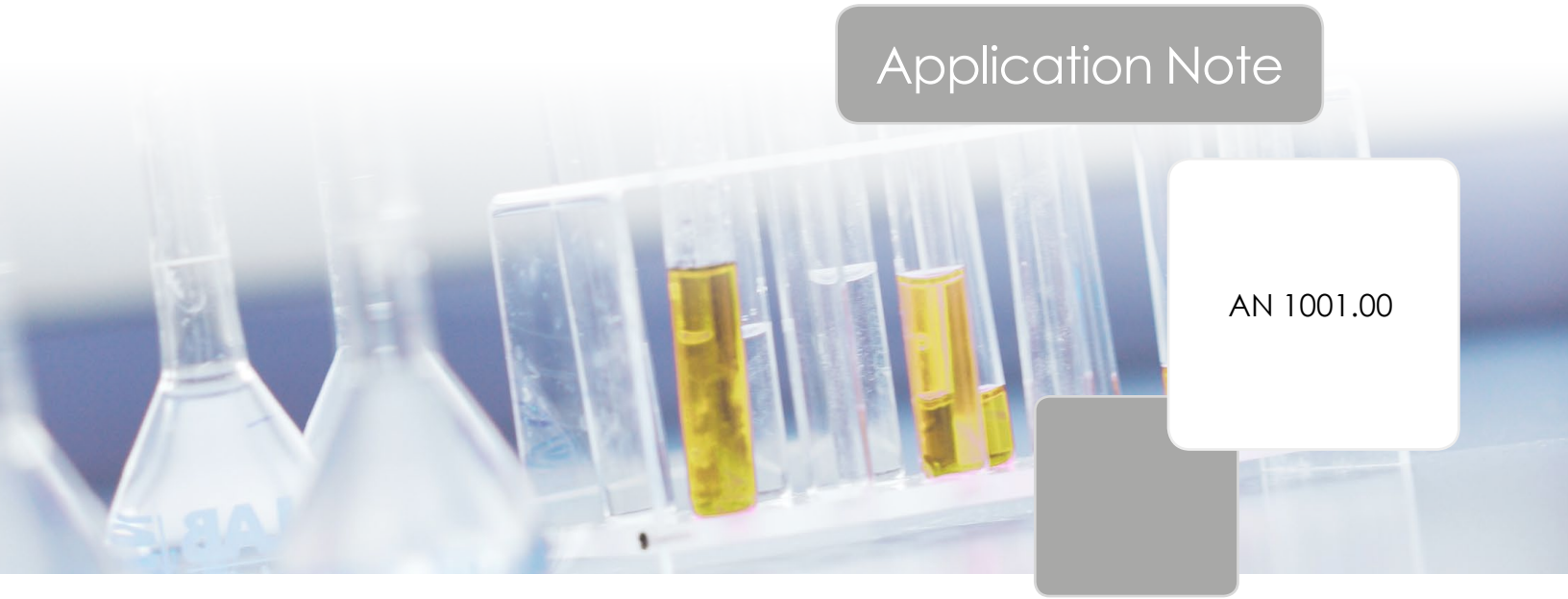

Application Note

AN 1001.00

Measuring the Water Whiteness of Liquids Using the APHA Index

"The more pure the solution, the more visually water white and the closer to zero the APHA index."

ABSTRACT

As the chemical, petroleum, plastic, and pharmaceutical industries have grown, they developed criteria to judge the color of their products. Descriptions of slightly colored clear liquids were based on visual comparisons to dilutions of platinum-cobalt (Pt-Co) stock solutions. The whiter the solution, the more desirable the purity of the product and the more dilute the stock solution. Related to this, A Hazen documented in 1892, the American Public Health Association (APHA) color index. APHA ranges from near zero for clean water and up to 500 for waste water discolored by undesirable impurities and organic materials.

This application note considers the use of the APHA index to measure the color of water white liquids.

The world's true measure of color

HunterLab

WHAT IS APHA?

APHA is a single number yellowness index where each APHA unit is based on a dilution of the 500 ppm stock solution of PtCo. A detailed description of solution preparation and measurement procedures may be found in ASTM D1209 and ASTM D5386.

While instrumental determination of APHA is allowed by D1209 and D5386, no formula is prescribed by either method. For APHA, HunterLab uses a custom correlation based on known APHA values compared to instrumental measurements. Please note that these correlations apply only to HunterLab instruments able to read in Transmittance (2° Standard Observer/ Illuminant C).

PREPARATION OF APHA STANDARDS

The APHA zero (0) standard is physically represented by distilled water (for water-based products, toluene or benzene for resins, and mineral oil for oils), can be used is a blank during the standardization process. Pre-mixed and certified intermediate standards can be purchased from RICCA Chemical (www.riccachemical.com). The APHA platinum-cobalt 500 ppm stock solution is available from Fisher Scientific. Intermediate standards can also be prepared from the stock as described in ASTM D1209.

SAMPLE PREPARATION

All APHA samples are to be prepared the same way and measured at the same temperature, after the same amount of mixing, etc.

In order for the APHA index to be meaningful, samples must be clear or slightly colored liquids that are similar in hue to the PtCo standards. In addition, steps should be taken to ensure that samples are non-scattering, or the APHA evaluation will be biased. Based on HunterLab's years of experience, a measured haze value above 5 % is visually hazy. The sample should be labeled as such or filtered before measurement.

APHA METHOD PARAMETERS	
Mode	TTRAN - Total Transmission
Illuminant/Standard Observer	C/2°
Color Scale	APHA Index
Pathlength	10, 20 or 50 mm path length cells, or 24 mm ID vials
Standards	Zero Standard, intermediate dilutions prepared to ASTM D1209
Sample Preparation Parameters	Temperature, Mixing Time, Filtering

If an APHA value is negative or much lower than expected, the sample may be off-hue. If an APHA value is very high, the sample may be of the correct yellow hue, but more saturated than the upper limit of the stock solution. In this case, the Gardner Index, which is designed for liquids that are darker yellow or brown may be used. Alternately a tristimulus color scale like CIE L*a*b* or Hunter L, a, b could be used.

APHA SAMPLE MEASUREMENT

The instrument must be standardized in Total Transmittance (TTRAN) mode using a transmission cell of the same path length as will be used in the measurement. Samples may be measured using a 10, 20, or 50 mm cell, and the calculations performed are specific to the cell size. Consistency with both the cell size used and the cell size indicated in the software is important or the measurements will not be comparable. For example, if a transmission cell with a path length of 20 mm is used this should also be selected in the software as APHA-20 mm.

METHOD PRECISION

Precision of the visual method is non-linear to the increase in APHA value. For example, repeatability for a single operator at an APHA value of 25, is determined to be 3 units. At an APHA 475, repeatability was 16 units. Experimental reproducibility among 10 analysts is 10 units at APHA 25 and 49 units at APHA 475. A similar phenomenon is observed instrumentally. Single operator repeatability when determining APHA instrumentally is within 0.9 unit under APHA 30 and multiple operator reproducibility is within 2 units, to a 95 % confidence level.

CONCLUSION

The APHA/Pt-Co/Hazen Color Index is useful for measuring the trace yellowness associated with the degree of contamination or processing quality of transparent liquid samples that are near-colorless.

REFERENCES

APHA Method 2120, Color by Visual Comparison, Standard Methods for the Examination of Water and Wastewater, American Public Health Association, Washington, D.C.

APHA Method 110.2, Color - Colorimetric - Platinum-Cobalt, Methods for the Chemical Analysis of Water and Wastes, U.S. Environmental Protection Agency, Washington, D.C., 1983.

ASTM D5386, Standard Test Method for Color of Liquids Using Tristimulus Colorimetry, describes how color measurement instruments correlate to the physical APHA/PtCo color standards described in ASTM D1209, ASTM International, West Conshohocken, Pennsylvania.

ASTM D1209, Standard Test Method for Color of Clear Liquids (Platinum-Cobalt Scale), ASTM International, West Conshohocken, Pennsylvania.

ISO 2211, Liquid Chemical Products - Measurement of Colour in Hazen Units (Platinum-Cobalt Scale), International Organization for Standardization, Geneva, Switzerland, 1973.

ISO 6271, Clear Liquids - Estimation of Colour by the Platinum-Cobalt Scale, International Organization for Standardization, Geneva, Switzerland, 1997.

Hazen, Allen, A New Color Standard For Natural Waters, American Chemist Journal (14:300), 1892.

Hazen, Allen, The Measurement of the Colors of Natural Waters, American Chemist Journal (18:264), 1896.

More Information about Color Measurement on our HunterLab Blog

measuretruecolor.com

ABOUT HUNTERLAB

HunterLab, the first name in color measurement, provides ruggedly dependable, consistently accurate, and cost effective color measurement solutions. With over 6 decades of experience in more than 65 countries, HunterLab applies leading edge technology to measure and communicate color simply and effectively. The company offers both diffuse/8° and a complete line of true 45°/0° optical geometry instruments in portable, bench-top and production in-line configurations. HunterLab, the world's true measure of color.

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