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GB/T 12157-2022

Replacing GB/T 12157-2007

Determination of dissolved oxygen in water for industrial circulating cooling system and boiler

工业循环冷却水和锅炉用水中溶解氧的测定

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Preview: page 1 of 5 shown, 13 in the full document. Complete English PDF, instant download:
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Table of Contents

1 Scope
2 Normative references
3 Terms and definitions
4 General
5 Iodometric method...
5.4 Test steps
5.5 Result calculation
6 Internal electrolysis method...
6.3 Instruments and equipment
6.3.1 Silver-zinc primary cells (electrolytic cells)
6.4 Test steps
7 Oxygen electrode method
7.2 Reagents or materials
7.4 Test steps

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1 Scope

GB/T 12157-2022 is the Chinese national standard on determination of dissolved oxygen in water for industrial circulating cooling system and boiler, in the field of environment and health protection, safety. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 9 March 2022 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 October 2022. Classification: ICS 13.060.50, CCS G76. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

This document describes the method for the determination of dissolved oxygen in industrial circulating cooling water, boiler feed water, and condensate water. The iodometric method in this document is suitable for the determination of the mass concentration of dissolved oxygen in industrial circulating cooling water ranging from 0.2mg/L to 8mg/L (as O2). The internal electrolysis method is suitable for the determination of the mass concentration of dissolved oxygen in boiler feed water and condensate water from 2μg/L to 100μg/L (as O2).

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The oxygen electrode method is suitable for the determination of the mass concentration of dissolved oxygen in industrial circulating cooling water and boiler water greater than 0.1μg/L (as O2).

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 601, Chemical reagent - Preparations of standard volumetric solutions

GB/T 603, Chemical reagent - Preparations of reagent solutions for use in test methods

GB/T 6682-2008, Water for analytical laboratory use - Specification and test methods

3 Terms and definitions

There are no terms and definitions that need to be defined in this document.

4 General

WARNING -- The strong acids and strong bases used in this document are corrosive. Avoid inhalation or contact with skin when using. If it splashes to the human body, rinse immediately with plenty of water. In severe cases, seek medical attention immediately.

5.2.6 Standard titration solution of sodium thiosulfate: c(Na2S2O3)=0.01mol/L. After preparation according to GB/T 601, dilute 10 times.

5.2.7 Potassium permanganate standard titration solution: . After preparation according to GB/T 601, diluted 10 times.

5.2.8 Starch indicator solution: 10g/L.

5.3 Instruments and equipment Sampling bottles: Two stoppered glass bottles. Measure the volume of water filled with the plug. One bottle is labeled A and the other bottle is labeled B. The volume shall be 200mL~500mL.

5.4 Test steps

5.4.1 Sampling Place the cleaned sampling bottle A and B in the cleaned sampling barrel at the same time. The sampling barrel shall be at least 15cm higher than the sampling bottle. Insert two cleaned polyethylene plastic tubes or inert material tubes into the bottom of bottle A and bottle B, respectively. Simultaneously introduce the water sample into bottle A and bottle B through the catheter by siphoning or other methods. The flow rate shall be about 700mL/min. Let the water naturally overflow from bottle A and B into the barrel until the level in the sampling barrel is more than 15cm above bottle A and B mouths.

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Preview: page 3 of 5 shown, 13 in the full document. Complete English PDF, instant download:
https://chinastandards.org/standards/gb-t-12157-2022

5.4.2 Pretreatment of water sample If there are suspended substances in the water sample that can fix or consume oxygen, potassium aluminum sulfate solution can be used to flocculate. Fill a 1000mL stoppered bottle with the water sample to be tested and let the water overflow (according to the sampling procedure in 5.4.1). Pipette 20mL of potassium aluminum sulfate solution and 4mL of ammonia water into the water sample to be tested. Stopper, mix, and allow to settle. Aspirate the supernatant into a narrow-mouthed bottle. Analyze according to the determination procedure.

5.4.3 Oxygen fixation and acidification Use a slender glass tube to pipette about 1mL of the manganese sulfate solution. Insert the glass tube into the middle of bottle A. Put in the manganese sulfate solution. Then add 5mL of alkaline potassium iodide mixed solution and 2.00mL of potassium permanganate standard titration solution in the same way. Place bottle A under the water layer of the sampling barrel. After precipitation in bottle A, open the cork under water. Add 5mL of sulfuric acid solution to bottle A. Close the bottle tightly. Take out to shake well. First add 5mL of sulfuric acid solution to bottle B. Then add about 1mL of manganese sulfate solution, 5mL of alkaline potassium iodide mixed solution, and 2.00mL of potassium permanganate standard titration solution at the same position where sulfuric acid is added. There shall be no precipitation. Otherwise, retest. Close the bottle tightly. Take out. Shake well. Place bottle B under the water layer of the sampling barrel.

5.4.4 Determination Pour the solution in bottle A and bottle B into two 600mL or 1000mL beakers, respectively. Use sodium thiosulfate standard titration solution to titrate until light yellow. Add 1mL of starch indicator solution to continue titration. The solution changes from blue to colorless. Use the titrated solution to rinse the original bottle A and B. Continue to titrate until colorless as the end point.

5.5 Result calculation

5.5.1 The mass concentration of dissolved oxygen in the water sample (rho1) (as O2), expressed in milligrams per liter (mg/L), is calculated according to formula (1): Where, c - The value of the concentration of the standard titration solution of sodium thiosulfate, in moles per liter (mol/L); M - The value of the molar mass of oxygen, in grams per mole (g/mol) (M = 16.0); V1 - The value of the volume of sodium thiosulfate standard titration solution consumed by titrating bottle A water sample, in milliliters (mL); VA - The value of the volume of bottle A, in milliliters (mL); VA' - The value of the sum of the volumes of manganese sulfate solution, alkaline potassium iodide mixed solution, sulfuric acid solution and potassium permanganate standard titration solution added to bottle A, in milliliters (mL); V2 - The value of the volume of the standard titration solution of sodium thiosulfate consumed by titrating the water sample of bottle B, in milliliters (mL); VB - The value of the volume of bottle B, in milliliters (mL); VB' - The value of the sum of the volumes of manganese sulfate solution, alkaline potassium iodide mixed solution, sulfuric acid solution and potassium permanganate standard solution added in bottle B, in milliliters (mL). Calculation results are expressed to two decimal places.

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https://chinastandards.org/standards/gb-t-12157-2022

5.5.2 If the water sample has been pretreated, the mass concentration of dissolved c - The value of the concentration of potassium permanganate standard titration solution, in moles per liter (mol/L); M - The value of the molar mass of oxygen, in grams per mole (g/mol) (M = 16.00); V - The value of the volume of the acid sodium indigo disulfonate solution pipetted, in milliliters (mL); 1/2 - The reaction coefficient of sodium indigo disulfonate and potassium permanganate converted to the reaction with dissolved oxygen.

6.2.8 Ammonia indigo sodium disulfonate solution: According to the required amount, mix equal volumes of ammonia-ammonium sulfate buffer solution and acid sodium indigo disulfonate stock solution. Due to the instability of the ammonia-based sodium indigo disulfonate solution, the solution shall be prepared when used.

6.2.9 Reduced sodium indigo disulfonate solution: Drain the water from the upper part of the silver-zinc reduction burette. Inject a small amount of ammoniacal sodium indigo disulfonate solution to wash the silver-zinc burette. Drain the washing liquid. Fill the burette with ammoniacal sodium indigo disulfonate solution. When the solution changes from blue to bright yellow, drain the blue solution at the tip of the burette. Then use. If the user is in a hurry, he can clamp the silver-zinc burette between the palms. Rub gently. Alternatively, hold the silver-zinc burette in hand and shake it up and down. It can also speed up the reduction of sodium indigo disulfonate. This solution shall be prepared at the time of use. After the solution originally stored in the burette is discarded, add a new solution to prepare. The use period is 4h.

6.2.10 Acid sodium indigo disulfonate standard solution: Pipette 50mL of acid sodium indigo disulfonate stock solution. Place in a 100mL volumetric flask. Use water to dilute to the scale. Each milliliter of this solution is equivalent to 20μg of O2.

6.2.11 Potassium permanganate standard titration solution: . After preparation according to GB/T 601, dilute 10 times.

6.3.1 Silver-zinc primary cells (electrolytic cells)

6.3.1.1 Preparation of sintered silver particles (porous silver particles) Weigh 50g of silver powder or precipitated silver. Spread in a 100mL porcelain evaporating dish. Flatten the surface. The thickness of silver powder is about 5mm. Put the porcelain evaporating dish into a 620°C high temperature furnace. Sinter for about 30min. Take out the silver block with a tool after cooling. Cut into silver bars with a width of 10mm and a length of 20mm. Put the silver bars back into the original evaporating dish. Then burn in an 800°C high temperature furnace for 30min. After taking out to cool, cut into porous silver particles with a particle size of 3mm~5mm.

6.3.1.2 Preparation of silver-zinc reduction burette (silver-zinc reduction battery) Take a 50mL acid burette. Pad about 10mm thick fiberglass on the bottom. Fill the burette with water. Remove air bubbles from the tip of the burette. Take the number of zinc particles with

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