

Standard Operating Procedure for the
Determination of True Color
CCAL 14A.0

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April 2006

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1.0 Scope and Application

- 1.1 This method is used to measure color in fresh waters and may indicate the presence of metallic and organic materials in samples.

2.0 Summary of Method

- 2.1 Color is determined by visual comparison of a sample with known concentrations of platinum-cobalt standard solutions. The unit of color is defined as that produced by 1 mg/L platinum in the form of the chloroplatinate ion. This method is useful for determination of color due to naturally occurring materials, but is not applicable to most highly colored industrial wastewaters. True color is defined as color from a filtered sample, in which turbidity and suspended matter has been removed. Apparent color is that of an untreated sample and includes color due to substances in solution as well as suspended material.

3.0 Definitions

- 3.1 DI water: Water that has been through a deionization system to produce water similar to ASTM Type I reagent with 16.7 Mohms resistivity (ASTM) (Reference 16.3).

4.0 Interferences

- 4.1 Turbidity results in high color values, and must be removed by filtration for determination of true color.
- 4.2 Color is extremely pH dependent and increases with increasing pH. pH of the sample at time of analysis should be reported with color data.

5.0 Safety

- 5.1 The toxicity or carcinogenicity of each reagent has not been precisely determined; however, each chemical should be regarded as a potential health hazard. Exposure to these chemicals should be reduced to the lowest possible level. Cautions are included for known extremely hazardous materials.
- 5.1.1 Hydrochloric acid
 - 5.1.2 Sodium hydroxide
 - 5.1.3 Cobalt(II) chloride hexahydrate
 - 5.1.4 Potassium hexachloroplatinate

6.0 Equipment and Supplies

Note: *Brand names, suppliers and part numbers are for illustrative purposes only. No endorsement is implied. Equivalent performance may be achieved using apparatus and materials other than those specified here, but demonstration of equivalent performance that meets the requirements of this method is the responsibility of the laboratory.*

- 6.1 Nessler tubes, matched – 50 mL low form
- 6.2 Filtration system - filter funnel, filter stage, filter barrel, clamps, erlenmeyer filter flask
- 6.3 Graduated cylinder
- 6.4 GF/F or GF/C filter papers
- 6.5 Stainless steel screen with 1 mm² mesh
- 6.6 Large porcelain buchner funnel
- 6.7 Vacuum system and connecting hoses
- 6.8 Lab Coat
- 6.9 Gloves
- 6.10 Safety Glasses

7.0 Reagents and Standards

- 7.1 Preparation of Standards
 - 7.1.1 *Potassium chloroplatinate standard stock solution:*

Dissolve 1.246 g of potassium chloroplatinate (K_2PtCl_6 ; equivalent to 500 mg of metallic platinum) and 1.00 g crystallized cobaltous chloride ($CoCl_2 \cdot 6H_2O$; equivalent of approximately 250 mg of metallic cobalt) in approximately 600 mL of DI water with 100 mL concentrated hydrochloric acid in a 1 L volumetric. Dilute to volume with DI water. Stock standard concentration is 500 CU (color units). Prepare fresh annually or as needed.

7.1.2 Potassium chloroplatinate working standards:

Volume of Stock Standard (mL)	Final Volume (mL)	Final Concentration (CU)
0.5	50	5
1.0	50	10
2.0	50	20
2.5	50	25
3.0	50	30
3.5	50	35
4.0	50	40
4.5	50	45
5.0	50	50
6.0	50	60
7.0	50	70

Determine necessary range of standards by visual inspection and comparison of samples with standards. When not in use, cover tubes with parafilm and store in the dark.

8.0 Sample Handling and Storage

- 8.1 Unfiltered samples are filtered upon receipt through glass fiber filters into clean HDPE bottles and stored at 4°C in the dark. Samples are analyzed within 48 hours to ensure sample integrity. If samples must be held prior to analysis, they are stored frozen at -18°C.

9.0 Quality Control

- 9.1 When using previously prepared calibration standards, prepare several new standards and check against old to ensure no degradation.

10.0 Calibration and Standardization

- 10.1 Balances: calibrated yearly by external vendor.

11.0 Procedure

11.1 Sample Preparation and Analysis

- 11.1.1 Add 50.0 mL of standard or sample to labeled Nessler's tubes.
- 11.1.2 Observe the color of each sample in comparison to the standard gradient. Look vertically down, through the tubes towards a white or specular surface placed at such an angle that light is reflected upward through the columns of water.
- 11.1.3 Record the color value of the nearest matching standard for each sample. Note as true color for filtered samples, and apparent color for unfiltered samples.
- 11.1.4 If the sample color exceeds 70 units, dilute sample to 50 mL with enough DI water to bring color within standard range. Record volume of sample added. Correct color value for the dilution (see calculations, 12.1).
- 11.1.5 Analyze samples quickly to minimize bacterial activity which may result in alteration of color.

11.2 Procedural Notes

- 11.2.1 Samples should be allowed to come to room temperature before analysis.

12.0 Data Analysis and Calculations

12.1 Correction for Dilution

$$\text{Color (CU)} = \frac{A \times 50 \text{ mL}}{B}$$

where A = color of the diluted sample, B = mL of sample used for dilution

- 12.2 Report results in whole numbers to nearest 1 for 1 – 50 CU, to nearest 5 for 51 – 100 CU, to nearest 10 for 101 – 250 CU and to the nearest 20 for 251 – 500 CU.

13.0 Method Performance

NA

14.0 Pollution Prevention

- 14.1 The chemicals used in this method pose little threat to the environment when properly managed.
- 14.2 All standards and reagents should be prepared in volumes consistent with laboratory use to minimize the volume of disposable waste.
- 14.3 For further information on pollution prevention consult *Less is better: Laboratory Chemical Management for Waste Reduction*, available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street NW, Washington D.C. 20036, (202) 872-4477.

15.0 Waste Management

- 15.1 It is the laboratory's responsibility to comply with all federal, state and local regulations governing waste management, and to protect the environment by minimizing and controlling all releases from fume hoods and bench operations. Compliance with all sewage discharge permits and regulations is required.
- 15.2 For further information on waste management, consult "The Waste Management Manual for Laboratory Personnel", and "Less is Better: Laboratory Chemical Management for Waste Reduction", both available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street NW, Washington DC, 20036.

16.0 References

- 16.1 Standard Methods For The Examination of Water and Wastewater, Method 2120 – Color, Visual Comparison Method. American Public Health Association. 21st Edition, 2005.
- 16.2 ASTM. American Society for Testing and Materials. Standard Specifications for Reagent Water. D1193-77 (Reapproved 1983). Annual Book of ASTM Standards, Vol. 11.01. ASTM: Philadelphia, PA, 1991.
- 16.3 Knight, A. G. 1951. The photometric estimation of color in turbid water. J. Inst. Water Eng. 5:625.

- 16.4 Jullander, I. and K. Brune. 1950. Light absorption measurements on turbid solutions. *Acta Chemi. Scandinav.* 4:870.
- 16.5 Lamar, W. L. 1949. Determination of color in turbid waters. *Anal. Chem.* 21:726.
- 16.6 Black, A. P. and R. F. Christman. 1963. Characteristics of color surface waters. *JAUWA* 55:753.

17.0 Tables, Diagrams, Flowcharts, and Validation Data

- 17.1 Color Analysis Results

