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(54) **CURING AND DRYING METHOD FOR WET LEAD PASTE ELECTRODE PLATE FOR LONG-LIFE VALVE REGULATED LEAD ACID BATTERY.**

(57) The present invention discloses a curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery. The wet lead paste electrode plate for the lead acid battery comprises a positive electrode plate and a negative electrode plate and comprises a curing stage and a drying stage, wherein a method for the curing stage comprises: staged curing of the positive electrode plate: in a first stage, a temperature is controlled to gradually rise from 58°C to 78°C, and curing is conducted in wet air with the relatively humidity of 99.9% and a curing time of 8 h. In the present invention, by employing a high-humidity curing method with alternate high temperature and low temperature, through process tests for many times and repeated verification, the method of the present invention is obtained, so that the cured and dried electrode plate has the main component of 4PbO·PbSO4 crystals which are better than 3PbO·PbSO4 crystals, and the strength of the electrode plate may be strengthened; and a storage battery, assembled by using such electrode plate, is long in service life, can overcome a premature capacity loss caused by a lead-calcium alloy and may obviously prolong the service life of the valve regulated lead acid battery.

CURING AND DRYING METHOD FOR WET LEAD PASTE ELECTRODE PLATE FOR LONG-LIFE VALVE REGULATED LEAD ACID BATTERY

LU502366

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field

[0002] The present invention relates to the field of lead acid batteries, and in particular to a curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery. The valve regulated lead acid battery is mainly applied to a motorcycle.

[0003] 2. Description of Related Art

[0004] A valve regulated lead acid battery is also called VRLA battery. The VRLA battery employs a lean liquid design; the vast majority of an electrolyte is adsorbed by a diaphragm material, and a small amount of the electrolyte is adsorbed by effective substances of an electrode plate; an oxygen cycle is achieved through a mechanism of absorption and oxidation by a negative electrode; and moreover, there is no flowing electrolyte in the battery, so that the battery may work standing up or laying, and then the valve regulated lead acid battery is also called a “lean liquid battery”.

[0005] In the VRLA battery, a positive electrode plate grid and a negative electrode plate grid are both made of a Pb-Ca multicomponent alloy; and each grid is coated with a wet lead paste, is cured in a curing chamber at a certain temperature and humidity and then is dried in a drying chamber after curing to obtain a green electrode plate. Each green electrode plate is subjected to an electrochemical reaction in an electrolyte solution with an H_2SO_4 solution as a main component and is converted to an electrode plate. Each green electrode plate has the main components of PbO in a form of a tetragonal crystal and tribasic lead sulfate and also a small quantity of metal lead, basic lead carbonate and tetrabasic lead sulfate.

[0006] Tetrabasic lead sulfate is beneficial to prolonging the service life of the lead acid battery; while a main body material of a battery of a motorcycle employs the Pb-Ca multicomponent alloy, the Pb-Ca multicomponent alloy battery is prone to a premature capacity loss to cause failure in service life of the battery in a charge-discharge cycle, and the service life of the battery is affected.

[0007] For this reason, how to solve the deficiencies in the prior art is a research topic of the present invention.

BRIEF SUMMARY OF THE INVENTION

[0008] To solve the above problems, the present invention discloses a curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery.

[0009] To achieve the objective, the present invention provides the following technical solution: disclosed is a curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery. The wet lead paste electrode plate for the valve regulated lead acid battery includes a positive electrode plate and a negative electrode plate and includes a curing stage and a drying stage,

[0010] where a method for the curing stage includes:

[0011] staged curing of the positive electrode plate: in a first stage, a temperature is controlled to gradually rise from 58°C to 78°C, and curing is conducted in wet air with the relatively humidity of 99.9% and a curing time of 8 h; and

[0012] in a second stage, the temperature is controlled to gradually decrease from 78°C to 50°C, the relative humidity is controlled to gradually decrease from 99.9% to 85%, and the curing time is 20 h.

[0013] Staged curing of the negative electrode plate:

[0014] in a first stage, a temperature is controlled to gradually rise from 55°C to 75°C, and curing is conducted in wet air with the relative humidity of 99.9% and a curing time of 8 h; and

[0015] in a second stage, the temperature is controlled to gradually decrease from 75°C to 50°C, the relative humidity is controlled to gradually decrease from 99.9% to 90%, and the curing time is 22 h.

[0016] A method for the drying stage includes:

[0017] staged drying of the positive electrode plate: in a first stage, a temperature is controlled to gradually rise from 45°C to 75°C, the relative humidity is controlled to gradually decrease from 70% to 0%, and the drying time is 4 h; and

[0018] in a second stage, the temperature is controlled to gradually decrease from 75°C to 30°C, the relative humidity is controlled to be 0%, and the drying time is 15 h;

[0019] staged drying of the negative electrode plate: in a first stage, the temperature is controlled to gradually rise from 45°C to 72°C, the relative humidity is controlled to gradually decrease from 80% to 0%, and the drying time is 3 h; and

[0020] in a second stage, the temperature is controlled to gradually decrease from 72°C to 30°C, the relative humidity is controlled to be 0%, and the drying time is 17 h.

[0021] In the above solution, a lead paste for the positive electrode plate includes the following components in parts by weight: 990-1010 parts of lead powder, 100-110 parts of dilute sulphuric acid, 115-125 parts of deionized water, 1-1.5 parts of short fibers, 1.5-2.5 parts of graphite and 1-1.5 parts of 4BS; a lead paste for the negative electrode plate includes the following components in parts by weight: 990-1010 parts of the lead powder, 70-80 parts of the dilute sulphuric acid, 110-120 parts of deionized water, 0.8-1.0 part of short fiber, 2.5-3.0 parts of humic acid, 1-1.5 parts of lignin, 7-9 parts of barium sulfide, 1.5-2.0 parts of acetylene black, 1-1.5 parts of stearic acid and 0.5-1 part of 4BS, where 4BS is the tetrabasic lead sulfate.

[0022] In the above solution, in staged curing of the positive electrode plate, a supply air rate in the first stage is controlled at 30%, and a supply air rate in the second stage is gradually increased from 30% to 45%.

[0023] In the above solution, in staged curing of the negative electrode plate, a supply air rate in the first stage is controlled at 30%, and a supply air rate in the second stage is gradually increased from 30% to 40%.

[0024] In the above solution, during curing and drying, wet lead paste electrode plates are placed on an electrode plate storage frame at an interval and are sent into a curing chamber; after curing is completed, a wet air discharge door is opened to discharge wet steam; and meanwhile, an air inlet door is opened, input fresh air is heated and then blown towards the electrode plates, and thus the electrode plates are dewatered and dried.

[0025] In the above solution, a specific gravity of the lead paste of the positive electrode plate is 4.08-4.15.

[0026] In the above solution, a specific gravity of the lead paste of the negative electrode plate is 4.35-4.45.

[0027] Only when the relative humidity approaches 100%, can one of changes in water loss-curing process of the lead paste be slowly conducted. When each wet lead paste electrode plate is in the curing chamber, temperatures of the electrode plate itself and nearby the plate surface can be higher than a room temperature, the reason for which is heat release with oxidation reaction of free metallic lead in the electrode plate; at this time, if the relative temperature is low, a water loss rate can be rapid, a dense crystal is difficult to form, and crude and sparse dry lead pastes easily fall off in a whole block; and when the procedure just enters drying after curing is completed, an oxidation rate of Pb is the fastest, which shows that heat is released fastest and most when the curing is completed and drying is started, mainly because the humidity starts to decrease from a state close to

saturation, the porosity of the electrode plate is increased, oxygen conduction is facilitated, and a certain humidity better facilitates lead oxidation. In the earlier stage of drying, the rest free Pb is rapidly oxidized, most of the Pb is oxidized, and a water loss rate of the electrode plate is rapid; in the later stageof drying, lead oxidation and water loss are conducted at reduced speeds and the humidity of the drying chamber of 0%, until the electrode plate is dried.

[0028] By employing a high-humidity curing method with alternate high temperature and low temperature, a green electrode plate with the main component of 4PbO·PbSO4 can be obtained, and the lead paste is guaranteed to contain suitable component of 3PbO·PbSO4, which can prolong the service life of the battery and also satisfy the capacity of the battery.

[0029] Compared with the prior art, the present invention has the following advantages that: by employing the high-humidity curing method with the alternate high temperature and low temperature, through process tests for many times and repeated verification, the method of the present invention is obtained, so that the cured and dried electrode plate has the main component of 4PbO·PbSO4 crystals which are better than 3PbO·PbSO4 crystals, and the strength of the electrode plate may be strengthened; and a storage battery, assembled by using such electrode plate, is long in service life (the end of the life of the storage battery is due to corrosion of the grids rather than falling of active substances), can overcome a premature capacity loss caused by a lead-calcium alloy and may obviously prolong the service life of the valve regulated lead acid battery.

[0030] Further, 4BS seed crystals are further added to a positive electrode addictive, so that a lead-calcium alloy grid and the active substances form a good corrosion layer, and binding force and adhesive strength of the active substances of the green electrode plate are strengthened; and the formed 4BS seed crystals are small and uniformly distributed, which may further prolong the service life of the storage battery.

DETAILED DESCRIPTION OF THE INVENTION

[0031] The present invention will be further described below in combination with specific implementations. It should be understood that these implementations are used for construing the present invention only, but not limiting its scope.

[0032] In the following embodiments and comparative examples, curing and drying equipment with a model of GH-1, manufactured by Chongqing Jiangling Industrial Co., Ltd. was employed for curing and drying; during curing and drying, wet lead paste

electrode plates were placed on an electrode plate storage frame and sent into a curing chamber, process and program numbers were selected, a start key was pressed, and the curing chamber entered a curing stage; a temperature and humidity controller detected indoor temperature value and humidity value through an indoor temperature and humidity sensor, and recirculating air produced by a variable-frequency fan blew wet steam and heat toward the electrode plates; after a curing program was ended, the procedure turned to a drying program, a wet air discharge door was opened, a moisture discharge fan ran to discharge the wet steam, an air inlet door was opened at the same time, and input fresh air was heated and then blown toward the electrode plates to enable the electrode plates to be dewatered and dried;

[0033] where a lead paste for a positive electrode plate includes the following components in parts by weight: 990 parts of lead powder, 100 parts of dilute sulphuric acid, 115 parts of deionized water, 1 part of short fibers, 1.5 parts of graphite and 1 part of 4BS;

[0034] a lead paste for a negative electrode plate includes the following components in parts by weight: 990 parts of the lead powder, 70 parts of the dilute sulphuric acid, 110 parts of deionized water, 0.8 part of short fiber, 2.5 parts of humic acid, 1 part of lignin, 7 parts of barium sulfide, 1.5 parts of acetylene black, 1 part of stearic acid and 0.5 part of 4BS (where 4BS is tetrabasic lead sulfate); a specific gravity of the lead paste of the positive electrode plate is 4.08; and a specific gravity of the lead paste of the negative electrode plate is 4.35.

[0035] Embodiments 1-3:

Annexed Table 1: Curing method for positive electrode plate in Embodiments 1-3

Stage	Embodiment 1 Temperature °C	Embodiment 2 Temperature °C	Embodiment 3 Temperature °C	Humidity %	Time h	Air quantity %
1	58	58	58	99.9	2	30
	65	68	71	99.9	2.5	30
	78	78	78	99.9	3.5	30
2	70	68	65	95	9	30
	62	60	58	92	4	40
	52	52	52	90	3	40
	50	50	50	85	2	45

	50	50	50	85	2	45

Annexed Table 2: Drying method for positive electrode plate in Embodiments 1-3

Stage	Embodiment 1 Temperature °C	Embodiment 2 Temperature °C	Embodiment 3 Temperature °C	Humidity %	Time h	Fan frequency Hz
1	45	45	45	70	1	40
	52	55	58	40	1	50
	65	68	68	10	1	50
	75	75	75	0	1	50
2	73	70	67	0	14	50
	30	30	30	0	1	50

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Annexed Table 3: Curing method for negative electrode plate in Embodiments 1-3

Stage	Embodiment 1 Temperature °C	Embodiment 2 Temperature °C	Embodiment 3 Temperature °C	Humidity %	Time h	Air quantity %
1	55	55	55	99.9	2	30
	62	65	68	99.9	2.5	30
	75	75	75	99.9	3.5	30
2	70	67	64	96	14	35
	55	55	55	92	4	40
	50	50	50	90	4	40

Annexed Table 4: Drying method for negative electrode plate in Embodiments 1-3

Stage	Embodiment 1 Temperature °C	Embodiment 2 Temperature °C	Embodiment 3 Temperature °C	Humidity %	Time h	Fan frequency Hz
1	45	45	45	80	1	40
	52	55	58	60	1	50
	72	72	72	0	1	50
2	70	67	67	0	16	50
	30	30	30	0	1	50

[0036] Embodiment 4

Annexed Table 5: Curing method for positive electrode plate in Embodiments 4

Stage	Embodiment 4 Temperature °C	Embodiment 4 Humidity %	Time h	Air quantity %
1	58	99.9	2	30
	65	99.9	2.5	30
	78	99.9	3.5	30
2	70	90	9	30
	62	88	4	40
	52	86	3	40
	50	85	2	45
	50	85	2	45

Annexed Table 6: Drying method for positive electrode plate in Embodiments 4

Stage	Embodiment 4 Temperature °C	Embodiment 4 Humidity %	Time h	Fan frequency Hz
1	45	70	1	40
	52	30	1	50
	65	10	1	50
	75	0	1	50
2	73	0	14	50
	30	0	1	50

Annexed Table 7: Curing method for negative electrode plate in Embodiments 4

Stage	Embodiment 4 Temperature °C	Embodiment 4 Humidity %	Time h	Air quantity %
1	55	99.9	2	30
	62	99.9	2.5	30
	75	99.9	3.5	30
2	70	98	14	35
	55	95	4	40
	50	90	4	40

Annexed Table 8: Drying method for negative electrode plate in Embodiment 4

Stage	Embodiment 4 Temperature °C	Embodiment 4 Humidity %	Time h	Fan frequency Hz
1	45	80	1	40
	52	40	1	50
	72	0	1	50
2	70	0	16	50
	30	0	1	50

[0037] Comparative Example 1:

Annexed Table 9: Curing method for positive electrode plate in Comparative Example 1

Stage	Comparative Example 1 Temperature °C	Humidity %	Time h	Air quantity %
1	48	99.9	2	30
2	58	99.9	1	30
3	58	99.9	24	30
4	52	95	4	30
5	52	92	4	40
6	52	90	3	40
7	50	85	2	40
8	50	85	2	45

Annexed Table 10: Drying method for positive electrode plate in Comparative Example 1

Stage	Comparative Example 1 Temperature °C	Humidity %	Time h	Fan frequency Hz
1	45	70	1	40
2	52	40	1	50
3	65	10	1	50
4	70	0	15	50
5	30	0	1	50

Annexed Table 11: Curing method for negative electrode plate in Comparative Example 1

Stage	Comparative Example 1 Temperature °C	Humidity %	Time h	Air quantity %
1	50	99.9	1	30
2	52	99.9	15	30
3	50	96	4	35
4	50	92	4	40
5	50	90	4	40

Annexed Table 12: Drying method for negative electrode plate in Comparative Example 1

Stage	Comparative Example 1 Temperature °C	Humidity %	Time h	Fan frequency Hz

1	45	80	1	40
2	52	60	1	50
3	65	0	1	50
4	70	0	15	50
5	30	0	1	50

[0038] Comparative Example 2:

Annexed Table 13: Curing method for positive electrode plate in Comparative Example 2

Stage	Comparative Example 2 Temperature °C	Humidity %	Time h	Air quantity %
1	58	90	2	30
	65	90	2.5	30
	78	90	3.5	30
2	70	85	9	30
	62	82	4	40
	52	80	3	40
	50	75	2	45
	50	75	2	45

Annexed Table 14: Drying method for positive electrode plate in Comparative Example 2

Stage	Comparative Example 2 Temperature °C	Humidity %	Time h	Fan frequency Hz
1	45	60	1	40
	52	40	1	50
	65	10	1	50
	75	0	1	50
2	73	0	14	50
	30	0	1	50

Annexed Table 15: Curing method for negative electrode plate in Comparative Example 2

Stage	Comparative Example 2 Temperature °C	Humidity %	Time h	Air quantity %
1	55	90	2	30
	62	90	2.5	30
	75	90	3.5	30

2	70	86	14	35
	55	82	4	40
	50	80	4	40

Annexed Table 16: Drying method for negative electrode plate in Comparative Example 2

Stage	Comparative Example 2 Temperature °C	Humidity %	Time h	Fan frequency Hz
1	45	70	1	40
	52	60	1	50
	72	0	1	50
2	70	0	16	50
	30	0	1	50

[0039] For batteries manufactured in the above embodiments and comparative examples, heavy-loaded lives are shown in Annexed Table 17:

[0040] A method and standard conditions for testing the lives are as follows:

[0041] each manufactured electrode plate was subjected to assembly, acid pouring and formation according to a BTX20-BS assembly process to obtain a lead acid battery, and then a performance test was conducted.

[0042] 1) A test for the heavy-loaded life is as follows:

[0043] Based on the Japanese Industrial Standards JIS D 5302: 2004 lead acid battery for a motorcycle;

[0044] 2) at the temperature 40-45°C, the battery was discharged for 1 h at a constant current of 5 A and charged for 5 h at 1.25 A, one charge-discharge cycle was one cycle life; the battery was continuously discharged at a current of 5 A every 50 times, and a final voltage was 10.2 V; and when a discharge capacity is lower than 40% of a rated capacity and is confirmed not to raise again, the test ended.

Annexed Table 17 Comparison on heavy-loaded lives of batteries

Number	Number of cycle life	Standard requirement	Comparative Example 1 C_{10}%	Embodiment 1 C_{10}%	Embodiment 2 C_{10}%	Embodiment 3 C_{10}%
1	50	≥40%	115.65	118.74	117.42	117.12
2	100	≥40%	100.28	116.23	115.21	115.84
3	150	≥40%	85.47	113.81	112.68	113.25
4	200	≥40%	73.24	109.31	108.36	107.65
5	250	≥40%	65.12	104.72	103.45	102.98
6	300	≥40%	48.26	100.10	99.25	98.87

7	350	≥40%	42.13	95.52	94.36	93.65
8	400	≥40%	36.42 (life ends)	89.42	88.72	87.79
9	450	≥40%		83.22	82.71	82.12
10	500	≥40%		78.77	77.43	78.05
11	550	≥40%		74.25	73.82	73.26
12	600	≥40%		69.47	68.48	67.37
13	650	≥40%		64.46	63.34	62.76
14	700	≥40%		58.43	57.58	56.48
15	750	≥40%		53.42	51.41	50.94
16	800	≥40%		48.57	45.52	44.25
17	850	≥40%		42.64	41.35	40.89
18	900	≥40%		38.86 (life ends)	36.72 (life ends)	35.41 (life ends)

Number	Number of cycle life	Standard requirement	Comparative Example 2 C_{10}%	Embodiment 4 C_{10}%
1	50	≥40%	112.65	116.97
2	100	≥40%	102.14	114.25
3	150	≥40%	93.25	111.18
4	200	≥40%	83.46	105.25
5	250	≥40%	72.68	101.74
6	300	≥40%	65.47	97.52
7	350	≥40%	56.79	92.44
8	400	≥40%	48.55	86.21
9	450	≥40%	39.42 (life ends)	81.02
10	500	≥40%		77.24
11	550	≥40%		72.14
12	600	≥40%		66.37
13	650	≥40%		61.76
14	700	≥40%		55.12
15	750	≥40%		50.25
16	800	≥40%		44.12
17	850	≥40%		40.98
18	900	≥40%		35.01 (life ends)

Results of testing 4PbO·PbSO4 in each lead paste electrode plate manufactured in the above Embodiments 1-4 and Comparative Examples 1-2 are shown in a following table:

	Embodiment 1	Embodiment 2	Embodiment 3	Embodiment 4	Comparative Example 1	Comparative Example 2
Content of 4PbO·PbSO4 in positive electrode plate	66.85	66.12	65.42	65.08	34.26	40.57
Content of 4PbO·PbSO4 in negative electrode plate	62.64	62.08	61.87	61.53	31.06	36.82

[0045] Here, a content of the tetrabasic lead sulfate was detected by using an X-ray diffractometer (XRD).

[0046] The technical means disclosed by the technical solution of the present invention are not limited to these disclosed in the above implementations and further include the technical solution formed by any combination of the above technical features. It should be noted that several improvements and embellishments may also be made without departing from the principles of the present invention to those of ordinary skill in the art, and these improvements and embellishments should also be considered to fall within the protection scope of the present invention.

CLAIMS

1. A curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery, the wet lead paste electrode plate for the valve regulated lead acid battery includes a positive electrode plate and a negative electrode plate, wherein includes a curing stage and a drying stage,

a method for the curing stage includes:

staged curing of the positive electrode plate: in a first stage, a temperature is controlled to gradually rise from 58°C to 78°C, and curing is conducted in wet air with the relatively humidity of 99.9% and a curing time of 8 h; and

in a second stage, the temperature is controlled to gradually decrease from 78°C to 50°C, the relative humidity is controlled to gradually decrease from 99.9% to 85%, and the curing time is 20 h.

staged curing of the negative electrode plate:

in a first stage, a temperature is controlled to gradually rise from 55°C to 75°C, and curing is conducted in wet air with the relative humidity of 99.9% and a curing time of 8 h; and

in a second stage, the temperature is controlled to gradually decrease from 75°C to 50°C, the relative humidity is controlled to gradually decrease from 99.9% to 90%, and the curing time is 22 h.

a method for the drying stage includes:

staged drying of the positive electrode plate: in a first stage, a temperature is controlled to gradually rise from 45°C to 75°C, the relative humidity is controlled to gradually decrease from 70% to 0%, and the drying time is 4 h; and

in a second stage, the temperature is controlled to gradually decrease from 75°C to 30°C, the relative humidity is controlled to be 0%, and the drying time is 15 h;

staged drying of the negative electrode plate: in a first stage, the temperature is controlled to gradually rise from 45°C to 72°C, the relative humidity is controlled to gradually decrease from 80% to 0%, and the drying time is 3 h; and

in a second stage, the temperature is controlled to gradually decrease from 72°C to 30°C, the relative humidity is controlled to be 0%, and the drying time is 17 h.

2. The curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery according to claim 1, wherein a lead paste for the positive electrode plate includes the following components in parts by weight: 990-1010 parts of lead powder, 100-110 parts of dilute sulphuric acid, 115-125 parts of deionized water, 1-1.5 parts of short fibers, 1.5-2.5 parts of graphite and 1-1.5 parts of 4BS; a lead paste for the negative electrode plate includes the following components in parts by weight: 990-1010 parts of the lead powder, 70-80 parts of the dilute sulphuric acid, 110-120 parts of deionized water, 0.8-1.0 part of short fiber, 2.5-3.0 parts of humic acid, 1-1.5 parts of lignin, 7-9 parts of barium sulfide, 1.5-2.0 parts of acetylene black, 1-1.5 parts of stearic acid and 0.5-1 part of 4BS.

3. The curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery according to claim 1, wherein in staged curing of the positive electrode plate, a supply air rate in the first stage is controlled at 30%, and a supply air rate in the second stage is gradually increased from 30% to 45%.

4. The curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery according to claim 1, wherein in staged curing of the negative electrode plate, a supply air rate in the first stage is controlled at 30%, and a supply air rate in the second stage is gradually increased from 30% to 40%.

5. The curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery according to claim 1,wherein during curing and drying, wet lead paste electrode plates are placed on an electrode plate storage frame at an interval and are sent into a curing chamber; after curing is completed, a wet air discharge door is opened to discharge wet steam; and meanwhile, an air inlet door is opened, input fresh air is heated and then blown towards the electrode plates, and thus the electrode plates are dewatered and dried.

6. The curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery according to claim 1, wherein a specific gravity of the lead paste of the positive electrode plate is 4.08-4.15.

7. The curing and drying method for a wet lead paste electrode plate for a long-life valve regulated lead acid battery according to claim 1, wherein a specific gravity of the lead paste of the negative electrode plate is 4.35-4.45.

Patentansprüche

1. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer, wobei die nasse Bleipaste der Elektrodenplatte der Bleisäurebatterie eine positive Elektrodenplatte und eine negative Elektrodenplatte umfasst, dadurch gekennzeichnet, dass es eine Aushärtungsphase und eine Trocknungsphase umfasst;

wobei die Aushärtungsphase wie folgt durchgeführt wird:

Stufenweise Aushärtung der positiven Elektrodenplatte: In der ersten Phase wird die Temperatur schrittweise von 58°C auf 78°C erhöht, wobei die Aushärtung in feuchter Luft mit einer relativen Luftfeuchtigkeit von 99,9% mit einer Aushärtungszeit von 8 Stunden erfolgt;

In der zweiten Phase werden die Temperatur von 78°C auf 50°C und die relative Luftfeuchtigkeit von 99,9% auf 85% reduziert, wobei die Aushärtung mit einer Aushärtungszeit von 20 Stunden erfolgt;

Stufenweise Aushärtung der negativen Elektrodenplatte: In der ersten Phase wird die Temperatur schrittweise von 55°C auf 75°C erhöht, wobei die Aushärtung in feuchter Luft mit einer relativen Luftfeuchtigkeit von 99,9% mit einer Aushärtungszeit von 8 Stunden erfolgt;

In der zweiten Phase werden die Temperatur von 75°C auf 50°C und die relative Luftfeuchtigkeit von 99,9% auf 90% schrittweise reduziert, wobei die Aushärtung mit einer Aushärtungszeit von 22 Stunden erfolgt;

wobei die Trocknungsphase wie folgt durchgeführt wird:

Stufenweise Trocknung der positiven Elektrodenplatte: In der ersten Phase wird die Temperatur schrittweise von 45°C auf 75°C schrittweise erhöht, und die relative Luftfeuchtigkeit von 70% auf 0% reduziert, wobei die Trocknungszeit 4 Stunden beträgt;

In der zweiten Phase werden die Temperatur von 75°C auf 30°C und die relative Luftfeuchtigkeit auf 0% schrittweise reduziert, wobei die Trocknungszeit 15 Stunden beträgt.

Stufenweise Trocknung der negativen Elektrodenplatte: In der ersten Phase wird die Temperatur schrittweise von 45°C auf 72°C schrittweise erhöht, und die relative Luftfeuchtigkeit von 80% auf 0% reduziert, wobei die Trocknungszeit 3 Stunden beträgt;

In der zweiten Phase werden die Temperatur von 72°C auf 30°C und die relative Luftfeuchtigkeit auf 0% schrittweise reduziert, wobei die Trocknungszeit 17 Stunden beträgt.

2. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer nach Anspruch 1, dadurch gekennzeichnet, dass die Bleipaste der positiven Elektrodenplatte die folgenden Gewichtskomponenten umfasst: 990-1010 Teile Bleipulver, 100-110 Teile verdünnte Schwefelsäure, 115-125 Teile entionisiertes Wasser, 1-1,5 Teile kurze Fasern, 1,5-2,5 Teile Graphit,1-1,5 Teile 4BS; wobei die Bleipaste der negativen Elektrodenplatte die folgenden Gewichtskomponenten umfasst: 990-1010 Teile Bleipulver, 70-80 Teile verdünnte Schwefelsäure, 110-120 Teile entionisiertes Wasser, 0,8-1,0 Teile kurze Fasern, 2,5-3,0 Teile Huminsäure, 1-1,5 Teile Lignin, 7-9 Teile Bariumsulfid, 1,5-2,0 Teile Acetylenruß, 1-1,5 Teile Stearinsäure, 0,5-1 Teile 4BS.

3. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer nach Anspruch 1, dadurch gekennzeichnet, dass die Luftzufuhr in der ersten Phase der stufenweisen Aushärtung der positiven Elektrodenplatten auf 30 % gesteuert wird und die Luftzufuhr in der zweiten Phase schrittweise von 30 % auf 45 % erhöht wird.

4. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer nach Anspruch 1 oder 3, dadurch gekennzeichnet, dass die Luftzufuhr in der ersten Phase der stufenweisen Aushärtung der negativen Elektrodenplatten auf 30 % gesteuert wird und die Luftzufuhr in der zweiten Phase schrittweise von 30 % auf 40 % erhöht wird.

5. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer nach Anspruch 1, dadurch gekennzeichnet, dass während der Aushärtung und Trocknung die nasse Bleipaste der Elektrodenplatten beabstandet auf das Lagerungsgestell der Elektrodenplattenplatziert und in

die Aushärtungskammer zugeführt werden, und dass nach dem Abschluss der Aushärtung die Ablufttür zur Feuchtigkeitsabfuhrgeöffnet wird, um die Feuchtigkeit abzuführen, wobei die Lufteinlasstür gleichzeitig geöffnet wird, um die einströmende Frischluft nach dem Erhitzen zu den Elektrodenplatten zu blasen, so dass die Elektrodenplatten entwässert und getrocknet werden.

6. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer nach Anspruch 1, dadurch gekennzeichnet, dass das spezifische Gewicht der Bleipaste der positiven Elektrodenplatte 4,08-4,15 beträgt.

7. Ein Verfahren zur Aushärtung und Trocknung der nassen Bleipaste der Elektrodenplatte für eine ventilgeregelte Bleisäurebatterie mit hoher Lebensdauer nach Anspruch 1, dadurch gekennzeichnet, dass das spezifische Gewicht der Bleipaste der negativen Elektrodenplatte 4,35-4,45 beträgt.