Tellurium in the Workplace Atmosphere

Method no.:	ID-132SG
Target concentration:	0.1 mg/m^3
Procedure:	The sample is collected on an MCE filter (0.8 µm) and analyzed by atomic absorption with a graphite furnace.
Recommended sampling time and sampling rate:	1.502 L/min for a total air volume of 1000L
Reliable quantitation limit:	0.4 µg/mL
Status of method:	Partially evaluated method. This method has been subjected to established evaluation procedures of the Methods Development Team and is presented for information and trial use.

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1. Introduction:

1.1 Scope

This method describes the collection and analysis of airborne tellurium. It is applicable for both ceiling (c) and time- weighted averages (TWA) exposure evaluations.

The analysis is based on the utilization of a graphite furnace.

1.2 Uses

Tellurium is used as a coloring agent in chinaware, porcelains, and glass. It is a reagent in producing a black finish on silverware. it is used as a rubber improver; in tellurium vapor "daylight" lamps; in cast iron, where minute amounts stabilize the iron carbide and appreciably increase the depth of the chill. Tellurium is a p-type semiconductor, and shows greater conductivity in certain directions, depending on alignment of the atoms. Its conductivity increases slightly with exposure to light. Tellurium is used in ceramics. Bismuth telluride has been used in thermoelectric devices. One such device, using two Bi-Te semiconductors, is reportedly capable of freezing or boiling water in seconds with the power from two flashlight batteries. The unit is said to be capable of bringing the temperature down to -75°C, using only two amperes of current. The gray iron industry uses hundreds of tons annually, a considerable amount being for hardening the surface of car wheels. It is also used in malleable iron to improve ductility and in stainless steel for machinability. A fraction of 1 per cent alloyed with lead improves the corrosion resistance, strength, and hardening properties of the lead. Tellurium is used to increase the machinability of copper and bronze, and to improve other metals and alloys. It is also used in several chemical processes, including use as a catalyst.

1.3 Physical and chemical processes

Crystalline tellurium has a silvery white appearance, and, when pure, exhibits a metallic luster. It is brittle and easily pulverized. Amorphous tellurium is formed by precipitating tellurium from a solution of telluric or tellurous acid. Whether this form is truly amorphous or trade of minute crystals is open to question. In air, tellurium burns with a greenish-blue flame forming the dioxide. See Table 1.

TABLE I

	Form I	Form II
molecular formula	Te	Te
molecular weight (g/mole)	127.60	127.60
color/crystalline form	brown black amorphous	rhombic silver white met
index of refraction	1.0025	1.0025
specific gravity	6.00	6.25
melting point (°C)	449.5	452
boiling point (°C)	1390	339
Solubility (g/100 ml)		
cold water	insoluble	insoluble
hot water	insoluble	insoluble
H_2SO_4	insoluble	insoluble
HNO_3	soluble	soluble
aqua regia	soluble	soluble
KCN	soluble	soluble
KON	soluble	soluble
HC1	insoluble	insoluble
CS_2	insoluble	insoluble

2. Range and Detection Limit:

A lower analytical limit, 0.4 µg/ml, was selected for routine analysis.

3. Interferences

None known

4. Sampling Procedure

4.1 The sample is collected on a 0.8 µm AA cellulose membrane filter using a flow rate between 1.5 and 2.0 liters per minute. Suggested minimum air volume is 100 liters. A sample blank should also be submitted. (If considerable loose dust is present in the cassette, a clear. filter should be placed over the dust before sealing).

4.2 The sample cassettes are plugged, sealed with OSHA tape, labeled, and sent to the laboratory for analysis.

4.3 No storage problems are normally anticipated. Vibration or jolting of samples should be kept to a minimum to avoid dislodging of dust from the filter.

5. Analytical Procedure:

5.1 Apparatus

Atomic absorption spectrophotometer equipped with graphite furnace, argon purge system, and deuterium arc background corrector.

Chart recorder.

Glassware.

2 or 3 piece filter cassettes

AA filters (0.8 µm, cellulose membrane filters 37-mm dia)

Personal sampling pump (capable of sampling between 1.0 and 2.0 L/pm).

5.2 Reagents

HCl, reagent grade

HNO_3, reagent grade

A certified aqueous standard such as "SPEX' 1,000 ppm standard follows:

1,000 ppm Ni solution

Diluting solution:

Twenty AA filters are ashed with 100 mL concentrated HNO_3 and 100 mL of 1,000 ppm Ni solution to a volume of 20 - 40 mL, diluted to 500 mL with deionized water and 2 mL HCl.

5.3 Standards Preparation

Standards are prepared to match the matrix of the samples (filter content acid and nickel concentration) as closely as possible according to the dilution scheme of Table III.

The 0.2. 1, 2, 5. 10 and 20 ppm "stock solutions" are made by serial dilution of the 1,000 ppm stock (with deionized water) as

5.4 Sample Preparation

Note: All Glassware must be rinsed with 1:1 HNO_3 and deionized water prior to use. Conical beakers used for the digestion are refluxed with 1:1 nitric acid and rinsed with deionized water before use.

Place filter in 125 mL conical beaker, add 5 ml of 1000 ppm Ni solution and 5 ml concentrated HNO_3 and ash to approximately 1-2 ml volume. After sample has cooled, add 2 drops HCl and swirl contents (no additional heating is done).

Quantitatively transfer sample to 25 mL volume flask, dilute to volume with deionized water, and mix. Additional dilutions for samples over 2 ppm are made with the diluting solution.

TABLE II: STOCK SOLUTIONS

STOCK SOL'N	SOL'N USED	M1 USED	M1 FINAL VOL
20 ppm	1000 ppm stock	2	100
10 ppm	100 ppm stock	10	100
5 ppm	100 ppm stock	5	100
2 ppm	100 ppm stock	2	100
1 ppm	10 ppm stock	10	100
0.2 ppm	10 ppm stock	2	100

The diluted stock solutions should be prepared just before using them to prepare the working standards as outlined in Table III.

When preparing the working standards from the stock solutions, all dilutions are made with the diluting solution.

TABLE III: WORKING STANDARDS

Standard	Stock Soln used	mL stock	H1 Final Vol.
0.1 ppm	1.0 ppm	5	50
0.2 ppm	2.0 ppm	5	50
0.5 ppm	5.0 ppm	5	50
1.0 ppm	10.0 ppm	10	100

Wavelength: 214.3 nm

Slit 3

*Tellurium Conditions

Dry= 90T, 50R, 40H, 150F
Char= 500T, 50R, 30H, 100F
Atomize= 2000T, Fr. 8H, 15F
Chart= Range 10
EDL Power= 9 watts
(Stds prepared same as As)
*These are guidelines parameters and may differ from your own.

5.5 Sample Analysis

The analysis for tellurium is performed using a graphite furnace.

Instrumental parameters are as follows:

Atomic absorption unit:

EDL wavelength: 214.3 nm
UV mode
slit setting 3
Absorbance function
Repeat mode
D_2 Background ON

Chart recorder:

10 mV range
20 mm/min speed
SERVO function

Temperature programs

Dry:	90° temp	
	50 sec ramp time	
	40 sec ramp time	150 ml/min INT flow
Char:	500° temp	
	50 sec hold time	
	30 sec hold time	100ml/min INT flow
Atomize:	2000° temp	

0 sec ramp time
8 sec ramp time 15 ml/min INT flow

Injection volume: 10 µL

The 1.0 ppm standard should give a near full scale deflection using these conditions. The entire series of standards should be run at the beginning and the end of the analysis. A standard should be run after every fourth or fifth sample in the sample rings.

5.6 Calculations

A linear regression of standard ppm vs standard peak height is performed using the OSHA Automatic AA program. The sample results are calculated based on sample peak heights; a function of sample absorption.

$$\text{mg/m}^3 = \frac{(\text{ppm Te*})\ (\text{sample volume, mL})\ (\text{Dilution factor})}{\text{air volume, liters}}$$

*blank corrected