17025 standards. In this way, users can be 100% confident that all PFX*i* readings are reliable. Certificates of Calibration are provided post process.

   RCMSi is not mandatory. It is simply an additional, purely optional, level of performance guarantee. There are a number of PFX*i* users worldwide who, for security or infrastructure reasons, do not use RCMSi. This does not have any negative effect on their day-to-day operations. They simply use the Glass Filter that ships as standard with the instrument or purchase additional Liquid Reference Standards or Glass Filters.

Conclusion

Colour Consistancy is simple to achieve if care is taken to eliminate possible causes of variation between instruments. Methods should be documented, circulated and complied with.

We suggest that the following information should be recorded for each colour measurement:

- instrument model used
- serial number (if multiple instruments available)
- date
- time (if relevant)
- name of observer/operator
- description of sample
- sample reference number (if relevant)
- temperature of sample if heated
- any comments on condition of sample (e.g. turbid or dirty etc.)
- path length of optical cell
- colour space or colour scale used.
- individual colour values.
- any other information required by the organisation
- any comment relevant to the colour match

As discussed, special care should be taken with regards to colour scales utilising Red and Yellow values.

Instruments should be maintained correctly and regularly checked using 3rd party standards.

The use of glass or liquid standards is very much up to the individual user requirements. With the development of modern networking capabilities online calibration is now a cost effective and technically viable tool.