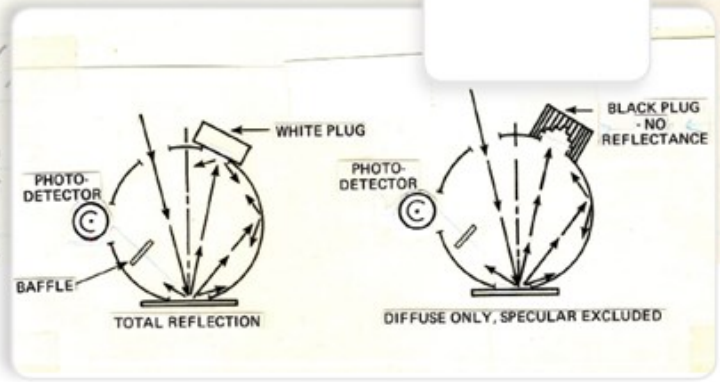
Applications Note

AN 1095



While thought of as a dichroic (two-color) phenomenon, the degree of opalescence is actually related to the degree of scattering of near-transparent liquids.

Abstract

Wikipedia describes the phenomenon of opalescence as follows:

Opalescence is a type of dichroism seen in highly dispersed systems with little opacity. The material appears yellowish-red in transmitted light and blue in the scatter light perpendicular to the transmitted light. The phenomenon is named after the appearance of opals.

Opalescence is not a common colorimetric application, though one application encountered is measuring the opalescence of the bleaching solutions used in dental whitening.

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Physical Standards for Visual Evaluation of Opalescence

There is a European Pharmacopoeia (EP) [www.pheur.org] reference for physical liquid standards used in visual evaluation of opalescence of pharmaceutical liquids. Section 2.2.1, "Clarity and degree of opalescence of liquids," defines visual clarity and describes a standard for opalescence (haze) relative to water.

The monograph defines a primary opalescent liquid suspension as a solution of 25 mL hydrazine sulfate solution and 25 mL of hexamethylenetetramine solution and provides instructions for the preparation of both. This suspension is stable for two months when stored in a glass container.

This primary suspension is then mixed with distilled water in proportions defined in the table below to define four levels of opalescent standards, with the fifth level being distilled water (no opalescence).

Standard Opalescence Level	I	II	III	IV
Amount of Primary Opalescent Suspension	5.0 mL	10.0 mL	30.0 mL	50.0 mL
Amount of Distilled Water	95.0 mL	90.0 mL	70.0 mL	50.0 mL

For visual evaluation, the liquid standards and a sample are placed in identical flat-bottomed test tubes (15-25 mm in diameter) to a depth of 40 mm. The evaluator looks down the tubes placed side-by-side against a black background under even daylight lighting. The sample is considered clear if its opalescence is similar to that of distilled water or no more than that of Opalescence Standard I.

Instrumental Correlation to EP Opalescence Liquid Standards

If the dichroic color difference in the opalescent sample is of interest, it is possible to measure the color difference based on two measurements, one straight through the sample (regular transmittance) and the other of the diffuse, or scattered, transmittance. The measurements would need to be made separately and manually.

However, in the case of liquids, it is usually the degree of scattering that is of interest, with the appearance of opalescence being the result of that scattering. Opalescence can be determined instrumentally for liquid samples by using a correlation between the EP Opalescence Liquid Standards and a Transmittance Haze measurement. The correlation method can be summarized as follows:

1. Select Haze as a read method/procedure for measurement using your software. It will only be available for a benchtop sphere instrument such as a Vista, UltraScan PRO or UltraScan VIS.
2. Standardize the instrument in TTRAN mode using a 50-mm transmittance cell filled with distilled water as a blank when setting the top of scale.
3. As an operational qualification (OQ) step, read back the cell of distilled water as a standard or sample. The reading should be very close to L*=100.0, a*=0.0, b*=1.0, and Haze %=0.0. If any of the values are more than ±0.05 unit away from these values, stop and determine what the problem is.
4. Measure the four EP Liquid Opalescence Standards in the 50-mm transmittance cell and save the measurements. You should see the Haze % of the standards increase with the standard number.

5. Using Microsoft Excel or another spreadsheet/graphing program, determine the optimum correlation between the EP Standard Number (0 for distilled water, then 1, 2, 3, and 4) and the Haze % values for your measurements.
6. Implement the formula below in one of your software's custom formula fields in the ***COLOR DATA TABLE > MASTER COLOR DATA*** view so that EP Opalescence will be automatically calculated and displayed:

   EP Opalescence = m*(Haze %) + b, where m and b are the correlation coefficients determined using Excel or your other spreadsheet program.

5. Refill the 50-mm transmittance cell with a liquid sample and measure it with your instrument. Observer the EP Opalescence value reported.

While EP visual Opalescence is reported in a rating system of single digits (corresponding to the standard the sample is most like), instrumental EP Opalescence may be reported to additional decimal places if desired.

About HunterLab

HunterLab is the technology leader in color measurement solutions, providing instruments, software, knowledge and service to a wide variety of industries.
With over 5 decades of experience in more than 65 countries, HunterLab applies our leading edge technology to your products helping you measure and communicate color simply and effectively.

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