Standard Operating Procedure for the Determination of Turbidity CCAL 16A.1

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1.0 Scope and Application

1.1 Turbidity is measurement of the optical property that causes light to be scattered and absorbed, rather than transmitted in straight lines through a sample with no change in direction. Turbidity in water is caused by suspended particulates such as clay, silt, organic and inorganic matter, algae and other microorganisms; hence it is proportional to the particulate concentration and a general indicator of water quality. Applicable range of this method is 0.1 – 1000 nephelometric turbidity units (NTU).

2.0 Summary of Method

2.1 Turbidity is determined using a HACH 2100A nephelometric turbidimeter. Intense light is projected up through the sample cell, and light scattered by the particles is detected at an angle of 90 degrees from the incident beam. The detector converts the light energy to an electrical signal which is amplified and displayed on the meter. The meter is calibrated using Formazin standard reference solutions, and the calibration checked with stable gel suspensions.

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 Particles consisting of light absorbing materials such as activated carbon

4.2 Debris or rapidly settling coarse sediment

4.3 Color due to dissolved, light absorbing matter

4.2 Dirty or scratched glassware, air bubbles in the sample, condensation on the sample cell

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 Formazin

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 HACH 2100A Nephelometric Turbidimeter, which includes: cells, riser, light shield, and sample cells

6.2 Primary and secondary standard reference suspensions

7.0 Reagents and Standards

7.1 Preparation of Standards

7.1.1 *Primary standard formazin suspension:* Stabilized formazin turbidity standards 1.0, 10.0, 100, and 1000 NTU were purchased from HACH Company for use as primary standard formazin suspensions. These standard formazin suspensions have a limited stability, and each standard's shelf life is dependent on the date made and concentration. Primary standards should not be used for calibration beyond their expiration date.

7.1.2 *Secondary standard:* Gelex standards for 0-10, 10-100, and 100-1000 NTU were purchased from HACH Company for use as secondary standards.

8.0 Sample Handling and Storage

8.1 Samples are stored in the dark at 4°C to minimize microbiological decomposition of solids and are analyzed within 72 hours to ensure sample integrity.

9.0 Quality Control

9.1 Quality Control Check Standard: A Gelex secondary standard run once per analysis batch for each sample range used.

9.2 Analytical Duplicate: Separate analysis from the same sample aliquot. Run a minimum of once every analysis set.

10.0 Calibration and Standardization

10.1 Calibration

Instrument calibration is checked against primary standard formazin suspensions each use, to ensure linearity between ranges and to verify the actual turbidity of Gelex secondary standards used for routine standardization. For true calibration and linearity adjustment of the instrument, refer to the HACH Model 2100A Laboratory Turbidimeter Instrument Manual.

10.2 Standardization

Before each series of measurements, the instrument should be standardized with formazin standards, and then checked with Gelex secondary standards on the range setting for which sample turbidity will be measured (see 11.0 Procedure). Refer to the HACH Model 2100A Laboratory Turbidimeter Instrument Manual to properly standardize the instrument. Standardization should be performed every time the measurement range is changed.

11.0 Procedure

11.1 Sample Preparation and Analysis

11.1.1 The instrument should be turned on and allowed to warm up for at least 30 minutes before use. Samples and standards should be at ambient temperature.

11.1.2 Slowly invert formazin standard cells 2 – 3 times and then let the sample sit undisturbed for 5 minutes before measurement. Do not shake the standard cells as it can take hours for bubbles to dissipate.

11.1.2 Select appropriate sample range and standardize using the primary formazin standard. Check range against appropriate Gelex standard; should be within 10% of noted turbidity.

11.1.3 Gently invert samples to mix. Fill sample tube with 25mL of sample, introducing as little air as possible when pouring sample into cell. Make sure the outside of the sample tube, specifically the bottom and sides, is free from water and fingerprints.

11.1.4 Repeat the previous step for the first 10 samples, noting cell position in rack on data sheet, and allow them to sit undisturbed for 5 minutes.

11.1.5 Insert the first sample cell into the sample compartment and cover with the light shield.

11.1.6 Read the turbidity of the sample from the scale corresponding to the range switch selection. The reading obtained is turbidity in Nephelometric Turbidity Units (NTU). See table 1.1 below for recording readings in different ranges. Sample turbidity should fall mid range. If necessary, change instrument measurement range and re-standardize as in 11.1.2.

11.2 Procedural Notes

11.2.1 Standardization should be performed every time the measurement range is changed.

11.2.2 The cell riser provided should be installed when operating in the 100 and 1000 NTU ranges.

11.2.3 Samples should be allowed to come to room temperature before analysis.

11.2.4 Reporting Accuracy by Measurement Range:

Range	Report to nearest
1000	50
100	5
10.0	0.5
1.0	0.05

Table 1.1: Accuracy and reporting values for different turbidity ranges

12.0 Data Analysis and Calculations

N/A

13.0 Method Performance

13.1 See Section 9.0, Quality Control

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 2130 – Turbidity. 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 HACH Model 2100A Laboratory Turbidimeter Instrument Manual. HACH Company; Loveland, Colorado.

16.4 HACH STABLCAL Stabilized Formazin Turbidity Standards Instruction Manual; October 2009, Edition 5. HACH Company; Loveland, Colorado

17.0 Tables, Diagrams, Flowcharts, and Validation Data

17.1 Turbidity Analysis Results

Turbidity Analysis Results

Project(s): _____ Date: _____ page___ of___.

Analyst: _____

Remarks: _____

Measurement Range: _____ Gelex Standard Reading: _____

Measurement Range: _____ Gelex Standard Reading: _____

Measurement Range: _____ Gelex Standard Reading: _____

Measurement Range: _____ Gelex Standard Reading: _____

Rack Position	Sample ID	Turbidity Range	Turbidity Reading (NTU)	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

18.0 Document Revision History

Original Document: May 2010
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Title: Standard Operating Procedure for the Determination of Turbidity

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New Version: 16A.1
Remove NWRI reference; Section 13
General editing