National Standard of the People's Republic of China

Sodium Hypochlorite Generator

1. Subject Content and Scope of Application

This standard specifies the product classification, technical requirements, test methods, and inspection rules for sodium hypochlorite generators using the diaphragmless electrolysis method for low-concentration brine.

This standard applies to sodium hypochlorite generators used for drinking water disinfection, wastewater treatment, health and epidemic prevention, and industrial production departments.

2. Referenced Standards

GB 3859 Semiconductor Power Converters
GB 5461 Edible Salt
GB 5749 Hygienic Standard for Drinking Water
GB 5750 Standard Test Method for Drinking Water
JB 1043 Anti-corrosion Low-voltage Electrical Appliances for Chemical Industry
JB 1045 Test Method for Corrosion of Electrical Products by Chemical Gases
JB 2759 General Technical Conditions for Packaging of Electromechanical Products

3. Terms and Definitions

3.1 Electrolytic Cell

In a sodium hypochlorite generator that electrolyzes low-concentration brine, the device where electrolysis and solution reactions occur is called an electrolytic cell. Depending on the operation mode and usage requirements, the electrolytic cell can adopt different cell structures and electrode shapes.

3.2 Available Chlorine Concentration (C)

The strength of the oxidizing ability of a sodium hypochlorite solution is quantitatively expressed by the available chlorine concentration. It represents the oxidizing ability per liter of solution, equivalent to the oxidizing ability of a certain mass of chlorine gas in water. The unit is g/L. The available chlorine concentration is twice the concentration of chlorine elements in a positive valence state in the solution. For every 1g of sodium hypochlorite in the solution, there is 0.953g of available chlorine.

3.3 Available Chlorine Production Rate (G)

The output of a sodium hypochlorite generator is expressed by the available chlorine production rate, which is equal to the mass of available chlorine generated per hour when the equipment is working under rated conditions (g), unit g/h. The available chlorine production rate is calculated by formula (1):

$$G=C\times Q \qquad (1)$$

In the formula: Q —— the flow rate of sodium hypochlorite solution per hour, L/h.

3.4 Current Efficiency (η)

The ratio of the actual amount of available chlorine generated to the theoretical amount of available chlorine generated after a certain amount of electric charge has passed through the electrolytic cell is called the current efficiency of the electrolytic cell. According to Faraday's law of electrolysis, the theoretical amount of available chlorine generated per 1 A·h of electric charge passing through the electrolytic cell is 1.323 g. The current efficiency is calculated by formula (2):

$$\eta = \frac{G}{I \times n \times 1.323} \times 100\%$$

In the formula:

I —— electrolytic current, A;

n —— number of electrode series;

1.323 —— theoretical amount of available chlorine generated per ampere-hour, g/(A·h).

3.5 Electrolytic Voltage (V)

When the sodium hypochlorite generator is operating under rated conditions, the direct current voltage applied between the anode and cathode of the electrolytic cell is called the electrolytic voltage, unit (V). When the electrolytic cell operates with multiple pairs of anodes and cathodes in series, the electrolytic voltage is expressed as the product of the voltage per pair of electrodes and the number of series, such as 4 V×3.

3.6 Nominal Electrolytic Current (I)

The value of the electrolytic current flowing through the electrolytic cell that maintains the rated production rate of the sodium hypochlorite generator is called the nominal electrolytic current, unit (A). When the device's electrolytic cell operates with multiple pairs of electrodes in parallel, the nominal electrolytic current can be expressed as the product of the current per pair of electrodes and the number of parallels, such as 50 A×2.

3.7 Electrolyte Concentration (S)

The sodium hypochlorite generator uses low-concentration brine as the electrolyte. The electrolyte concentration is expressed as the number of grams of NaCl per liter of solution, unit g/L.

3.8 DC Power Consumption (P_{DC})

The DC power consumed in the electrolytic cell per kilogram of available chlorine generated when the sodium hypochlorite generator is operating under rated conditions is called its DC power consumption, unit (kW·h)/kg, calculated by formula (3):

$$P_{DC} = \frac{U \times I}{G} = \frac{U \times I}{Q \times C}$$

In the formula: U —— electrolytic voltage (V_{DC});

I —— electrolytic current (A_{DC});

G —— available chlorine production rate (g/h);

Q —— sodium hypochlorite solution production rate (L/h);

C —— available chlorine concentration of sodium hypochlorite (g/L).

3.9 AC Power Consumption (P_{AC})

When the sodium hypochlorite generator is operating under rated conditions, the AC power consumed by the entire machine per kilogram of available chlorine generated is called its AC power consumption, unit (kW·h)/kg, calculated by formula (4):

$$P_{AC} = \frac{P_1 \times 1000}{G} \quad \text{...... (4)}$$

In the formula: $P1$ —— input active power of the entire machine, kW.

3.10 Salt Consumption (Ui)

The mass of NaCl consumed per kilogram of available chlorine generated when the sodium hypochlorite generator is operating under rated conditions is called its salt consumption, unit kg/kg, calculated by formula (5):

$$U_i = \frac{S}{C} \quad \text{...... (5)}$$

In the formula: S —— electrolyte concentration, g/L;

C —— available chlorine concentration, g/L.

4 Product Classification

4.1 Classification Principle: Sodium hypochlorite generators are classified according to their use, operation mode, specifications, and quality grade.

4.1.1 Sodium hypochlorite generators are divided into two categories based on their use: sanitary disinfection and environmental protection. Sanitary disinfection types can be used for environmental protection, but environmental protection types must not be used for sanitary disinfection. Sanitary disinfection types refer to those used for drinking water disinfection, sanitary equipment and tableware disinfection, vegetables, fruits, and food. Sodium hypochlorite generators for environmental protection refer to those used for industrial wastewater treatment, hospital sewage treatment, and other industrial sectors that use sodium hypochlorite solutions, which are not directly related to human health.

4.1.2 The operation modes of sodium hypochlorite generators are divided into continuous operation and intermittent operation.

4.1.3 The specifications of sodium hypochlorite generators are based on the effective chlorine production rates of 5, 10, 25, 50, 75, 100, 150, 200, 250, 300, 400, 500, 750, 1000, 1500, 2000, 3000, 5000 g/h. Specifications exceeding 5000 g/h are determined according to actual needs.

4.1.4 Sodium hypochlorite generators are classified into premium grade (A), first grade (B), and qualified grade (C) based on quality.

4.2 Product Marking

4.2.1 The product marking of sodium hypochlorite generators consists of three parts, arranged in the following order:
Product name; Technical characteristics; Standard number.

4.2.2 The product name part is "Sodium Hypochlorite Generator."

4.2.3 The technical characteristics part consists of letters and numbers indicating the device's use, operation mode, specifications, and quality grade.

4.2.3.1 The first Chinese phonetic letter in the technical characteristics part indicates the device's use. The letter W indicates use for sanitary disinfection, and the letter H indicates use for environmental protection.

4.2.3.2 The second Chinese phonetic letter in the technical characteristics part indicates the device's operation mode, with the code L for continuous electrolysis and J for intermittent electrolysis.

4.2.3.3 The third Arabic numeral in the technical characteristics part indicates the device's specifications, with the numerical value representing the device's rated production rate.

4.2.3.4 The fourth English letter in the technical characteristics part indicates the product's quality grade. The letter A indicates premium grade, B indicates first grade, and C indicates qualified grade.

4.2.4 The standard number part in the product marking indicates that the product complies with this standard, represented by GB12176.

4.3 Example of Product Marking

For example, a sodium hypochlorite generator used for sanitary disinfection, operating continuously, with a rated production rate of 100 g/h, and achieving first-grade quality, is marked as:

Sodium Hypochlorite Generator WL100 B GB 12176-90

4.4 The quality grade marks and compliance marks used in the product marking must be approved by a national authority or designated quality monitoring unit.

4.5 The specific model of the product is allowed to be determined by the manufacturer according to the requirements of this standard.

5 Technical Requirements

5.1 Environmental Conditions: Sodium hypochlorite generators should be able to operate normally under the following environmental conditions.

5.1.1 Ambient temperature: 0 to 40°C.

5.1.2 Ambient humidity: The maximum relative humidity in the air should not exceed 90% (at an equivalent air temperature of 20±5°C).

5.1.3 Low-voltage electrical appliances selected for sodium hypochlorite generators of premium quality grade must comply with the requirements of JB 1043 in addition to their respective product technical requirements.

5.2 Basic Technical Requirements

5.2.1 Sodium hypochlorite generators should be manufactured according to drawings and technical documents approved through specified procedures.

5.2.2 The specifications of sodium hypochlorite generators should comply with the requirements of section 4.1.3 of this standard.

5.2.3 Sodium hypochlorite generators are classified into quality grades according to the provisions of section 5.4 of this standard. Products achieving a certain quality grade must meet all the requirements of that grade.

5.2.4 Sodium hypochlorite generators must be equipped with a grounding bolt on the casing. All parts of the casing and metal structural parts of the power supply section must have reliable electrical connections to the grounding bolt, with a measured connection resistance of less than 0.1Ω. The grounding bolt should have a clear grounding mark.

5.2.5 The electrolytic cells and liquid storage tanks used in equipment with a production rate greater than 25 g/h must adopt a closed structure and be equipped with standard interfaces for connecting to outdoor exhaust pipelines.

5.2.6 Equipment with a production rate greater than 25 g/h should have interchangeable standard interfaces for connecting to auxiliary brine preparation and injection devices.

5.2.7 Equipment with a production rate greater than 25 g/h must be equipped with monitoring instruments for electrolytic current and electrolytic voltage, with an accuracy of at least 2.5 grade. Continuous operation equipment must be equipped with a flow metering device for the electrolyte, and intermittent operation equipment must be equipped with a liquid level gauge on the electrolytic cell or circulation tank.

5.2.8 Physicochemical performance requirements for the sodium hypochlorite solution produced by the equipment.

5.2.8.1 The sodium hypochlorite solution should be clear and transparent, free of visible impurities.

5.2.8.2 The content of heavy metal ions such as chromium and lead in the sodium hypochlorite solution produced by generators used for sanitary disinfection should comply with the relevant provisions of Chapter 2 of GB 5749 regarding water quality standards and sanitary requirements.

5.2.8.3 Sodium hypochlorite generators used for sanitary disinfection must not use graphite electrodes or aluminum dioxide-coated anodes.

5.3 Operating Parameters and Performance of Sodium Hypochlorite Generators

5.3.1 Power supply: The input power for sodium hypochlorite generators should be:

$$AC \quad 220\,V/380\,V \pm 10\% \quad 50Hz \pm 5\%$$

5.3.2 The adjustment range of the electrolytic current should be greater than ±10% of the rated electrolytic current.

5.3.3 Sodium hypochlorite generators should ensure the rated production rate during long-term operation and should be able to safely operate at 10% above the rated production rate for 1 hour.

5.3.4 The recommended concentration range for the electrolyte used in the equipment is 30 to 50 g/L. The entire process of equipment performance testing should use an electrolyte of a fixed concentration selected within this range.

5.3.5 The electrolyte consumption in continuous operation electrolytic cells is expressed as the flow rate of the electrolyte per hour, in L/h. In intermittent operation electrolytic cells, it is expressed as the amount of brine used per electrolysis cycle and the electrolysis cycle (h), in L/h, such as 50 L/5h.

5.3.6 The product should specify the dimensions, weight, and installation dimensions of the equipment and auxiliary equipment. For drinking water disinfection and sewage treatment, an installation diagram should be provided with the equipment.

5.3.7 The equipment should ensure that the temperature of the electrolyte during electrolysis is less than 40°C, and necessary cooling measures should be taken if required.

5.4 Technical and Economic Indicators and Quality Grading (Table 1)

Table 1 Technical and Economic Indicators and Quality Grading

Technical and Economic Indicators	**Unit**	**Quality Grade**		
		A	B	C
Electrolytic Cell Current Efficiency	%	≥72	≥65	≥60
DC Power Consumption	kW·h/kg	≤4.5	≤5.0	≤6.5
AC Power Consumption	kW·h/kg	≤6.0	≤7.0	≤10
Salt Consumption	kg/kg	≤4.0	≤4.5	≤6.5
Anode Life (Intensified Test Failure Time)	h	≥20	≥15	≥10

5.5 Appearance Requirements

5.5.1 The exterior of the equipment should be neat and aesthetically pleasing. Instruments, switches, indicator lights, and nameplates on the panel should be installed correctly and securely.

5.5.2 The surface of the equipment should be coated with a non-glare, reflective layer, with uniform color and a clean surface, free of streaks, bubbles, cracks, paint leakage, or peeling.

5.5.3 The welding of the equipment frame and casing should comply with the requirements of GB 985 "Basic Types and Dimensions of Manual Arc Welded Joints." All welds should be uniform and secure, without obvious deformation or burn-through defects, and the exterior should be free of rust marks and noticeable irregularities.

5.6 Electrolytic Power Supply for Sodium Hypochlorite Generators

5.6.1 The electrolytic power supply for sodium hypochlorite generators should operate normally under the following conditions.

5.6.1.1 The continuous fluctuation range of the input power voltage should not exceed ±10% of the rated value.

5.6.1.2 The frequency variation range should not exceed ±5% of the rated value.

5.6.2 The insulation test for the electrolytic power supply of sodium hypochlorite generators includes a withstand voltage test and an insulation resistance measurement. The specific technical requirements should comply with the relevant provisions of GB 3859.

5.6.3 The temperature rise test for the electrolytic power supply of sodium hypochlorite generators should comply with the specifications in Table 2.

Table 2 Maximum Temperature Rise of Electrolytic Power Supply Components

Component or Device	Maximum Temperature Rise	Measurement Method
Rectifier Tube Casing	Refer to Rectifier Tube Technical Conditions	Thermocouple or Thermistor Method
Wire Connection	45℃	Thermometer, Thermocouple, or Thermistor Method
Transformer	Coil 80℃	Resistance Method
	Core Surface 60℃	Thermometer Method

5.6.4 The electrolytic power supply should be equipped with an electrolytic current regulation and control device. Within the allowable input voltage range of the equipment, the DC electrolytic current adjustment range should meet the requirements specified in section 5.3.2 of this standard.

5.6.5 The electrolytic power supply should be able to operate continuously for 1 hour without damage under conditions where the current exceeds 10% of the rated electrolytic current.

5.7 Electrolytic Cell

5.7.1 The electrolytic cell should be made of materials resistant to sodium hypochlorite corrosion.

5.7.2 The electrolytic cell must have measures to separate electrolytic gas and electrolyte.

5.7.3 The electrolytic cell must be equipped with a drain port for the electrolyte. When the drain valve is opened, the electrolyte should be completely discharged within 5 minutes.

5.7.4 The structural design of the electrolytic cell should facilitate the cleaning of electrodes, and both the anode and cathode should be easily detachable.

5.7.5 The electrolytic cell of the sodium hypochlorite generator should include measures to prevent operational issues due to electrode scaling. The equipment should ensure cumulative operation of more than 250 hours without maintenance or acid washing of the electrodes.

5.7.6 For continuous operation electrolytic cells, if the cell is pressurized, the body should withstand a hydraulic test at 1.5 times the working pressure without leakage or seepage.

5.8 Electrolytic Electrodes

5.8.1 Electrolytic Anode Lifespan

The corrosion resistance and lifespan of the electrolytic anode are assessed by the failure time during an intensified lifespan test under high current density in a sulfuric acid solution. Equipment of different quality grades should meet the corresponding requirements in section 5.4 of this standard.

5.8.2 The electrolytic anode must use an active anode with a metal oxide coating.

5.8.3 The cathode material should be made of 1Cr18Ni9Ti or stainless steel with better corrosion resistance, or pure titanium or titanium alloy can also be used.

5.9 Brine Preparation Device

5.9.1 The saturated brine tank in the brine preparation device should be able to hold the solid salt required for 100 hours of operation of the associated equipment.

5.9.2 The tank, pipelines, and valves of the brine preparation system should be made of corrosion-resistant materials.

5.9.3 The concentration of the brine prepared by the brine preparation device should comply with the provisions of section 5.3.5 of this standard. During continuous operation, the concentration variation should be less than ±10% of the set value.

5.9.4 The turbidity of the prepared brine should be less than 20 mg/L.

5.9.5 The brine preparation device used with continuous operation equipment must have measures to maintain a constant flow rate of the electrolyte. During normal operation of the sodium hypochlorite generator, the variation in brine flow rate should be less than ±5% of the rated flow rate.

5.9.6 If the brine preparation device associated with the sodium hypochlorite generator requires on-site construction, the manufacturer should provide detailed drawings.

5.10 Sodium Hypochlorite Solution Storage Tank

5.10.1 Sodium hypochlorite generators with intermittent operation and an effective chlorine production rate greater than 25 g/h must be equipped with a sodium hypochlorite solution storage tank.

5.10.2 The effective volume of the storage tank should be greater than the volume of sodium hypochlorite solution produced by the equipment operating at full load for 4 hours.

5.10.3 The sodium hypochlorite solution storage tank should be equipped with a liquid level gauge, a scale on the liquid level gauge, and a mark indicating the rated capacity.

5.10.4 The sodium hypochlorite solution storage tank should have a liquid drain port. When the drain valve is opened, the liquid should be completely discharged within 10 minutes.

5.10.5 The material of the storage tank should be made of opaque, corrosion-resistant material.

6 Test Methods

6.1 Physicochemical Performance Test of Sodium Hypochlorite Solution

6.1.1 Sensory Inspection of Sodium Hypochlorite Solution

While the equipment is operating normally, take a sample of sodium hypochlorite solution from the electrolytic cell using a 100 mL beaker. Use visual inspection to check the color and transparency of the solution. The results should meet the requirements of section 5.2.8.1 of this standard.

6.1.2 Analytical Method for Effective Chlorine Concentration in Sodium Hypochlorite Solution

6.1.2.1 Analytical Principle: In an acidic solution containing potassium iodide, sodium hypochlorite undergoes a redox reaction with potassium iodide, releasing an equivalent amount of iodine. The iodine is then titrated with a standard sodium thiosulfate solution. The effective chlorine concentration of the sodium hypochlorite solution is calculated based on the volume of sodium thiosulfate solution used.

6.1.2.2 Reagents

a. Potassium iodide solution: 1 N, analytical grade (GB 1272);

b. Glacial acetic acid: 36%, analytical grade (GB 676);

c. Starch indicator: Refer to GB 5750, section 15.14.10;

d. Sodium thiosulfate standard solution: 0.05 N, prepared and standardized as per GB 5750, section 15.1.4.3.

6.1.2.3 Test Procedure

a. Use a pipette to draw 5 mL of the well-mixed sodium hypochlorite solution to be tested and place it in a 250 mL iodine flask;

b. Add 50 mL of distilled water to the iodine flask;

c. Quickly add 5 mL of 36% glacial acetic acid solution to the iodine flask, cover with a water seal, and shake well;

d. Quickly add 10 mL of 1 N potassium iodide solution to the iodine flask, cover with a water seal, and shake well;

e. Let the solution stand in a dark place for 5 minutes;

f. Titrate the sample with 0.05 N sodium thiosulfate standard solution;

g. When the sample turns from brownish-yellow to light yellow during titration, add 1 mL of starch indicator;

h. Continue titrating with the sodium thiosulfate standard solution until the blue color just disappears;

i. Record the volume of titrant consumed in milliliters.

6.1.2.4 After testing, calculate the effective chlorine concentration of the sodium hypochlorite solution using formula (6), with the unit in g/L.

$$C = \frac{N \times V \times 35.45}{5}$$

In the formula: 35.45——atomic weight of chlorine;

C——effective chlorine concentration;

N——normality of the sodium thiosulfate standard solution, N;

V——volume of sodium thiosulfate standard solution consumed during titration, mL.

6.1.3 Analysis of Heavy Metal Ion Content in Sodium Hypochlorite Solution

Sanitary disinfection equipment should measure the heavy metal ion content according to the requirements of section 5.2.8.2 of this standard. The analysis method should follow the relevant methods and procedures specified in GB 5750.

6.2 The electrical components of sodium hypochlorite generators of premium quality grade should meet the requirements of section 5.1.3 of this standard. However, if the manufacturer of the low-voltage electrical components provides a qualified certificate for this technical requirement, this test may be omitted. The test results provided by the manufacturer should be conducted according to the test methods specified in JB 1045. The chemical gas used should be chlorine with a concentration of 1 mg/L, and the test should be conducted for 10 cycles as specified.

6.3 Visual Inspection

The basic technical requirements in section 5.2 (5.2.1 to 5.2.7) and the appearance requirements in section 5.5 should be inspected using visual inspection methods.

6.4 The test methods for the withstand voltage test and insulation resistance measurement of the electrolytic power supply should comply with the relevant provisions in GB 3859.

6.5 The temperature rise test method for the electrolytic power supply can be conducted according to the relevant provisions in GB 3859. The temperature rise test can be performed simultaneously with continuous operation.

6.6 The power-on operation test of the sodium hypochlorite generator should check the overall working state of the equipment and the adjustment range of the electrolytic current.

6.6.1 Before the test, check the assembly of the circuits and pipelines according to the drawings. After confirming that everything is normal, connect the brine pipeline and fill the electrolytic solution according to the equipment's rated state. All parts should work normally without any leakage.

6.6.2 Connect the equipment's power supply and adjust the electrolytic current to the rated value. Operate the equipment for 30 minutes, and it should function normally.

6.6.3 Adjust the electrolytic current control device. When the external power supply voltage is at the rated value -10%, the output electrolytic current should be adjustable to the rated value +10%. When the power supply voltage is at the rated value +10%, the electrolytic current should be adjustable to the rated value -10%. During the test, an autotransformer can be used to change the input voltage. The test results should comply with the requirements of sections 5.3.2 and 5.6.1.1 of this standard.

6.6.4 After the test, empty the electrolytic cell and storage tank, and record the drainage time. The drainage time should comply with the requirements of sections 5.7.3 and 5.10.4 of this standard.

6.7 Continuous Operation Test (Tests for electrolytic voltage, rated production rate, current efficiency, DC power consumption, AC power consumption, salt consumption, total input power, electrolyte temperature rise, and electrolytic power supply temperature rise).

6.7.1 Test Method: Operate the sodium hypochlorite generator continuously under the rated working conditions specified in section 6.7.2. Record the operating parameters as shown in section 6.7.4 during the operation and calculate each parameter using the specified formulas.

6.7.2 Rated Working Conditions for Continuous Operation Test.

6.7.2.1 The electrolyte used in the test should meet the following requirements:

a. The electrolyte should be prepared using refined salt and tap water. The refined salt should meet the requirements for refined salt in GB 5461. The tap water quality should comply with the drinking water standard in GB 5749;

b. The electrolyte concentration and its variation range during the test should comply with the requirements of section 5.9.3 of this standard;

c. The temperature of the electrolyte input into the electrolytic cell during the test should be 20±5℃;

d. The electrolyte flow rate during the test should be maintained at the rated value. For continuous operation, the flow rate variation should be less than ±5% of the rated value. For intermittent operation, the electrolyte injection volume and electrolysis time should be maintained at the rated value.

6.7.2.2 The electrolytic current during the test should be maintained at the rated value, with a deviation of less than ±2.5%. Voltage stabilization or regulation devices may be added at the power input end.

6.7.3 The operation time for continuous electrolytic cells is 4 hours after the equipment reaches a stable state. For intermittent electrolytic cells, the operation should cover 4 electrolytic cycles.

6.7.4 Recording of Operation Data: For continuous electrolysis, record the following data every 0.5 hours during operation. For intermittent electrolysis, record the data at the beginning and end of each electrolytic cycle. The data to be recorded includes:

electrolysis time, input power voltage, input power current, electrolytic voltage, electrolytic current, electrolyte flow rate (electrolyte volume), electrolyte concentration, sodium hypochlorite solution flow rate, available chlorine content in the sodium hypochlorite solution, electrical contact temperature, electrolyte temperature, sodium hypochlorite solution temperature, ambient temperature, and the signature of the experimenter. When recording data from the equipment's own instruments, also record the data from laboratory instruments installed during the test.

6.7.5 Test Instruments: The laboratory instruments used in the test should have an accuracy of at least 0.5 grade, and the resolution of the thermometer should be 0.2℃.

6.7.6 In the experiment, the flow rate Q of the sodium hypochlorite solution for continuous electrolytic cells is calculated using a measuring cylinder and a stopwatch by dividing the volume by the time. Each flow rate parameter should be sampled at least 3 times, with each sampling time not less than 1 minute, and the average value of several measurements should be taken.

6.7.7 Calculation of Available Chlorine Production Rate

For continuous operation sodium hypochlorite generators, the available chlorine production rate can be calculated according to formula (1) in section 3.3 of this standard. The flow rate Q of the sodium hypochlorite solution is taken as the average value of the recorded flow rates during the operation test, and the available chlorine concentration C is also taken as the average value of the recorded concentrations.

For intermittent operation sodium hypochlorite generators, the brine consumption per electrolytic cycle is expressed as the electrolyte volume divided by the electrolysis time, and the available chlorine production rate per cycle is calculated according to formula (1). The available chlorine production rate of the tested equipment should be the average value of the measured available chlorine production rates over several electrolytic cycles.

6.7.8 Calculation of Current Efficiency η

Calculate according to formula (2) in section 3.4 of this standard based on the measured production rate G and the average value of the electrolytic current during the continuous operation test.

6.7.9 Calculation of DC Power Consumption

Calculate according to formula (3) in section 3.8 based on the average values of electrolytic voltage, electrolytic current, and available chlorine production rate during the continuous operation test.

6.7.10 Calculation of AC Power Consumption Test Results

Calculate according to formula (4) in section 3.9 based on the average value of the AC input power and the average value of the rated production rate obtained during the continuous operation test.

6.7.11 Total Input Power ($P1$)

During the test, the total input power can be calculated by dividing the measured value from the electricity meter installed on the power supply line of the equipment by the electrolysis time under rated operating conditions, or it can be directly measured using a wattmeter, with the unit in kW.

6.7.12 Electrolyte Temperature Rise

For continuous operation electrolytic cells, the electrolyte temperature rise is calculated by subtracting the inlet temperature of the electrolyte from the outlet temperature of the sodium hypochlorite solution at the end of the continuous operation test, with the unit in ℃.

For intermittent operation electrolytic cells, the electrolyte temperature rise is calculated by subtracting the initial electrolyte temperature from the temperature of the sodium hypochlorite solution at the end of one electrolytic cycle, with the unit in ℃.

6.7.13 Electrical Contact Temperature Rise

During steady-state operation of the equipment, when the temperature change at the detection point is less than 1℃/h, the difference between the contact temperature and the ambient temperature is the temperature rise at that point. The temperature of electrical contacts is measured using a semiconductor point thermometer, and the ambient temperature is measured using two or more glass thermometers installed 1 meter away from the equipment at a height of 1 meter. During the temperature rise test, the ambient temperature should be within the range of 10 to 40℃, and there should be no light, heat radiation, or airflow that could affect the temperature rise measurement.

6.7.14 During the test, the displayed values on the equipment's instruments should have an error of less than 2.5% compared to the values displayed by 0.5-grade instruments.

6.8 Overload Test

The overload test is conducted after the continuous operation test. During the test, the electrolytic current and electrolyte flow rate should be maintained at 110% of their respective rated values. The overload test duration is 1 hour, and the equipment should operate normally without any damage to components, complying with the relevant provisions of section 5.3.3 of this standard.

6.9 Cumulative Working Time Test of Sodium Hypochlorite Generator Without Cleaning Electrodes

6.9.1 Operate the test equipment under the rated working conditions specified in section 6.7.2. The electrolyte used in the test should meet the requirements of section 6.7.2.1, but the total hardness of the tap water used (calculated as calcium carbonate) should be greater than or equal to 200 mg/L. If necessary, manually prepare the water and record the operating parameters specified in section 6.9.4. When one of the phenomena described in section 6.9.2 occurs, the electrodes should be cleaned, and the test should be terminated. The cumulative working time before this point is the cumulative working time of the equipment without cleaning the electrodes.

6.9.2 Conditions for determining the need to clean the electrodes include: the actual electrolytic cell voltage increases by 50% compared to the normal electrolytic voltage; the electrolytic current cannot reach the rated value; breakdown occurs between the electrolytic cathode and anode due to scaling; the electrolyte flow rate cannot reach the rated value due to blockage between the electrodes; the available chlorine production rate cannot reach the rated value; the equipment cannot operate normally due to electrode scaling.

6.9.3 This test may be conducted intermittently and can be performed by the manufacturer and inspection unit during the user testing phase.

6.9.4 During operation, record the test time, cumulative operating time, electrolytic voltage, electrolytic current, and electrolyte consumption once per hour or per electrolytic cycle. Measure the production rate for 1 hour or one electrolytic cycle each day.

6.10 Electrolytic Anode Intensified Life Test

6.10.1 Test Principle

Use a rapid life test method involving electrolysis of the anode in a sulfuric acid solution under high current density. Compare the lifespan of different anodes by testing the failure time of different test anodes under the same concentration, temperature, and high current density in a sulfuric acid solution.

6.10.2 Test Setup

a. 500 mL beaker;

b. Test anode: The test anode should be directly taken from the electrode of the test equipment and processed. Use a mechanical processing method to retain an effective reaction area (projected area) of 1.0 cm^2±5% of the active coating on the test anode surface;

c. Cathode: Made of 1Cr18Ni19Ti stainless steel. If the test anode is flat, the cathode should be flat; if the test anode is tubular, the cathode should be ring-shaped. The effective cathode area should be much larger than the effective anode reaction area, and the distance between the anode and cathode should be no less than 1 cm;

d. The DC power supply used for the test should have a rated current greater than 3 A;

e. The DC ammeter and voltmeter used for the test should have an accuracy of 0.5 grade;

f. Precision constant temperature water bath, with water temperature control accuracy of less than ±1℃.

6.10.3 Test Conditions

a. Electrolyte: 1.0 N H_2SO_4 (GB 625);

b. Electrolyte temperature: 40±1℃;

c. Anode current density: 200 A/dm^2.

6.10.4 Operating Steps

a. Pour 1.0 N H_2SO_4 solution into the beaker, fix and install the electrolytic anode and cathode, and completely submerge the effective working part of the cathode;

b. After the electrolyte temperature rises to 40℃, connect the power supply and adjust the electrolytic current to the specified value, maintaining it constant during the test. Periodically add a certain amount of distilled water and H_2SO_4 during the electrolysis process to maintain the electrolyte level and concentration;

c. Record the electrolysis time, electrolytic current, and electrolytic cell voltage every half hour;

d. Stop the test when the electrolytic cell voltage begins to rise rapidly and significantly;

e. The cumulative electrolysis time from the start of the test until the electrolytic cell voltage begins to rise significantly is referred to as the failure time of the intensified life test for the test electrode.

6.11 Determination of Brine Concentration

Use the gravimetric method and hydrometer method. If the results differ, the gravimetric method shall prevail.

7 Inspection Rules

7.1 Inspection is divided into factory inspection and type inspection.

7.2 Factory Inspection

7.2.1 Equipment must undergo factory inspection item by item according to the specified items and test methods before delivery. Products can only be delivered for use after passing the factory inspection.

7.2.2 Factory Inspection Items

Factory inspection should be conducted according to the requirements of sections 5.2.4, 5.5.6.2, and 5.6.4 of this standard, and visual inspection, power-on operation, and insulation tests should be performed according to the provisions of sections 6.3 and 6.6.

7.3 Type Inspection

7.3.1 Type inspection must be conducted under any of the following circumstances:

a. Trial production and finalization appraisal of new products or when old products are transferred to a new factory for production;

b. When there are significant changes in the main materials and components of the product after formal production, when the structural parameters of the electrolytic cell are changed, or when the electrode processing technology is altered;

c. During normal production, for every 100 units produced (or once a year if the annual production is less than 100 units);

d. When production resumes after a long-term shutdown;

e. When there is a significant difference between the factory inspection results and the last type inspection;

f. When national quality supervision agencies request a type inspection.

7.3.2 Type inspection should be conducted according to the technical requirements specified in Chapter 5 and the test methods specified in Chapter 6 of this standard.

7.3.3 If any item fails during the type inspection of a tested device, double the number of samples should be taken from the batch for re-inspection of the failed item. If it still fails, production should be halted, and after identifying the cause, the type inspection should be conducted again.

7.3.4 The number of samples for type inspection should not be less than 3 units.

7.3.5 Products that fail the type inspection cannot be produced.

8 Marking, Packaging, Transportation, and Storage

8.1 Each device should have a nameplate fixed at the designated position, with the following content:

a. Manufacturer's name and trademark;

b. Equipment name;

c. Product marking and model number;

d. Equipment manufacturing number (or date) or production batch number;

e. Main technical parameters of the product (available chlorine production rate, power supply voltage, rated electrolytic current, electrolytic voltage, electrolyte concentration, electrolyte consumption).

8.2 Packaging

8.2.1 Packaging method: Generally boxed, individual spare parts and accessories can also be bundled.

8.2.2 Packaging should be moisture-proof and shockproof. The external dimensions and weight of the packaging should comply with the provisions of JB 2759, and the top of the packaging is generally flat.

8.2.3 Before packing, the product's center of gravity should be centered and low. Products with a high center of gravity should be packed horizontally as much as possible. Products with an obviously off-center center of gravity should take corresponding balancing measures.

8.2.4 The packaging box should have sufficient strength, and the lifting test, stacking test, and road transport test should comply with the provisions of JB 2759.

8.2.5 The product should be packaged for rain protection, complying with the requirements of section 2.7 of JB 2759.

8.2.6 Packaging marks should be made with indelible paint, ink, etc., accurately, clearly, and firmly sprayed or brushed on the box surface. The marks generally include:

a. Product model, name, specifications, and quantity;

b. Box number;

c. Maximum external dimensions of the box (length × width × height (cm));

d. Net weight and gross weight (kg);

e. Made in the People's Republic of China (this mark is not required for domestic shipments).

8.2.7 When the product is packed in multiple boxes, the box number is expressed as a fraction, with the numerator as the box number and the denominator as the total number of boxes. The main unit box should be box number 1.

8.2.8 For packaging that requires lifting and has an obviously off-center center of gravity, the marks "Lift Here" and "Center of Gravity" should be accurately sprayed or brushed on the corresponding positions of the packaging.

8.2.9 Random documents include:

a. User manual;

b. Product qualification certificate;

c. Packing list;

d. List of random accessories;

e. Other relevant technical documents.

When packaged separately, random documents are generally placed in the main unit box.