Benzotriazole/Tolyltriazole

DOC316.53.01008

UV Photolysis Method[1]

Method 8079

1.0 to 16.0 mg/L Benzotriazole

Powder Pillows

1.0 to 20.0 mg/L Tolyltriazole

Scope and application: For cooling or boiler water. This method as written is not suitable for use with HRA.

[1] Adapted from Harp, D., Proceedings 45th International Water Conference, 299 (October 22-24, 1984)

Test preparation

Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows sample cell and orientation requirements for reagent addition tests, such as powder pillow or bulk reagent tests.

To use the table, select an instrument, then read across to find the applicable information for this test.

Table 1 Instrument-specific information

Instrument	Sample cell orientation	Sample cell
DR 6000 DR 3800 DR 2800 DR 2700 DR 1900	The fill line is to the right.	2495402 
DR 5000 DR 3900	The fill line is toward the user.	
DR 900	The orientation mark is toward the user.	2401906 

Before starting

Install the instrument cap on the DR 900 cell holder before ZERO or READ is pushed.
Wear UV safety goggles while the UV lamp is on.
Do not touch the UV lamp surface with bare fingers. Fingerprints can damage the glass. Rinse the lamp and wipe with a soft, clean tissue between tests.
The sample temperature must be 20–25 °C (68–77 °F) for accurate results.
Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.
Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

Items to collect

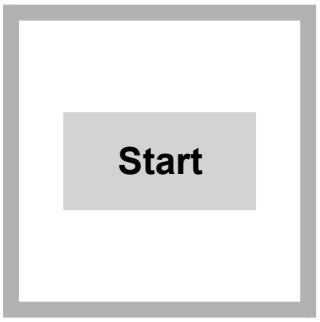
Description	Quantity
Triazole Reagent Powder Pillows	1
Square mixing bottle, 25-mL	1
Ultra-violet lamp with power supply	1
UV safety goggles	1
Sample cells (For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.)	2

Refer to Consumables and replacement items on page 5 for order information.

Sample collection

- Collect samples in clean glass or plastic bottles.
- Analyze the samples as soon as possible for best results.

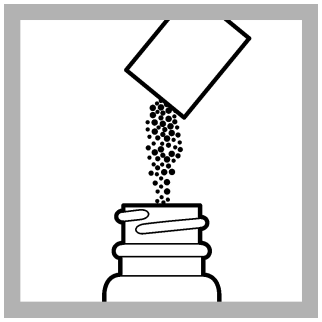
Powder pillow procedure with UV photolysis



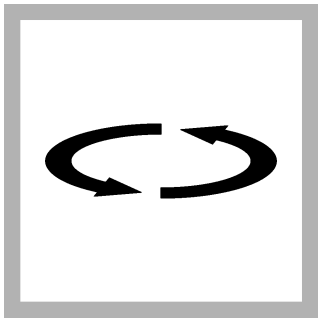
1. Start program **30 Benzotriazole** or program **730 Tolyltriazole**. For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.

Note: *Although the program name can be different between instruments, the program number does not change.*

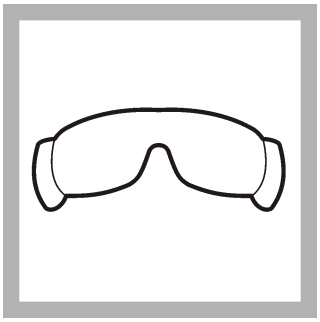
2. Prepare the sample: Fill a marked mixing bottle to the 25-mL line with sample.



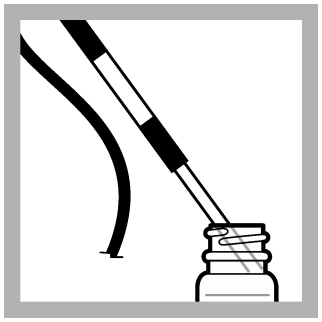
3. Add the contents of one Triazole Reagent Powder Pillow.



4. Swirl to mix.
Make sure all of the powder is dissolved.



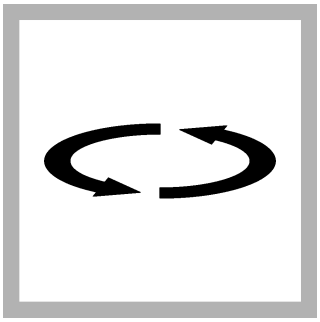
5. Put on UV safety goggles.



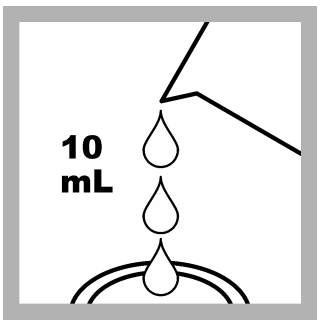
6. Put the ultraviolet lamp into the mixing bottle. Turn on the UV lamp.

7. Start the instrument timer. A 5-minute reaction time starts.

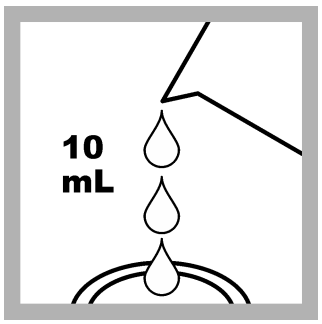
Low results will occur if the UV photolysis is more than or less than 5 minutes. A yellow color will show if triazole is in the sample.



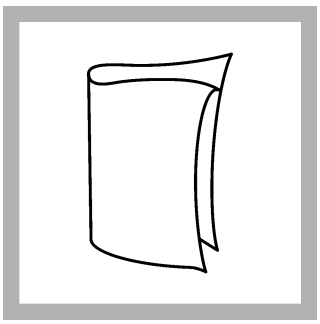
8. When the timer expires, turn off the lamp. Remove the lamp from the mixing bottle. Swirl the mixing bottle to mix thoroughly.



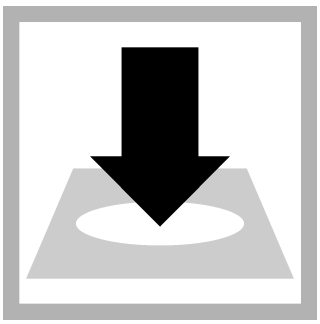
9. Fill a sample cell with 10 mL of the reacted (prepared) sample.



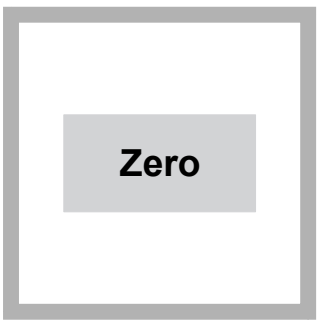
10. Prepare the blank: Fill a second sample cell with 10 mL of unreacted sample.



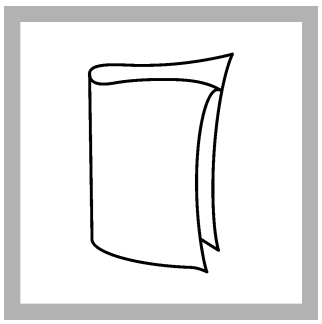
11. Clean the blank sample cell.



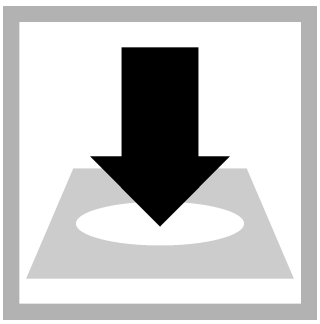
12. Insert the blank into the cell holder.



13. Push **ZERO**. The display shows 0.0 mg/L Benzotriazole or Tolyltriazole.



14. Clean the prepared sample cell.



15. Insert the prepared sample into the cell holder.

16. Push **READ**. Results show in mg/L Benzotriazole or Tolyltriazole.

Interferences

Interfering substance	Interference level
Acrylates (as methyl acrylate)	More than 50 mg/L
Alum	More than 400 mg/L
Borate (as sodium tetraborate (borax))	Adjust the sample pH to 4–6 with 1 N sulfuric acid, then start the test procedure. If the sample contains more than 4000 mg/L, dilute the sample.
Chlorine (as Cl_2)	More than 20 mg/L

Interfering substance	Interference level
Chromium (as chromate)	More than 12 mg/L
Color	Causes a positive interference
Copper	More than 10 mg/L
Hardness	More than 500 mg/L as $CaCO_3$. Add 10 drops of Rochelle Salt Solution before the reagent is added.
Iron	More than 20 mg/L
Lignosulfonates	More than 40 mg/L
Magnesium	More than 300 mg/L as $CaCO_3$
Molybdenum (as molybdate)	More than 200 mg/L
Nitrite	Adjust the sample pH to 4–6 with 1 N sulfuric acid, then start the test procedure. If the sample contains more than 4000 mg/L, dilute the sample.
Phosphonates (AMP or HEDP)	More than 100 mg/L
Sulfate	More than 200 mg/L
Zinc	More than 80 mg/L
Strong oxidizing or reducing agents	Interfere at all levels

Accuracy check

Standard additions method (sample spike)

Use the standard additions method (for applicable instruments) to validate the test procedure, reagents and instrument and to find if there is an interference in the sample.

Items to collect:

- Benzotriazole Standard Solution, 500 mg/L
- Pipet, TenSette®, 0.1–1.0 mL
- Pipet tips for TenSette® Pipet, 0.1–1.0 mL

1. Use the test procedure to measure the concentration of the sample, then keep the (unspiked) sample in the instrument.
2. Go to the Standard Additions option in the instrument menu.
3. Select the values for standard concentration, sample volume and spike volumes.
4. Open the standard solution.
5. Prepare three spiked samples: use the TenSette pipet to add 0.1 mL, 0.2 mL and 0.3 mL of the standard solution, respectively, to three 25-mL portions of fresh sample. Mix well.
6. Use the test procedure to measure the concentration of each of the spiked samples. Start with the smallest sample spike. Measure each of the spiked samples in the instrument.
7. Select **Graph** to compare the expected results to the actual results.

   Note: *If the actual results are significantly different from the expected results, make sure that the sample volumes and sample spikes are measured accurately. The sample volumes and sample spikes that are used should agree with the selections in the standard additions menu. If the results are not within acceptable limits, the sample may contain an interference.*

UV lamp check

Complete this procedure to make sure that the UV lamp operates correctly. If the result is significantly low, replace the lamp. The normal UV lamp life is approximately 5000 hours.

Items to collect:

- Benzotriazole Standard Solution, 500 mg/L
- 1-L volumetric flask, Class A

- 5-mL volumetric pipet, Class A and pipet filler
- Deionized water

1. Prepare a 5.0 mg/L benzotriazole standard solution as follows:
   a. Use a pipet to add 10.0 mL of a 500-mg/L benzotriazole standard solution into the volumetric flask.
   b. Dilute to the mark with deionized water. Mix well. Prepare this solution daily.
2. Use the test procedure to measure the concentration of the prepared standard solution.
3. Compare the expected result to the actual result.
   Note: *If the test result is significantly below 5 mg/L, replace the lamp.*

Method performance

The method performance data that follows was derived from laboratory tests that were measured on a spectrophotometer during ideal test conditions. Users can get different results under different test conditions.

Program	Standard	Precision (95% Confidence Interval)	Sensitivity Concentration change per 0.010 Abs change
30	10 mg/L benzotriazole	9.7–10.3 mg/L benzotriazole	0.2 mg/L benzotriazole
730	12 mg/L tolyltriazole	11.6–12.4 mg/L tolyltriazole	0.2 mg/L tolyltriazole

Summary of method

Benzotriazole or tolyltriazole, used in many applications as corrosion inhibitors for copper and copper alloys, are determined by a proprietary catalytic ultraviolet (UV) photolysis procedure that takes less than 10 minutes to complete. The measurement wavelength is 425 nm for spectrophotometers or 420 nm for colorimeters.

Consumables and replacement items

Required reagents

Description	Quantity/test	Unit	Item no.
Triazole Reagent Powder Pillow	1	100/pkg	2141299

Required apparatus

Description	Quantity/test	Unit	Item no.
UV safety goggles	1	each	2113400
Bottle, square, with 25-mL mark	1	each	1704200
Select one based on available voltage:			
Lamp kit, UV, with power supply, 115 VAC, 60 Hz	1	each	2704500
Lamp kit, UV, with power supply, 230 VAC, 50 Hz	1	each	2704502

Recommended standards

Description	Unit	Item no.
Benzotriazole Standard Solution, 500-mg/L	100 mL	2141342

Optional reagents and apparatus

Description	Unit	Item no.
Flask, volumetric, Class A, 1000-mL glass	each	1457453
Paper, pH, 0–14 pH range	100/pkg	2601300
Pipet filler, safety bulb	each	1465100
Pipet, TenSette®, 0.1–1.0 mL	each	1970001
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	50/pkg	2185696
Pipet tips for TenSette® Pipet, 0.1–1.0 mL	1000/pkg	2185628
Sulfuric Acid Standard Solution, 1 N	100 mL MDB	127032
Rochelle Salt Solution	29 mL	172533
Pipet, volumetric, Class A, 10-mL	each	1451538

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