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Copper, Cadmium, Lead, Zinc - Mercury Film Electrode

(Standard Comparison Method) - Application 1

Application 1 involves the use of an instrument connected to a computer running software for the detection of copper, cadmium, lead, and zinc ions in water samples. It utilizes a mercury-plated glassy carbon electrode and linear sweep voltammetry, employing the standard comparison method for detection. This method is suitable for detecting surface water with low organic content and relatively clean conditions, as organic matter may adhere to metal surfaces and hinder detection. Therefore, heavily polluted wastewater and natural water require pretreatment, such as digestion, is required prior to detection.

Reproducibility: When detecting solutions containing 100 ppb of the target metals, the standard deviation is less than 3% (for more than 5 measurements).

Known Interferences: Thallium and bismuth may interfere with detection. Thallium's peak appears around -0.55V, which may interfere with the separation of lead. Copper tends to form intermetallic compounds with zinc, causing mutual interference in detection. Therefore, copper and zinc cannot be detected simultaneously.

Peak Positions:

Cu: -350 mV to 40 mV vs. Ag/AgCl
Cd: -750 mV to -450 mV vs. Ag/AgCl
Pb: -600 mV to -300mV vs. Ag/AgCl
Zn: -1150 mV to -900 mV vs. Ag/AgCl

Electrolyte: CCLZ electrolyte.
Standard Solutions: Copper, cadmium, and lead standard solution; zinc standard solution.
Other Reagents: Mercury plating solution; zinc additive; ultrapure water.

Reagent Addition Reference:

Reagent Addition		CCLZ Electrolyte	Ultrapure Water	Copper, Cadmium, Lead Standard Solution (20 ppm)	Water Sample
Blank Sample		10 mL	10 mL	0	0
Copper, Cadmium, Lead Standard Sample ((Range)	10 ppb	10 mL	10 mL	10 µL	0
	50 ppb	10 mL	10 mL	50 µL	0
	200 ppb	10 mL	10 mL	200 µL	0
	1 ppm	10 mL	9 mL	1 mL	0
	10 ppm	10 mL	0 mL	10 mL	0
Sample to be Tested		10 mL	0	0	10 mL

Reagent Addition		CCLZ Electrolyte	Ultrapure Water	Zinc Standard Solution (20 ppm)	Zinc Additive	Water Sample
Blank Sample		10 mL	10 mL	0	50 µL	0
Zinc Standard Sample (Range)	10 ppb	10 mL	10 mL	10 µL	50 µL	0
	50 ppb	10 mL	10 mL	50 µL	50 µL	0
	200 ppb	10 mL	10 mL	200 µL	50 µL	0
	1 ppm	10 mL	9 mL	1 mL	50 µL	0
	10 ppm	10 mL	0 mL	10 mL	50 µL	0
Sample to be Tested		10 mL	0	0	50 µL	10 mL

Analysis Steps: The YSHM-200W analyzer is user-friendly. The following are the basic steps required for both standalone and computer-controlled analyses. These seven main steps are:

1.Electrode Pre-treatment: For detecting copper, cadmium, lead, and zinc, a mercury-coated glassy carbon electrode is used. First, polish and clean the glassy carbon electrode using sandpaper and velvet cloth, then soak it in ultrapure water for a few minutes as detailed in the manual. Next, fill the reference electrode's inner tube with fresh 3M KCl solution and immerse it in the soaking solution (saturated KCl solution) for a few minutes. Finally, rinse the electrodes with ultrapure water. Place the three electrodes in their respective positions in the electrode holder and connect the corresponding colored plugs.

2.Electrode Maintenance: Pour the mercury solution into the "Maintenance Solution" analysis cup and perform the "Mercury Film" operation under the "Electrode Maintenance" menu. After completion, promptly pour the mercury solution back into the bottle for reuse 5-10 times.

3.Preparation of Blank, Standard, and Sample Solutions: Place the analysis cup on the analysis stand in sequence, preparing the blank sample, standard sample, and test sample according to the addition order listed above.

4.Blank Sample Testing: Verify that the electrolyte, electrodes, and analysis cup are not contaminated.

5.Select Metal and Measurement Range: Analyze the known concentration standard sample.

6.Analyze the Test Water Sample: The instrument will compare the signal obtained from the test water sample with that of the standard sample to display the analytical results.

7.Electrode Cleaning: Perform the "Remove Mercury Film" step in the blank sample to dissolve the mercury film (or use lint-free paper to wipe off the mercury film). Then, polish and thoroughly clean the electrodes. Perform the "Glass Carbon Cleaning" step in electrode maintenance if needed. Dispose of the liquid in the reference electrode's inner tube and refill it before the next test to effectively prevent deterioration.

Notes:

①After calibrating the standard sample, approximately ten sample analyses can be performed. If the results' reproducibility deteriorates after this number of analyses, consider recalibrating the standard sample. It is advisable to prepare fresh blank and standard samples during recalibration.

②Ensure correct connection of the three-electrode system, and avoid reversing connections (match the colors).

③After use, maintenance solutions, cleaning water, blank samples, standard samples, and test samples should be returned to their designated positions on the analysis rack to prevent mix-ups.

④When adding liquids, avoid generating bubbles in the analysis cup. Add the liquid along the wall of the analysis cup using the pipette tip, and handle carefully to avoid splashing, which may affect the test results.

⑤If a zinc additive is required, it must be added to the blank sample, standard sample, and test sample to maintain consistency.

⑥When the concentration of zinc ions in the water is significantly higher than that of copper ions (at least 100 times), the addition of zinc additive can be optional. If testing for copper, cadmium, lead, and zinc is required, it is recommended to measure cadmium and lead first,

followed by copper, and finally zinc. If the copper concentration exceeds 200 ppb, dilute the test sample to below 100 ppb of copper before adding the zinc additive for zinc measurement. Otherwise, using zinc additive may cause the three-electrode system and stirring rod to turn black, making further testing difficult. If this occurs, soak the components in 5% hydrochloric acid until the black residue is completely removed before continuing. **After zinc measurement, soak the electrode probe and stirring rod in dilute hydrochloric acid (approximately 5%) for a few hours to prevent any impact on subsequent tests.**