TAIHANG **Nickel-iron Storage Battery**

Operation & maintenance

manual

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PREFACE

The nickel-iron storage battery has a nickel oxide-hydroxide anode and iron cathode, with an electrolyte of potassium hydroxide. the active material are packed in perforated pockets. it is a very robust battery which can be tolerant of abuse (overcharge, overdischarge) and can have very long life (2000cycles)even if so treated, it is often used in backup situations where it can be continuously charged and can last for more than 20 years，Operating temperature is -20℃~60℃. nickel-iron storage battery have the properties of green ,environmentally friendly to nature ,high capacity, rigid construction, long service life, no corrosive gas during operation, high reliability to operation, etc.

They are widely used as DC power supply for mine tractor、USP、EPS、wind and solar power systems、electrical vehicles and boats, etc.

Electrochemistry

$$3Fe+8NiOOH+4H_2O \rightleftharpoons 8Ni(OH)_2+Fe_3O_4$$

(Discharging is read left to right, charging is from right to left.)

.The electrolyte mixture of potassium hydroxide and lithium hydroxide is not consumed in charging or discharging, Lithium hydroxide improves the performance of the cell.

Durability

The ability of these batteries to survive frequent cycling is due to the low solubility of the reactants in the electrolyte.

Operation and maintenance

1.Storage and transportation

It is not allowed to put together the nickel-iron battery and acidic battery in the same place in order to avoid causing the chemical change.

1.1 **The storage of batteries**

The storage of the batteries could be effected by storage conditions, ambient temperature , air humidity, their state prior to storage. Storage and maintenance of the batteries should meet the specified requirement so as to prolong their service life

Short-time storage(one year)

For your convenience, the battery can be stored with the electrolyte in the charge state or discharge state..Adjust the electrolyte level and screw the vent plug before storing, keep the battery in a dry, acidless and well-ventilated room where the

temperature is not more than 35℃.

Long-time storage

If the battery is stored for a long time, pour out the electrolyte. it is advisable to screw the vent-plug tightly in discharge state. Clean the metalwares, coat them with vaseline oil and store them in a day, acidless, and well-ventilated room where the temperature is not more than 35℃, where the relative humidity is not more than 75%.

1.2 **Battery transportation**

For transportation safety. please keep the batteries in the discharge state, pour out the electrolyte. Or else, it may cause a fire due to the short-circuit, also, it may cause serious injury to the people.

2. Preparation method of the electrolyte for the battery

2.1 Preparation method

Put water into the vessel, add KOH slowly with constant stirring, then add the required lithium hydroxide into the vessel, stir to dissolve thoroughly. Cool to 20±5℃.Finally, measure the density and adjust to the required value, then clear liquid can be used. please refer to the following table.

No.	Operating ambient temperature (℃)	Electrolyte Density (g/cm^3)	Electrolyte composition	Weight ratio (alkali: water)
1	-15~45	1.20±0.02	KOH+20g/LLiOH	1:3

Note: When preparing for electrolyte, you must have a pair of goggles and rubber gloves. In case your skin touch the alkali electrolyte, please immediately flush with 3% boric acid solution or drinking water.

2.2 Technical requirements for raw material:

KOH: chemical pure or industrial grade。

LiOH: industrial pure LiOH content should not be less than 50%.

Water: distilled water or purified water.

2.3Vessels and implements:

The vessels for preparation of the electrolyte should be plastic, porcelain enamel wares or stainless steel. The tools include: hydrometer (range of 1.10~1.30), thermometer graduate cylinder, funnel, plastic scoop, platform scale, stirrer or plastic rod.

3.Method of charge and discharge

3.1Initial charge

The new battery and the battery stored for more than 6 months should be charged at $0.25C_5A$ for 13 hours, then discharged at $0.2C_5A$ to 1.0V/cell, repeatedly the above charge and discharge for 3-5cycles. If the discharge duration isn't less than 5hours and the battery voltage isn't less than 1.0V/cell, the battery can be put into operation according to normal charge(see the following table)

Charge Regime	Charge Current	Charge Duration	Reference Temperature
Normal charge	$0.2C_5A$	8	20±5℃
Overcharge	$0.2C_5A$	12	
Fast charge	$0.5C_5$ A	4	

NOTE:

1.When charging at 20±5℃, it is good for batteries

2.Batteries are charged by the method of constant current charge, but the method of constant voltage with current limit can be used according to equipment requirement.

(1)Constant current charge method: the charger should be set at 1.9V/cell×n, in the colder region ,the charger should be set at 2.2V/cell×n.

(2)Constant voltage with current limit method: the charger should be set 1.55V/cell×n～1.65V/cell×n, the current limit is set at 0.2 C_5A, when the charge current decrease to 0.02 C_5A, then changed into float charge method, the voltage range of the float charge is 1.48V/cell×n～1.50V/cell×n, the current limit is 4mA/Ah～6mA/Ah.With the change of normal temperature the charge voltage should be adjusted properly, In general, the temperature exceeds the normal temperature of 25℃, the charge voltage decreases by 0.003V per 1℃. when the temperature is less than the normal temperature of 25℃, the charge voltage increases by 0.003V per 1℃.

3. C_5 denotes the output capacity of the battery discharged to cut-off voltage of 1.0v with 5 hours rate at 20℃, namely, the nominal capacity.

4.Under normal circumstances, the battery should be charged by normal charge rate (0.2 C_5A). In the case of emergency ,the fast charge method (0.5 C_5A) can be used. The battery must be charged at normal charge rate(0.2 C_5A) for 12 hours when it is overcharged.

3.2Discharge

Please choose the discharge method according to the following table

Discharge method	Discharge Current (A)	DischargeFinalVoltage (V)	Discharge Duration
1hour	1 C_5	≥0.5	≥1h
2hours	0.5C_5	≥0.7.	≥2h
3hours	0.33C_5	≥0.9	≥3h
5hours	0.2C_5	≥1.0	≥5h
8hours	0.125C_5	≥1.10	≥8h
10hours	0.1C_5	≥1.10	≥10h
20hours	0.05C_5	≥1.15	≥20h

Note: 5 hours discharge is normal discharge method.

4.Electrolyte replacement

4.1Replacement time

During operation, the electrolyte inside the battery can easily absorb the carbon dioxide in the air, thus adding carbonate into the battery. when the carbonate content is more than 60g/L ,or find that the electrolyte is polluted due to some reason, consequently cut down the capacity. the electrolyte should be replaced

4.2Replacement method

The battery should be discharged to 1.0V , then replace the electrolyte. Open the air plug ,shake up the electrolyte with the dust inside the battery and pour out. If necessary, please flush with clear water prepared for electrolyte for 1~2 times, then inject the fresh electrolyte in time.

5 .Performance check

During operation, please check the battery performance at regular intervals. If you find some capacity- reducing batteries in the battery modules, please replace the capacity-reducing battery, or else , it will affect the battery modules' performance.

In the process of charging the battery, professional staff should be assigned to take charge of the accuracy of charge current and enough charge time .otherwise ,the battery will not be charged fully.

6.Instruments calibration

Please calibrate the instruments at regular intervals in order to keep their accuracy. Such as ammeter, voltmeter, thermometer, hydrometer etc.

7.Water replenishment (distilled water or purified water)

The electrolyte density will increase due to water evaporation and electrolysis, it's necessary to check the electrolyte level and density at regular intervals, and replenish the water , the period of water replenishment should depend on the temperature and operating environment.

8.Trouble and trouble shootings

Trouble	Cause	Trouble shootings
The capacity of the batteries decrease	The electrolyte has been used for a long time and the carbonate content is too high	Replace the new electrolyte
	The electrolyte isn't enough ,and the plates are exposed	Replenish the distilled water or adjust the density . then overcharge the batteries.
	Harmful impurities contained in the electrolyte is too high	Replace the new electrolyte
	The charge and discharge method is not correct	Adopt the correct charge/discharge method.
	Short-circuit or slight short-circuit in the cell	Replace the short-circuit cell
	Short-circuit or slight short-circuit occurs outside of cell	Keep the cell dry temperature
	The instruments used is not correct	Check and rectify the ammeter and voltmeter
Voltage is not correct	The inner circuit of the cell is short or cut, the electrolyte has been run out	Clean the cell, or change the electrolyte
	The external circuit of the cell is short or cut	Keep the cell dry, and check
	Contact fault	Check and repair
The cell container swell	The positive plate swells	If necessary, change the cell
	The vent plug is blocked up	Clean with hot water or replace it.
	The inner circuit of cell is short, or there are too many impurities in the electrolyte	Check and replace the electrolyte
Bubbles appear in the inside of the cell	The electrolyte contains organic impurities	Replace the electrolyte

9. Environmental impact

Nickel-iron batteries do not have the lead or cadmium of the lead-acid and nickel-cadmium batteries, so they have no harm to human and ecological health.

Date sheet of nickel-iron rechargeable battery

Models	Nominal Voltage (Ah)	Nominal capacity (v)	External dimension (mm)			Terminal	Container Material
			Length	width	Height		
TN10-(2)	1.2	10	85	39	126	M5	ABS
TN30-(2)	1.2	30	145	54	248	M10×1	ABS
TN40-(2)	1.2	40	145	54	248	M10×1	ABS
TN45-(2)	1.2	45	142	67	223	M10×1	ABS
TN50-(2)	1.2	50	142	67	223	M10×1	ABS
TN60-(2)	1.2	60	136	51	368	M10×1	PP
TN80-(2)	1.2	80	139	79	362	M10×1	ABS
TN100-(2)	1.2	100	141	80	365	M16	ABS
TN150-(2)	1.2	150	167	162	343	M20	ABS
TN200-(2)	1.2	200	167	162	343	M20	ABS
TN250-(2)	1.2	250	277	139	420	M16	PP
TN300-(2)	1.2	300	277	139	450	M16	PP
TN350-(2)	1.2	350	277	139	450	M16	PP
TN400-(2)	1.2	400	176	161	535	M2×1.5	ABS
TN450-(2)	1.2	450	291	174	505	M2×1.5	ABS
TN500-(2)	1.2	500	291	174	505	M2×1.5	ABS
TN600-(2)	1.2	600	291	174	505	M2×1.5	ABS
TN700-(2)	1.2	700	399	184	562	M2×1.5	ABS
TN800-(2)	1.2	800	399	184	562	M2×1.5	ABS
TN1000-(2)	1.2	1000	399	184	572	M2×1.5	ABS