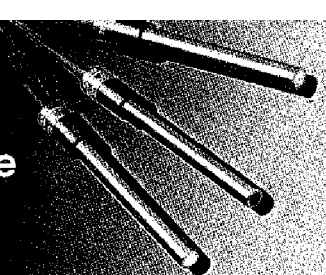


# IOTRODE™

## Ion-Selective Electrode Applications



Bulletin No. 000111

## Determination of Thiocyanate in Water

### INTRODUCTION

The following procedure will provide the user with concentration of thiocyanate ions in most water sources. The only limitation is the sample be free of sulfide, mercury, and iodine ions.

### EQUIPMENT

#### Meter:

pH/Millivolt meter. Readability of 1 mV required; 0.1 mV preferred. Specific ion meter will provide direct readout of final answer or concentration factor. Consult manual for millivolt measurement instructions.

#### Electrodes:

Measuring Electrode: Iotrode AB-150 Thiocyanate ISE.  
Reference Electrodes—Double Junction—Refillable  
Calomel — RD-101 Removable Sleeve  
                  RD-201 Non-Removable Sleeve  
Ag/AgCl — RD-301 Removable Sleeve  
                  RD-401 Non-Removable Sleeve

#### Glassware:

1. 1 ml, 2 ml, and 10 ml pipets
2. 150 ml beakers
3. 100 ml graduated cylinders
4. 100 ml, 1000 ml volumetric flasks
5. Magnetic stirrer and stirbars or glass stirring rods

### REAGENTS

1. **Ionic Strength Adjustor (ISA):** Dissolve 101 grams  $KNO_3$  in 500 ml of deionized water and dilute to one liter in a 1000 ml volumetric flask.
2. **1000 ppm Thiocyanate Standard:** Dissolve 1.378 grams reagent grade sodium thiocyanate into 500 ml deionized water in a 1000 ml volumetric flask. Dilute to mark with deionized water.

Reference Electrode Outer Junction Filling Solution: Dilute ISA 1:1 with deionized water.

### ELECTRODE SET-UP

If the electrode is being used for the first time, please follow the instructions for polishing the membrane surface. Plug the sensing electrode into the G.E. or Glass jack of the meter. Fill the inner and outer chambers of the reference electrode with appropriate solutions. Plug the reference electrode into the REF or Reference jack of the meter. Technique Hints:

1. **Stirring:** Electrode response is improved if samples and standardizing solutions are stirred at a fixed rate during measurements. If magnetic stirring is not available, stir solution one minute with a clean glass stirring rod before measuring.
2. **Temperature:** The slope of the sensing electrode and the absolute potential of the reference electrode are temperature dependent. Therefore, samples and standardizing solutions should be at the same temperature.
3. **Cleaning Electrodes:** Rinse both electrodes with a fresh portion of deionized water and blot dry with tissue between all measurements.

### ELECTRODE CALIBRATION

The primary criterion for electrode performance verification is the span test. If 55 millivolts or greater change is observed for a decade change in concentration, the performance is considered satisfactory.

1. Put 100 ml deionized water and 2 ml ISA into a 150 ml beaker. Place the pH meter into the MV. mode. Place electrodes in the solution to a minimum depth of one inch.
2. Pipet 1 ml of 1000 ppm thiocyanate standard into the solution. Stir thoroughly. Read stable electrode potential in millivolts and record value as E1.
3. Add 10 ml of 1000 ppm thiocyanate standard and stir thoroughly. Read stable electrode potential in millivolts and record as E2. Calculate S by  $E2 - E1$ . Assume S value as the slope of the electrode.

NOTE: If the slope value is below 55 mV, check electrode set-up and repolish sensing electrode.

**PROCEDURE**

**Sample Standardization:** Add 100 ml of sample solution and 2 ml of ISA solution to a 150 ml beaker. Place electrodes in the solution to a minimum depth of one inch. Read stable electrode potential in millivolts and record as E3.

**Standard Addition:** Pipet 1 ml of 1000 ppm thiocyanate standard into the solution. Stir thoroughly. Read stable electrode potential in millivolts and record value as E4. Calculate  $\Delta E$  by E4 - E3.

Note: If  $\Delta E$  is more than 30mV, dilute standard 1:10 with deionized water and divide concentration of standard by 10. If  $\Delta E$  is less than 8 mV, dilute sample 1:10 with deionized water and remeasure. Remember to multiply final answer by 10.

**CALCULATIONS**

To perform the calculation for standard addition, the following factors are needed:

- $V_s$  = Sample Volume
- $V_a$  = Volume of standard added
- $C^*$  = Concentration of standard
- $\Delta E$  = Change in potential (see procedure section)
- $S$  = Slope of the electrode (see electrode calibration section)

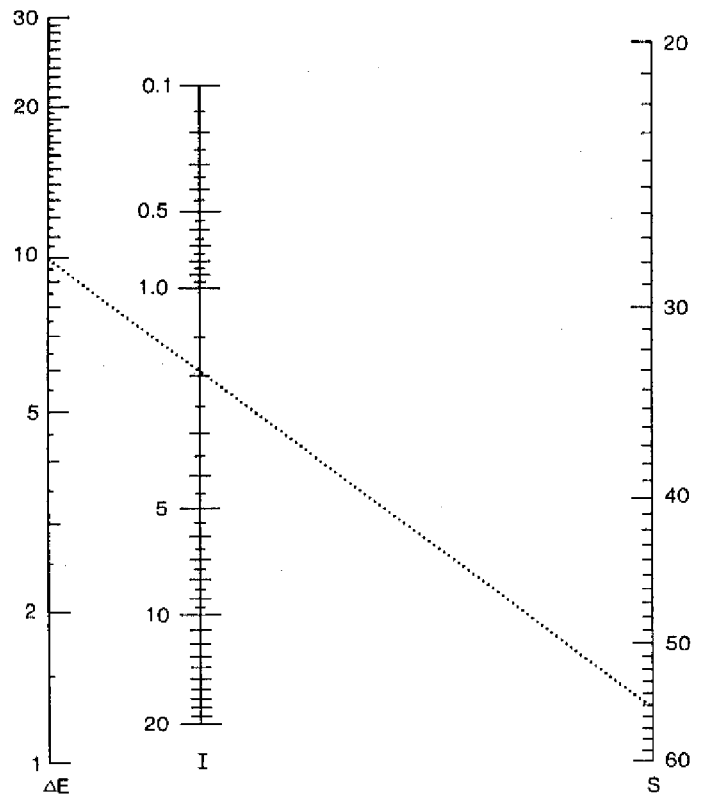
$$\text{Concentration of Sample} = \frac{C^* \left[ \frac{V_a}{V_a + V_s} \right]}{\left[ \text{antilog} \frac{\Delta E}{S} \right] - \left[ \frac{V_s + V_a}{V_s} \right]}$$

Note: If the sample is diluted, multiply sample concentration by appropriate dilution factor.

**REFERENCES:**

Mascini, M., 1972, 'Preparation and Analytical Evaluation of a New Thiocyanate Solid State Heterogeneous Membrane Electrode', *Anal.Chim.Acta.*, 62, 29.

**Standard Addition Nomograph for use with Iotrode™ Electrodes**



The standard addition nomograph method of calculation is valid when the increment of standard added to the sample is small compared to the volume. Therefore, if more than 1 ml of standard is added, please utilize the mathematical procedure above.

The following data must be known to utilize the nomograph: (See above for description of factors)

$$\Delta E, S, C^*, \text{ and } V_s$$

Utilizing  $\Delta E$  and  $S$ , draw a straight line to find  $I$  on the nomograph.

$$\text{Concentration of Sample} = \frac{(I) (C^*)}{V_s}$$

The concentration of Sample will be in the same units of concentration as  $C^*$ .

- Example:  $\Delta E = 10$  mv
- $S = 55$  mv
- $C^* = 1000$  ppm
- $V_s = 100$  ml
- $I = 2.0$  (from Nomograph)

$$\begin{aligned} \text{Sample Concentration} &= \frac{(2.0) (1000 \text{ ppm})}{100 \text{ ml}} \\ &= 20 \text{ ppm} \end{aligned}$$