Automatic High Concentration Sodium Hypochlorite Generator

User Manual

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Version V3.0

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Operating Instructions for High Concentration Sodium Hypochlorite Systems

1. Summarize

Principle of high concentration sodium hypochlorite device

Sodium hypochlorite is produced by electrolysis of sodium chloride brine to produce sodium hydroxide (commonly known as caustic soda) and chlorine and hydrogen gas. Sodium hydroxide reacts with chlorine gas to produce sodium hypochlorite, sodium chloride and water, with the following chemical reaction equation.

Electrolytic reactions.

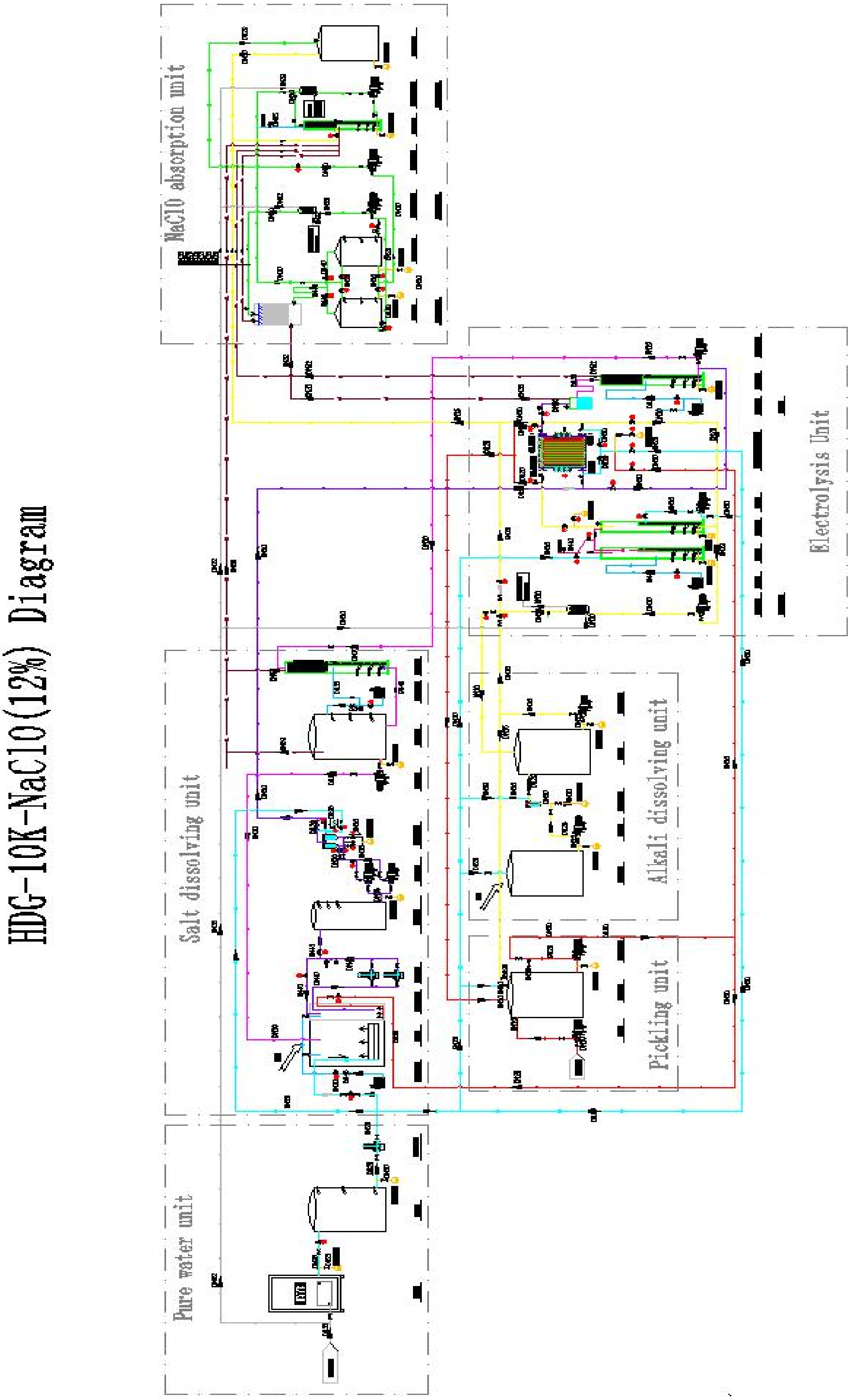
$$2NaCl + 2H_2O = 2NaOH + Cl_2\uparrow + H_2\uparrow$$

Sodium hypochlorite reaction :

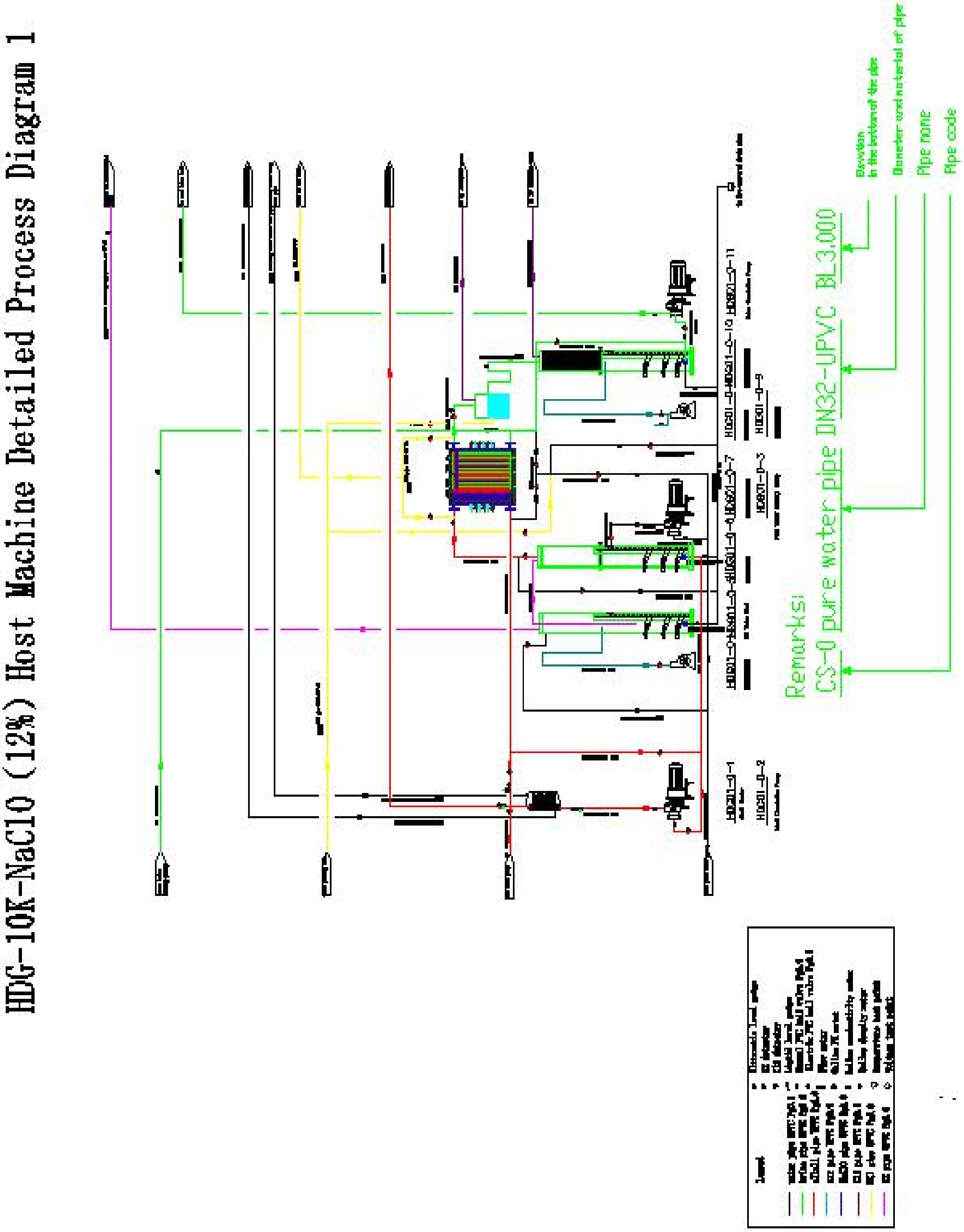
$$Cl_2 + 2NaOH = NaClO + NaCl + H_2O$$

From the above reaction equation, it can be seen that the reaction equation is carried out in two steps. And in the high concentration sodium hypochlorite plant the two reactions are carried out separately, i.e. the electrolysis reaction is carried out in the electrolytic tank, the reaction products sodium hydroxide and chlorine gas and hydrogen gas are separated by a diaphragm (ion membrane), and then sodium hypochlorite reaction is carried out with sodium hydroxide and chlorine gas in the sodium hypochlorite reaction plant after moving out of the electrolytic tank, and the end point of the reaction is judged by controlling the pH of the reaction circulating liquid. The sodium hypochlorite reaction is an exothermic reaction.

2. Process Flow



10k sodium hypochlorite equipment process flow chart



10k sodium hypochlorite generator mainframe process flow chart

3. Technical specifications for the operation of the device

3.1 Ion membrane electrolyzer

3.1.1 Indicators of brine requirements

NaCl	300~315 g/L
Ca^{2+}+Mg^{2+}	≤ 5 mg/ L
NaOH	≤ 0.4 mg/L
Al^{3+}	≤ 0.1 mg/L
I	≤ 0.2 mg/L
Ba^{2+}	≤ 0.5mg/L
Sr^{2+}	≤ 2.5 mg/L
Fe^{3+}	≤ 0.02mg/L
Na_2CO_3	≤ 0.4 mg/L
SO_4^{2-}	≤ 5 g/L
$NaClO_3$	≤ 12g/L
free chlorine	undetected
ss	≤ 10 mg/L
pH	9-11

3.1.2 Indicators of electrolytic requirements

electrolytic current	≤650A
Electrolytic voltage	≤70V
Electrolytic bath temperature (T3-2)	55°C±2°C
Electrolytic tank cathode feed temperature (T1-1)	≤30°C
Anode feed temperature of	≤30°C

electrolytic tank (T2-1)	
Electrolyzer cathode discharge temperature (T1-2)	55°C±2°C
Anode discharge temperature of electrolytic tank (T2-2)	55°C±2°C
Concentration (conductivity) of brine entering the electrolyzer	450ms/cm
Fresh brine out of the tank (pH 6)	＞ setting value
Light brine after acid addition (pH 4)	＞ setting value
Electrolyte concentration	Specific gravity 1.18 to 1.22

3.2 Indicators of absorption requirements for sodium hypochlorite

1# absorber tower temperature (T4-1)	35°C±2°C
2# absorption tower sodium hypochlorite temperature (T4-2)	35°C±2°C
1# sodium hypochlorite recirculation tank pH (pH1)	＞ setting value
2# sodium hypochlorite recirculation tank pH (pH2)	＞ setting value
2# absorber tower pH (pH3)	＞ setting value
Effective chlorine concentration of sodium hypochlorite discharge	＞10%(120,000ppm)

Remarks: pH setting value (setting value: the pH meter display value is 0.3~0.5 smaller when playing into the lye, e.g.: pH meter display value 12 when playing into the lye, sodium hypochlorite discharge setting value is 11.7~11.5)

3.3 Indicators of public sector requirements

Make-up lye concentration	20% (specific gravity 1.18 to 1.22)
Concentration of dilute hydrochloric acid tank	3 to 5%

3.4 Indicators of raw material requirements

1. Table salt needs to meet the quality requirements of the national standard (GB5461-2016) of excellent solid granular salt
2. 30% ionic membrane caustic soda or greater than 98% caustic soda
3. 30% hydrochloric acid
4. Pure water conductivity ≤ 10uS/cm
5. Clean cooling water temperature ≤ 25°C

1.5 Technical parameters of sodium hypochlorite device

To make 1kg of effective chlorine salt consumption	< 2.5kg
Electricity consumption for the production of 1 kg of effective chlorine	< 3.5KW
To make 1 kg of effective chlorine sodium hydroxide (100%) consumes	< 0.1kg
Effective chlorine concentration setting range	5%-13% (adjustable)

4. System commissioning

For system commissioning use pure water as raw material, add the crude brine tank, pure water tank, alkali tank and acid tank with pure water to high level. The following steps are then followed.

1. The main switch of the power cabinet feeds power to the electrolysis mainframe and control cabinet respectively.
2. Feed all air switches in the electrolysis mainframe and control cabinet.
3. Turn on the power switch on the main electrolysis panel and the control cabinet panel, the power indicator light is on, the lower row indicators of the dissolved base system, dissolved salt system, acid system and absorption system are on, and the system program enters the standby state. The pure water pump automatically starts to supply water to the system, and the dilute acid pump automatically turns on to supply acid. Check whether all the instruments and displays on the panel are normal, check whether all the level switches level indication is normal (pull on each level switch with magnetic float and observe whether the corresponding panel shows the level is normal).
4. Click Run from the touch screen display, the Login interface pops up, enter the user name admin, password 123456 (password confidential, only allow management personnel to know), click OK, enter the maintenance interface, the electric valve status page, check the page open to the valve number to green, if there is a valve number red light, indicating that the valve open to the fault, the fault table will pop up the list interface, the Show the valve failure. Click on the test box to return to the running state (must return to the running state, otherwise the system will not run automatically).
5. Touch screen click to enter the parameter setting interface, take a picture of the original setting parameters on the interface and save it, set the conductivity to 0 and pH1, pH2 and pH3 to 6.
6. Commissioning of absorption systems

（1）Touch screen click to enter the absorption unit interface, click on the word "first alkali replenishment", it will show first alkali replenishment on, the system will automatically turn on the alkali pump, replenish alkali to the middle level of the hydrogen separation tower of the electrolysis host, replenish alkali to the high level of the No. 2 absorption tower, and then replenish alkali to the middle level of the No. 1 and No. 2 circulation tanks through the No. 2 absorption pump, when the liquid level on the interface is in place, the system will automatically turn on the alkali pump. Click on the word "first alkali charge" to display the first alkali charge off (must be closed after the alkali charge).

（**2**）Click on the word block below the pH5 word block of auto, auto becomes manual, and at the same time the word block of start pops up, at this time the system is in manual state, click on the word block of start, the word block shows on, at this time the absorption system is independent auto cycle under manual start, click again to show off, the auto cycle is off. **When electrolysis is to be started, the word block below the pH5 word block must be in automatic state, otherwise electrolysis cannot be started.**

（3）There is an automatic or manual switching block above the first alkali replenishment block, click on this block to switch the operation of No.1 and No.2 circulation tank manually. When the absorption system is running automatically, this block must be in the automatic switching state, otherwise the circulation tank cannot switch automatically which will cause the electrolysis system to stop.

（4）Observe whether the absorption system operates normally, check whether the electric valve is open and closed as indicated by the interface, whether there are leaks in the equipment and piping, and whether the liquid level is at the normal position as indicated by the interface. Is the data displayed by the instrument consistent with the data displayed by the interface. Everything is normal, turn off the automatic cycle and return the word block display to the automatic state.

7. Commissioning of electrolysis and absorption system linkage

（1）Click from the electrolysis mainframe display to enter the electrolysis system interface and enter 650 in the Current Given field. turn the blank off on the electrolysis power supply down (test run with no power to the electrolyzer).

（2）Press and hold the electrolysis start switch on the electrolysis mainframe panel for 3 seconds, the electrolysis system, absorption system, brine pump and brine filter will enter into automatic operation, and after the electrolysis mainframe enters into timing for 900 seconds, the chlorine and hydrogen fans will start automatically, and DC power will be sent automatically at

60% of the given current, and the current will rise to 100% after 30 minutes of sending DC power (not actually sent).

（3）Adjust the manual valve of brine and lye flow meter, keep the flow rate at 300L/h. Observe whether the electrolysis system operates normally, check whether the electric valve is open and closed as indicated by the interface, whether there is water leakage from equipment and pipeline, and whether the liquid level is at the normal position as indicated by the interface. Whether the data displayed by the meter is consistent with the data displayed by the interface.

（4）Check the electrolysis automatic alkali discharge program: Click on the touch screen to enter the parameter setting interface, set the upper limit of the specific gravity parameter of electrolysis on the interface to 0.9 and the lower limit to 0.8, observe whether there is alkali discharge and whether the level of hydrogen separator is from the replenishment to the high level. If normal, set the upper and lower limits of specific gravity parameter to the original parameter value, and stop the alkali output.

（5）Check the automatic discharging procedure of sodium hypochlorite: click into the absorption unit interface from the touch screen, observe whether the circulating tank being absorbed is No.1 or No.2, if it is No.1, click into the parameter setting interface from the touch screen, set the pH value of No.1 on the parameter setting interface to be greater than the meter display value of 1 or more (if the meter display pH value is 6, then set it to 7), and automatically switch to No.2 absorption circulating tank for absorption when discharging. No.1 absorption cycle tank discharge to low level, discharge automatically stop, No.1 absorption cycle tank level make up to high level. no.2 absorption cycle tank and no.2 absorption tower also test as above. no.2 absorption tower discharge out to no.1 and no.2 absorption cycle tank. If normal, set the parameters to the original values.

8. Commissioning of pickling system linkage

（1）From the electrolysis mainframe display, click into the pickling system interface. On the electrolysis mainframe panel, press the pickling start button and the pickling indicator light will come on to enter automatic pickling operation.

（2）The process and time of the pickling process is displayed on the pickling system interface. In the touch screen interface, the pickling cycle and time can be set on the parameter setting screen.

9. Switching commissioning of brine filters No. 1 and 2 and fine brine pumps No. 1 and 2

(1) Click on the touch screen to enter the dissolved salt unit interface, click on the word "1, 2 fine salt water pump automatic switch", you can switch the work of 1, 2 fine salt water pump. After the test is completed, you have to return to the automatic switching status (otherwise the system will not operate automatically).

(2) Click on the touch screen to enter the dissolved salt unit interface, click on the word "brine filter automatic switch", you can switch the No. 1 and 2 brine filter work, and automatic backwashing. In the absorption system display interface, you can set the filter cleaning cycle and backwashing time on the parameter setting interface. After the test is completed, return to the automatic switching state (otherwise the system will not operate automatically).

The above commissioning is completed, the systems are normal, click into the parameter setting interface from the touch screen, set the conductivity, pH1, pH2, pH3 on the interface to the original photo parameters. Then you can feed and start the machine. Electrical commissioning operation see electrical manual.

5. Prepare for the first start-up

First, follow steps 1, 2, and 3 of the fourth, system commissioning.

1. Pure water: manually open electric valve 1 to pure water tank to high level, close electric valve 1, pure water pump to supply pure water to the system.

2. Brine: Fill the crude brine tank with treated brine concentration more than 25% (specific gravity measured by specific gravity meter, control above 1.19) net brine to the middle of the liquid level.

3. Lye distribution: add sodium hydroxide flake to the dissolved lye tank, open the manual valve and slowly add pure water, and stir manually with a stirring bar, close the manual valve after the dissolved lye tank is full. When cooled to below 50℃, measure the specific gravity with specific gravity meter, control at 1.18~1.22, i.e. the concentration of lye is about 20%, open manual valve, open dissolved lye pump and filter through filter into concentrated lye tank to store full. Turn off the lye pump and the manual valve.

4. Acid dispensing: Insert the hose into the 30% hydrochloric acid drum, open the manual

valve, open the dilute hydrochloric acid pump and add 30% hydrochloric acid to the dilute hydrochloric acid tank, add water in the ratio of 1:5 (acid: water = 1:5) to make 5% hydrochloric acid by opening the manual valve, and dispense until the tank is full. Close the manual valve and the dilute hydrochloric acid pump.

5. System alkali addition: Follow step 6.(1) of "IV. System commissioning".

6. Cooling: Turn on the ice machine supplemental water valve (or cooling water master valve) and turn on the three cooler cooling water. Turn on the ice machine to cool to 5 to 10°C.

7. Parameter setting: Click from the touch screen to enter the parameter setting interface, and set the system operation parameters according to the range specified in "III. Technical index requirements for device operation".

6. Boot up

1. Pre-boot checks

Check that the switches on each system panel are in automatic operation according to steps 6, 7 and 9 of "IV. System commissioning".

2. boot up (a computer)

（1）From the electrolytic mainframe display, click into the electrolytic system interface and enter 650 in the Current Given field. turn the blank on the electrolytic power supply up.

（2）Press and hold the electrolysis start switch on the panel of electrolysis mainframe for 3 seconds, the electrolysis system, absorption system, brine pump, brine filter, etc. will enter into automatic operation, and after the electrolysis mainframe enters into timing for 900 seconds (let the electrolysis tank be filled with brine and lye), the chlorine and hydrogen fans will start automatically and send 60% DC of the fixed current automatically, and the current will rise to 100% or 650A automatically after 30 minutes of sending DC power.

（3）Adjust the manual valve of brine and lye flow meter to keep the flow rate at 300L/h±5%. After adjusting the flow rate, open the two exhaust valves above the electrolysis main unit for exhausting, and close the exhaust valves after the gas is exhausted (the electrolysis tank exhaust is required every time). Wait for 20 minutes, electrolysis power start, pay attention to observe the flow rate of brine and lye to keep at 300L/h±5%. Make sure that the electrolyzer cathode and anode chamber must be full of liquid within twenty minutes after the start of electrolytic automatic program before power supply (the liquid in the electrolyzer cathode and anode chamber is automatically emptied when shutting down), and you can observe whether there is liquid flowing out from the transparent tube at the top of the electrolyzer, if the above phenomenon is not observed within twenty minutes after the start of electrolytic automatic program, the electrolytic automatic program should be stopped immediately. Restart it again and re-timer it for twenty minutes and then send current automatically. It is strictly forbidden to send DC current without liquid in the cathode and anode chamber of electrolyzer, which will damage the ion membrane by dry burning.

（4）Close the inlet cooling water valve of the alkali cooler and wait for the electrolyzer temperature (T3-2) to rise to 55°C. Then adjust the inlet cooling water valve to keep the electrolyzer temperature running at 55°C ± 2°C.

（5）Set the specific gravity meter (according to the instructions), so that the measured specific gravity of the outgoing lye (the specific gravity of the lye is measured with the specific gravity meter for calibration of the specific gravity meter setting range) is controlled at 1.18 to 1.22 (making 12% hyposodium concentration) , (making 10% hyposodium concentration 1.14 to 1.17).

（6）When pH4 is greater than 3, the acid transfer pump will automatically start and the No. 2 electric valve will automatically open to add acid to the salt tank until pH4 is less than 3, when this operation will automatically stop.

（7）Sodium hypochlorite liquid pH1,2,3 control: when the pH value of 1# and 2# sodium hypochlorite circulating tank drops to the set value (set value: 0.3~0.5 smaller than the value displayed by pH meter when feeding lye, for example: pH meter displays 12 when feeding lye, sodium hypochlorite discharge set value is 11.7~11.5) or below, take sample to analyze the concentration of sodium hypochlorite, it reaches 12% (the measured specific gravity of lye is controlled at 1.18~1.22) or above. 1.22 conditions) or more qualified, pH down to the set value after the system automatically switch the circulation tank and discharge. If replace the new pH meter, pay attention to observe the pH drop, and set the starting point of rapid pH drop as the end point, i.e. the pH value of the discharged material.

（8）Adjust the absorption 1 and 2 cooler cooling water inlet valves to keep T4-1 and T4-2 temperatures below 30°C for operation.

Observe whether the electrolysis system operates normally, check whether the electric valve is open or closed as indicated by the interface, whether there is water leakage from equipment and piping, and whether the liquid level is at the normal position as indicated by the interface. Check whether the data displayed by the instrument is consistent with the data displayed by the interface. Stop the automatic electrolysis program immediately if it is not normal.

3. The current, tank voltage, electrolyzer temperature, effluent alkali flow, effluent brine flow, sub-sodium recirculation tank temperature, effluent alkali specific gravity, and sub-sodium pH were recorded hourly, as per the log sheet.

7. Stop the Machine

7.1 Normal stoppage

7.1.1 When the electrolysis stop button is pressed, the DC power indicator will go out and the current will show 0A. The system brine circulation pump, lye circulation pump, hyposodium absorption pump and fan will continue to run for 10 minutes after the DC power is stopped and then stop automatically. After the machine and pump are stopped, the system will automatically empty the liquid in the cathode and anode chamber of the electrolyzer.

7.1.2 Close the cooling water valve and stop the ice machine.

7.1.2 Turn off the power half an hour after the machine and pump have both stopped.

7.2 Steps for handling prolonged downtime

7.2.1 Procedure for prolonged electrolysis mainframe shutdown (shutdown for more than 5 days)

7.2.2 Manual pickling: press the pickling switch on the control panel of the electrolysis mainframe, the mainframe enters the automatic pickling program and carries out automatic pickling, and after the pickling is finished, it will rinse and discharge by itself, which will end after about 2 hours.

7.2.3 Recovery of NaOH liquid: enter the test interface, open the electric control valve No. 11 and 24, turn on the lye circulation pump, wait until the liquid level is below the lowest level, stop the pump and close the electric control valve No. 11 and 24.

7.2.4 Recycle brine: enter the test interface, open the electric control valves 14 and 15, turn on the brine circulation pump, wait until the dechlorination tower liquid level is below the lowest level, stop the pump and close the electric control valves 14 and 15.

7.2.5 Cleaning of electrolytic host systems.

7.2.6 Enter the test interface and open the electric control valves 18, 16, 11, 14, 21, 19 and 53, and open the dechlorination tower and hydrogen separator drain manual valves.

7.2.7 Turn on the lye circulation pump and keep the flow rate of 300L/h circulating for 5 minutes, stop the pump.

7.2.8 After 10 minutes of cleaning, close the electric control valves of 18, 16 and 19, open the electric control valves of 25 and 36, and after the dechlorination tower and hydrogen separator are emptied, close all electric control valves, drain valves and turn off the power.

7.2.9 Absorption unit shutdown processing steps (within 5 days)

7.2.10 Short downtime (less than 1 day)

Within 1 day of shutdown, the absorber tank material is not emptied, only the material in coolers 1 and 2 must be emptied. Enter the test interface, open No. 38 and No. 45 electric control valves, and close them after 15 minutes. Open No. 46 electronically controlled valve to prevent the decomposition of the material in the pipe to generate pressure.

7.2.11 Long downtime (more than 1 day)

A long shutdown should clean the system of materials and add pure water for recirculation cleaning followed by drainage, as follows.

7.2.12 The material in absorber tanks 1 and 2 should be reacted to an effective chlorine concentration of 100,000 ppm or more before shutdown. Close the overfeed manual valve from tower #2 to absorber tanks #1 and #2. Manually switch the reaction of absorber tanks 1 and 2 to the required active chlorine concentration. System shutdown.

7.2.13 Enter the test interface and open the overfeed manual valve from tower 2 to absorber tanks 1 and 2. Turn on the No. 2 absorption pump and stop the No. 2 absorption pump after emptying the material in the No. 2 absorption tower.

7.2.14 Open the electric control valves 38 and 45, open the electric control valves 39, 40 and 46, open the discharge pump to empty the material in the absorption tank 1 and 2, and then stop the discharge pump.

7.2.15 Manually add pure water to absorber tanks #1 and #2 to the level 30 scale, and add water to the level 70 scale in tower #2 after unscrewing the cap from the upper end of the level gauge.

7.2.16 Return to the operating interface, turn on the absorption cycle manually, switch the cycle for 10 minutes each for absorption tanks 1 and 2, and stop the absorption cycle.

7.2.17 Open the manual valves for absorption tank 1 and 2 and absorption tower 2 discharge and close them after draining the liquid.

8. Pickling

Automatic pickling: The system sets automatic pickling cycle program, which can pickle according to the rising voltage of electrolytic tank, i.e. the scaling condition of electrolytic tank. Press the acid wash button on the electrolysis main panel, the system will enter into automatic acid wash cycle, tap on the acid wash interface, observe the acid wash situation, turn on the alkali pump after the automatic acid wash is finished, add alkali to the acid tank and neutralize it to pH=7, then empty the acid tank and re-distribute the acid.

9 . System automatic control safety protection and troubleshooting

Operating Instructions

The system is set up with a public system fault interface and an electrolysis host system fault interface, as well as a fault list. Click "Enter Absorption Unit Interface" from the touch screen, click "Fault Interface", when the fault dot is green, it is normal, red is fault, when there is a fault, the interface will pop up a list, showing the fault point and time. When the fault is finished, click "Fault Reset" on the interface, the system will return to normal. Click "!" in the upper left corner of the fault interface to open the fault list. block to open the fault list. The operation procedure is the same for each host system fault interface.

10. Cause of failure and treatment

1. public system

1.1. Fresh brine tank high level alarm: fresh brine tank level is high, stop DC power, troubleshoot fresh brine pump.

1.2. Net brine tank low level alarm: Net brine tank low level, stop DC power. Check filter, crude brine pump, saturated brine tank level.

1.3. Absorption tower 2 liquid level low alarm: Absorption tower 2 liquid level low, stop DC power. Check alkali storage tank level, alkali pump, electric valve 26, 41, 42 for failure.

1.4. Lack of alkali alert: low alkali storage tank, DC power outage. Make up alkali.

1.5. Water shortage alert: Pure water tank is low, replenish pure water.

1.6. Lack of salt alert: brine concentration (conductivity) <450ms/cm, stop DC power and add salt.

1.7. Acid deficiency tip: dilute acid tank low, replenish acid.

1.8. Absorption unit temperature alarm: No. 1 and 2 absorption tower sub-sodium temperature (T4-1, T4-2) ＞38℃, stop DC power. Adjust chilled water valve of inlet cooler, check chilled water temperature.

1.9. High chlorine gas concentration alarm: The chlorine gas concentration in the workshop space exceeds the control value, stopping to check the chlorine system equipment pipe seal.

1.10. High hydrogen concentration alarm: The hydrogen concentration in the workshop space exceeds the control value, shut down and check the hydrogen system equipment duct sealing and the hydrogen fan air volume.

After the above faults are fixed, press Fault Reset for a long time and the system returns to normal.

1.11. Electrolysis host communication error alarm: check the network cable connector between the communication error electrolysis host and the control cabinet. Communication error alarm cannot be recovered by fault reset, and will be automatically eliminated after the fault is repaired.

1.12. Each machine pump overload and electric valve failure, check equipment and wiring, replace machine pump and electric valve.

Any fault in the fault list with a red text color will cause the system to shut down automatically, and any fault with a black text color will not cause the system to shut down automatically.

2. Electrolytic host system

2.1. Electrolytic power supply failure: high temperature or overload of electrolytic power supply, stopping DC power. Find and troubleshoot the power supply according to the electrolytic power supply manual.

2.2. Electrolysis tank broken membrane prompt: discharge tank light brine (pH 6) > 7, stop DC power. Check out the broken membrane unit tank and replace the ion membrane.

2.3. Electrolyzer temperature alarm: Electrolyzer temperature (T3-2) ＞75℃, stop DC power. Check the chilled water temperature and increase the alkali cooler water inlet valve, increase the flow of brine and alkali into the tank (<400L/h).

2.4. Hydrogen separator fill timeout (high level switch damaged): When the high level of the level meter is damaged, the fill water over reaches the set time (2 minutes) to stop the fill pump. Check the high level level switch, or float loss of magnetism needs to be replaced.

2.5. Hydrogen separator level failure: hydrogen separator level to below low level, stop DC power, check low level switch, or float loss of magnetism needs to be replaced.

2.6. Acid pump not on prompt: Acid pump not on during acid wash, acid wash program stopped. Troubleshoot the acid pump.

2.7. Adjusting Acid Flow Tip: After adding acid the light brine (pH 4) is > 2.7. Increase the acid flow.

2.8. Absorption not turned on prompt: The electrolysis mainframe does not detect the sub-sodium absorption system on signal, and the electrolysis mainframe cannot start. Check the sub-sodium absorption system and discharge the fault.

2.9. Both brine pumps fail and shut down: check pump and wiring, replace pump.

2.10. Absorption pump 1 fault shutdown: check pump and wiring, replace pump.

2.11. Absorption pump 2 fault shutdown: check pump and wiring, replace pump.

2.12. Electrolysis mainframe communication fault: Check the network cable connector between the electrolysis mainframe and the absorption master cabinet. Communication fault alarm cannot be restored by fault reset, and will be automatically eliminated after the fault is repaired.

2.13. Each machine pump overload, failure and important electric valve 11, 14, 21 failure, stop DC power, other electric valve failure, do not stop DC power. Check equipment and wiring, replace pumps and electric valves.

11 Common Failure Phenomena and Analysis

Serial number	Fault Phenomenon	Failure Analysis	Troubleshooting
1	Sudden rise in electrolytic tank voltage	Lack of liquid in the cathode and anode chambers	Increase the inlet brine and circulating alkali flow.
		Decrease in concentration of brine and lye in cathode and anode chamber	Increasing the concentration of incoming brine and circulating lye
		Broken ionic membrane, cathode and anode chamber collusion	Shutdown to replace ion membrane
		Brine impurities and clogged membranes	Clean the salt filter, or replace the cartridge. Perform acid cleaning.
2	Decrease in sodium hypochlorite	Sodium hypochlorite circulates at temperatures above 35 degrees and decomposes	Adjust the inlet heat exchanger cooling water valve.

	concentration	Specific gravity of electrolytic lye below 1.16	The specific gravity of the electrolysis of the set net is greater than 1.18.
		High pH setting at the end of the reaction	Lower the endpoint pH setting.
		Heat exchanger gasket leaks, cooling water cascades in	Replace the heat exchanger gasket.
3	Odor in the workshop or exhaust gas	1. Leakage in chlorine gas piping or equipment seals 2. No. 1 and No. 2 Absorber Tower Liquid Break 3. Absorbent pH too low	1. Check with dilute ammonia sticky cloth, the smoke, i.e. the leak, is eliminated. 2. Checking pump pumping 3. Check for malfunctioning pH meter
4	After-sales service phone number	18559918328	

12 Emergency rescue plan for high concentration sodium hypochlorite plant accidents

1. hazard source

Sodium hydroxide, sodium hypochlorite, hydrochloric acid, hydrogen gas, chlorine gas, etc.

The above hazardous chemical substances have the potential danger of serious accidents such as fire, explosion, personnel poisoning, asphyxiation and burns in case of contact, leakage, uncontrolled operation or in case of natural disasters. The most probable production accidents are: H_2explosion and combustion in electrolysis system, Cl_2leakage poisoning, high concentration NaClO and NaOH burning accidents.

2. Principles of emergency response to accidents

On-site personnel need not wait for orders to save people and protect equipment first, control the accident as much as possible to prevent expansion, and report it while handling it; until this plan is activated, handle it according to normal dispatching and accident handling procedures.

1. (a) Following the accident, personnel on the scene first resuscitated the casualties at the scene of the accident.
2. (a) The team where the accident occurred urgently implemented first aid on the scene to control the expansion of the accident.

3. Incident handling methods

3.1 Explosion in the sodium hypochlorite electrolysis process system

Possible locations and hazards: Depending on the characteristics of the production, explosions may occur in the electrolytic process system, and the degree of explosion hazard is closely related to the oxygen content in the hydrogen.

3.2 H_2 System tube blowing and burning, explosion, electrolyzer explosion

A. The operator on duty immediately stops according to the emergency stop procedure, cuts off the power to the main engine, extinguishes the fire with a dry powder fire extinguisher, and quickly reports the incident to the supervisor according to the accident reporting procedure.

B. After receiving the report, the superior leader quickly called the police and reported immediately, and at the same time organized the rescue and rescue team to quickly rush to the scene to find out whether there were casualties at the scene and provide timely rescue to the injured employees to prevent the accident from expanding.

C. The operator on duty is responsible for checking the stopping situation and ensuring that all stops have been made and that there is no further risk of explosion before organizing the discharge of material from the electrolyzer and reaction tower.

3.3 Reddening and burning of the copper row of the electric bath

A. Phenomenon: The copper row of the electrolytic tank is red or smoldering, and in serious cases, it burns.

B. On-site incident management.

C. (a) The electrolytic tank appears to have a red copper row, the current is quickly reduced to 0, the copper row of the accident tank is re-tightened, and then the current is raised to normal values.

D. If there is smoke or burning in the electrolytic tank, immediately stop the tank according to the normal stopping procedure, cut off the power to the main unit and extinguish the fire with a dry powder extinguisher.

3.4 electrocution

A. Minor electric shock accident: cut off the power supply, carry the electrocuted person to a ventilated and dry place and place it in a flat trip.

B. Serious electric shock accident: cut off the power supply, carry the electrocuted person to a ventilated and dry place, place the person in a flat trip, and take first aid on the spot such as artificial respiration according to the degree of electrocution of the electrocuted person, and report immediately to the shift supervisor. The shift supervisor is responsible for organizing first aid at the scene.

3.5 First aid for chlorine gas poisoning

Rescuers enter the accident site in groups of two, wearing protective masks, and two or more groups at the same time. One group is the rescue team and the other group is the emergency team, headed by the production shift leader, quickly cut off the source of the hazard and control the spread of chlorine gas with fire-fighting fog water. The ambulance team quickly carries the poisoned person away from the contaminated area, keeps the poisoned person warm, uses 2% sodium bicarbonate nebulization for the poisoned person to inhale and wash the eyes, or washes the eyes with physiological saline mouthwash; the heavy person can inhale $_2$oxygen mixed with 5% CO, while removing the poisoned person's contaminated clothes, cleaning the poisoned person's skin, hair and nail crevices, and prohibits pressing the patient's chest. After the initial first aid, the patient should be quickly sent to the nearest hospital in condition, and the safety and environmental protection department should send someone to provide physical and chemical data such as chlorine toxicity and necessary assistance.

3.6 First aid for NaClO burns

Rinse the skin thoroughly with water and the eyes should be washed thoroughly with running water for at least 15 minutes before being taken to a hospital for medical attention. If ingested orally, vomit immediately with salt water or warm soapy water and then take to hospital for treatment. If a small amount is inhaled or if toxic fog is inhaled in a fire, move the patient quickly to fresh air and perform artificial respiration if necessary.

3.7 First aid for NaOH burns

Rinse the skin with running water, especially the eyes, thoroughly and promptly with running water, and neutralize with 2% boric acid water or dilute acetic acid solution. For those who enter through the mouth, rinse the patient's mouth with plenty of water and then drink milk, soy milk and protein to protect the mucous membrane of the mouth and digestive tract. If the above items are not available, have the patient drink plenty of water before receiving treatment from a physician.

3.8 First aid for hydrochloric acid burns

Rinse the skin with plenty of water or sodium bicarbonate solution, and use 2% sodium bicarbonate nebulized inhalation for acid mist inhalation. If aspirated by mouth, lavage stomach immediately, drink milk, soy milk and protein, magnesium oxide suspension; avoid lavage with sodium bicarbonate and other alkaline drugs.

13 Central Control Analysis

sodium hypochlorite solution

1. Determination of effective chlorine content in sodium hypochlorite solution

1.1. principle

In acidic medium, hypochlorite reacts with potassium iodide to precipitate iodine, which is titrated with standard titration solution of sodium thiosulfate using starch as indicator solution until the blue color disappears as the end point. The reaction formula is as follows.

$$2H^+ + OCl^- + 2I^- = I_2 + Cl^- + H_2O$$

$$I_2 + 2S_2O_3^{2-} = S_4O_6^{2-} + 2I^-$$

1.2. reagents

1.2.1. Potassium iodide solution: 100g/L

Weigh 100 g of potassium iodide, dissolve in water, dilute to 1000 ml and shake well.

1.2.2. Sulfuric acid solution.

Measure 15 ml of sulfuric acid, slowly inject into 500 ml of water, cool, and shake well.

1.2.3. Standard titration solution of sodium thiosulfate: $c(Na_2S_2O_3) = 0.1$ mol/L

1.2.4. Starch indicator solution: 10g/L

1.3. instrumentation

General laboratory instruments.

1.4. Analysis steps

1.4.1. trial run

Approximately 20 ml of laboratory sample was measured and placed in a 100 ml beaker filled with 20 ml of water and weighed (to the nearest 0.01 g). Then transfer all into a 500 ml volumetric flask, dilute to the scale with water and shake well.

1.4.2. survey and evaluate

Measure 10.00 ml of the test material (1.4.1), place it in a 250 ml iodine flask containing 50 ml of water, add 10 ml of potassium iodide solution (1.2.1) and 10 ml of sulfuric acid solution (1.2.2), seal the flask quickly with a tight stopper, leave it in a dark place for 5 min, titrate with sodium thiosulfate standard titration solution (1.2.3) until light yellow, add 2 ml of starch indicator solution (1.2.4) and continue the titration until the blue color disappears, that is, the end point.

1.4.3. Calculation of results

Effective chlorine is expressed as the mass fraction X1 of chlorine, with values expressed as %, and is calculated according to equation (1).

(V/1000) cM 5VcM
X1 = ------- × 100 = -- - .... (1)
m x 10/500 m

where.

V - the value of the volume of the standard titration solution of sodium thiosulfate in millilitres (ml).

c - the exact value of the concentration of the standard titration solution of sodium thiosulphate in moles per litre (mol/L).

m - the numerical value of the mass of the test material, in grams (g).

M - value of the molar mass of chlorine in grams per mole (g/mol) (m = 35.453).

1.4.4. allowed error

The absolute value of the difference between the parallel measurements does not exceed 0.2%.

The arithmetic mean of the parallel measurements was taken as the reported result.

2. Determination of free base content in sodium hypochlorite solutions

1.1. principle

Decompose hypochlorite with hydrogen peroxide and titrate with standard titration solution of hydrochloric acid using phenolphthalein as indicator to a slight red color as the end point. The reaction equation is as follows.

$$ClO^- + H_2O_2 = Cl^- + O_2\uparrow + H_2O$$

$$OH^- + H^+ = H_2O$$

1.2. reagents

1.2.1. Hydrogen peroxide solution: 1 + 5

1.2.2. Hydrochloric acid standard titration solution: c(HCl) = 0.1 mol/L

1.2.3. Phenolphthalein indicator solution: 10g/L

1.3. instrumentation

General laboratory instruments.

1.4. Analysis steps

1.4.1. trial run

Approximately 20 ml of laboratory sample was measured and placed in a 100 ml beaker filled with 20 ml of water and weighed (to the nearest 0.01 g). Then transfer all into a 500 ml volumetric flask, dilute to the scale with water and shake well.

1.4.2. survey and evaluate

Measure 50.00 ml of the test material (1.4.1), place it in a 250 ml conical flask, add hydrogen peroxide solution (1.2.1) dropwise until the solution does not bubble, add 2 to 3 drops of phenolphthalein indicator solution (1.2.3) and titrate with hydrochloric acid standard titration solution (1.2.2) until slightly red as the end point.

1.5. Calculation of results

The free base is expressed as sodium hydroxide (NaOH) mass fraction X2 and the value is expressed as %, according to equation (2).

$$X_2 = \frac{(V/1000)\,cM}{m \times 50/500} \times 100 = \frac{VcM}{m} \quad \text{...... ....} \quad (2)$$

where.

V - the value of the volume of the standard titration solution of hydrochloric acid, in millilitres (ml).

c - the exact value of the concentration of the standard titration solution of hydrochloric acid, in moles per litre (mol/L).

m - the numerical value of the mass of the test material, in grams (g).

M - The value of the molar mass of sodium hydroxide in grams per mole (g/mol) (M = 40.00).

1.6. allowed error

The absolute value of the difference between the parallel measurements is not greater than 0.04%.

The arithmetic mean of the parallel measurements was taken as the reported result.

Saline analysis

1. Analysis of crude brine

1.1. Determination of NaCl content

1.1.1. Measurement principle

A standard solution of silver nitrate is used to titrate chloride ions in a neutral or weakly basic solution with potassium chromate as indicator. Since the solubility of silver chloride is less than that of silver chromate, silver chloride precipitates first in the titration process, and when the equivalence point is reached, the silver ions increase to reach the solubility product of silver chromate and immediately form a brick-red precipitate of silver chromate, which is the end point. The reaction formula is.

$$AgNO_3 + NaCl = AgCl\downarrow \text{ (white)} + NaNO_3$$

$$AgNO_3 + K_2CrO_4 = Ag_2CrO_4\downarrow \text{ (brick red)} + 2KNO_3$$

1.1.2. Reagents and solutions

Silver nitrate (GB670-77) Analytical purity: 0.05 mol/L standard titration solution. (Prepared and formulated according to GB601-77 < the preparation method of standard solution >)

Potassium chromate (HGB305-60) analytical purity: 50g/L (5%) potassium chromate solution

1.1.3. Measurement method

Use a pipette to accurately absorb 5mlof crude brine in a 250ml volumetric flask diluted to the scale with distilled water, shake evenly, then use a pipette to absorb 5ml in a triangular flask, dilute to 40ml, add 10 drops of 5% analytically pure potassium chromate (K_2CrO_3) indicator, then use 0.05mol/l silver nitrate ($AgNO_3$) standard solution, the titration solution shows light red, that is, the end point.

1.1.4. calculation method

$$NaCl(g/l)=\frac{V\times C/1000\times 58.46}{5\times 5/250}\times 1000$$

where.

V...... volume of $AgNO_3$standard solution used for titration, ml.

C...... molar concentration of standard solution$_3$ of AgNO

58.46 ...... molar mass of NaCl

1.2. Determination of Ca^{2+}content

1.2.1. reagents

Triethanolamine solution: 1:2 triethanolamine solution by volume

Hydroxylamine hydrochloride solution: 100g/L hydroxylamine hydrochloride solution

NaOH solution: 80g/L NaOH (GB629-81 analytical purity) solution

Calcium Indicator (HGB3508-62) Chrome Orchid Black R: Weigh 50 g of NaCl (analytically pure) dried at 1100C for about 2 hours, grind it well with 0.5 g of calcium reagent (Chrome Orchid Black R) in a milk bowl, store in a mill stopper bottle and keep it in a desiccator for backup.

1.2.2. Measurement principle

In strong alkaline medium, the magnesium ion is transformed into magnesium hydroxide precipitate, the solution is added with triethanolamine masking agent to eliminate the interference of Fe^{3+} ,Al^{3+} ,Cu^{2+},$Mn^{2+}$and other metal ions, with solid calcium indicator (chromium orchid black R) as the indicator, titrated with EDTA standard solution, the calcium indicator can be under the calcium ion to generate red chromium complex, titrated with EDTA, EDTA complexed with calcium ions, so that the calcium indicator After titration with EDTA, EDTA complexes with the calcium ion, causing the calcium indicator to free out and show pure blue, indicating the end point of titration. The reaction formula is.

Calcium reagents form complexes with calcium ions

$$Ca^{2+} + H_2In^{2-}\text{ (azure)} = CaIn^{2-}\text{ (burgundy)} + 2H^+$$

When titrated with EDTA to the equivalence point, the complex $CaIn^{2-}$destroyed and the free Ca reagent is released.

$$CaIn^{2-}\text{ (burgundy)} + H_2Y = CaY + H_2In^{2-}\text{(azure)}$$

1.2.3. Operation steps

Take 5 ml of the sample accurately in a 250 ml triangular flask, add 10 ml of triethanolamine, 5 ml of hydroxylamine hydrochloride and 20 ml of NaOH solution to keep the pH value above 13 (mainly to produce $Mg(OH)_2$ precipitate from 2+), then add about 0.2 g of calcium reagent and titrate with 0.01 mol/l EDTA standard solution until the end point of light blue color.

1.2.4. Resulting formula

$$Ca^{2+}\text{ (g/l)}=\frac{C\times V/1000\times 40.08}{5}\times 1000=\frac{V\times C\times 40.08}{5}$$

where.

V...... ml of EDTA consumed for titration

C...... molar concentration of EDTA standard solution

40.08 ...... molar mass of calcium atoms

1.3. Determination of Mg^{2+}content

1.3.1. Reagents and Formulation

Triethanolamine solution: 1:2 triethanolamine solution by volume

Hydroxylamine acid solution: 100g/L hydroxylamine hydrochloride solution

Buffer ($NH_3\ H_2O$-$NH_4\ Cl$) pH=10: Weigh 54 g of NH_4Cl dissolved in 200 ml of distilled water, add 350 ml of concentrated ammonia (NH_3H_2O) to dissolve and dilute to 1 liter.

Chromium black T indicator: take 0.5 g of chromium black T dissolved in 50 ml of warm triethanolamine, add 5 ml of 100 g/L hydroxylamine hydrochloride solution, then dilute to 100 ml with anhydrous ethanol and store in a brown bottle.

1.3.2. Operation steps

Add 10 ml of triethanolamine, 5 ml of hydroxylamine hydrochloride, 10 ml of pH=10 buffer solution, 0.2 ml of chromium black T indicator (about 4 drops) and titrate with 0.01 mol/l EDTA until the solution changes from light red to pure blue . The content of Ca in the same sample was $^{2+}$also determined by referring to the method for determination of Ca content.$^{2+}$

1.3.3. Resulting formula

$$Mg^{2+}\ (g/l)=\frac{C(V1-V2)/1000\times 24.32}{5}\times 1000$$

where.

C...... concentration of EDTA standard titration solution, mol/l

V1...... volume of EDTA used for titration of Ca $^{2+}$Mg^{2+}, ml

V2...... volume of EDTA consumed to titrate Ca2+ in the same sample, ml

24.32 ......Mg^{2+}of molar mass

1.3.4. note

1.3.4.1. Chromium black T polymerizes easily in aqueous solutions and oxidizes easily in alkaline solutions.

1.3.4.2. The addition of triethanolamine prevents its polymerization and the addition of hydroxylamine hydrochloride prevents its oxidative discoloration.

1.3.4.3. Ethanolamine can mask the $^{3+}$ions of Fe^{3+}, Al, etc., so that no interference occurs when measuring Ca^{2+}, Mg.$^{2+}$

Determination of sodium hydroxide

1. Determination of sodium hydroxide

1.1. Measurement principle

An excess of BaCl $_2$solution was added to the specimen to produce a white precipitate of CO$_3$$^{2-}$, which was titrated with a standard solution of hydrochloric acid using phenolphthalein as an indicator, with the reaction equation

$CO_3^{2-} + Ba^{2+} = BaCO_3$

$NaOH + HCl = NaCl + H_2O$

1.2. reagents

Hydrochloric acid standard solution: 0.1000 mol/l

Barium chloride solution: 100g/L

Phenolphthalein indicator: 10g/L ethanol solution

1.3. Measurement method.

Use a pipette to accurately draw 25ml of the sample in a 250ml triangular flask, add 10ml of barium chloride solution, add 1-2 drops of phenolphthalein indicator and titrate the sample with hydrochloric acid standard solution until the red color disappears, which is the end point.

1.4. Calculation method.

$$\mathrm{NaOH\ (g/L)} = \frac{C \times \mathrm{V} / 1000 \times 40}{25} \times 1000$$

where.

C...... concentration of standard titration solution of hydrochloric acid, mol/l

V...... volume of standard solution of hydrochloric acid used, ml

40 ...... molar mass of sodium hydroxide.

Determination of hydrochloric acid content

1. Determination of hydrochloric acid content

1.1. Measurement Principle

Alkali titration with methyl orange as indicator.

1.2. Reagents and solutions

Standard titration solution of sodium hydroxide: 0.1000 ml/L solution.

Methyl orange as indicator: lg/L solution.

1.3. Measurement method

Use a graduated pipette to accurately pipette 0.5ml into a 150ml triangular flask, add an appropriate amount of water, add 1-2 drops of methyl orange indicator and titrate the specimen with NaOH standard solution until it changes from red to yellow, which is the end point.

1.4. calculation method

$$\text{HCl (\%)} = \frac{C \times V / 1000 \times 36.5}{0.5} \times 100$$

where.

C...... concentration of the standard titration solution of sodium hydroxide. mol/L

V...... volume of sodium hydroxide standard titration solution used to go,ml

36.5 ...... molar mass of hydrochloric acid.

14 Physical data of materials

Table of conductivity of sodium chloride brine as a function of temperature

Table 1 Variation of conductivity of sodium chloride brine with temperature (temperature coefficient 2.3%/°C)

Conductivity ms/cm	Brine 15%	Brine 18%	Brine 20%	Brine 23%	Brine 26%
15 ℃	392.9	421.9	450.3	504.7	539.7
20℃	389.8	446.9	490.4	542.7	560.5
25℃	366.9	398.9	446.8	491.0	497.8
30℃	354.2	379.0	412.6	441.1	467.3
35℃	345.9	370.5	442.8	458.9	462.8
40℃	336.8	370.8	423.0	437.1	451.7
45℃	338.5	368.8	409.5	439.4	451.3
55℃	360.9	384.5	430.5	455.5	472.5

65℃	385.1	444.5	460.8	516.4	542.2

Sodium chloride, sodium hydroxide concentration, temperature and specific gravity comparison table

Table 2 Concentration, temperature and specific gravity of sodium chloride (NaCl) against

%	0℃	10℃	25℃	40℃	60℃	80℃	100℃
1	1.00747	1.00707	1.00409	0.99908	0.99	0.9785	0.9651
2	1.01509	1.01442	1.01112	1.00593	0.9967	0.9825	0.9719
4	1.03038	1.0292	1.02530	1.01977	1.0103	0.9988	0.9855
8	1.06121	1.05907	1.05412	0.04798	1.0381	1.0264	1.0134
12	1.09244	1.08946	1.08365	1.07699	1.0667	1.0549	1.0420
16	1.12419	1.12056	1.11401	1.10688	1.0962	1.0842	1.0713
20	1.15663	1.15254	1.14533	1.13774	1.1268	1.1146	1.1017
24	1.18999	1.18557	1.17776	1.16971	1.1584	1.1463	1.1331
26	1.20709	1.20254	1.19443	1.18614	1.1747	1.1626	1.1492

Table 3 Comparison of sodium hydroxide (NaOH) concentration, temperature and specific gravity

%	0℃	15℃	20℃	40℃	60℃	80℃	100℃
1	1.0124	1.0107	1.0095	1.0033	0.9941	0.9824	0.9693
2	1.0244	1.0220	1.0207	1.0139	1.0045	0.9929	0.9797
4	1.0482	1.0444	1.0428	1.0352	1.0254	1.0139	1.0009
8	1.0943	1.0889	1.0869	1.0780	1.0676	1.0560	1.0432
12	1.1399	1.1333	1.1309	1.1210	1.1101	1.0983	1.0885
16	1.1849	1.1776	1.1751	1.1645	1.1531	1.1408	1.1277
20	1.2296	1.2216	1.2191	1.2079	1.1960	1.1833	1.1700

24	1.2741	1.2658	1.2629	1.2512	1.2388	1.2259	1.2124
28	1.3182	1.3094	1.3066	1.2942	1.2814	1.2682	1.2546
32	1.3614	1.3520	1.3490	1.3362	1.3232	1.3097	1.7960
36	1.4030	1.3933	1.3900	1.3768	1.3634	1.5498	1.3360
40	1.4435	1.4334	1.4300	1.4164	1.4027	1.3889	1.3750
44	1.4825	1.4720	1.4685	1.4545	1.4406	1.4266	1.4127
48	1.5210	1.5102	1.5065	1.4822	1.4781	1.4647	1.4503
50	1.5400	1.5290	1.5253	1.5109	1.4967	1.4527	1.4690

Sodium hydroxide content in sodium hypochlorite versus pH

Table 4 Sodium hydroxide concentration versus pH

Sodium hydroxide concentration %	Sodium hydroxide concentration mol/L	OH mol/L	1gOH	pH
0.01%	0.00250	0.0025	-2.60206	11.40
0.05%	0.01250	0.0125	-1.90309	12.10
0.10%	0.02500	0.025	-1.60206	12.40
0.50%	0.12500	0.125	-0.90309	13.10
1.00%	0.25000	0.25	-0.60206	13.40
1.50%	0.37500	0.375	-0.42597	13.57
2.00%	0.50000	0.5	-0.30103	13.70
2.10%	0.52500	0.525	-0.27984	13.72
2.20%	0.55000	0.55	-0.25964	13.74
2.30%	0.57500	0.575	-0.24033	13.76
2.40%	0.60000	0.6	-0.22185	13.78

2.50%	0.62500	0.625	-0.20412	13.80
2.60%	0.65000	0.65	-0.18709	13.81
2.70%	0.67500	0.675	-0.1707	13.83
2.80%	0.70000	0.7	-0.1549	13.85
2.90%	0.72500	0.725	-0.13966	13.86
3.00%	0.75000	0.75	-0.12494	13.88
3.50%	0.87500	0.875	-0.5799	13.91
4.00%	1.00000	1	0	14.00

Annex

1. High concentration sodium hypochlorite plant operation log sheet, summary of various instrumentation value fields and problems
2. Electrical instrument operating instructions
3. Process flow diagram of high concentration sodium hypochlorite generator with control points