

SPECIFICATION

Preparation of nickel hydroxide for positive electrodes of alkaline storage batteries or cells

- 5 The invention relates to the preparation of nickel hydroxide for use as active mass for positive electrodes in alkaline storage batteries or cells. In particular the nickel hydroxide may be used on
- 10 active mass for electrodes in button cells.
- Two important criteria for the quality of the active mass of positive electrodes is the electrical capacity (measured e.g. in ampere hours) and swelling behaviour of the electrodes. In this context the term
- 15 "swelling" is understood as being the increase in thickness of the electrode during the absorption of electrolyte, which arises during operation of the battery or cell independently of subsequent volume alterations. If however the initial swelling produced
- 20 by the electrolyte wetting exceeds a certain value, difficulties arise when assembling the battery or cell. Certain steps in the preparation of the active mass, including drying, have a definite influence on both the capacity of the electrode and its swelling tendency.

- 25 According to a known method for preparing nickel hydroxide for use as active mass for positive electrodes in alkaline storage batteries or cells, nickel hydroxide is precipitated from a nickel salt solution and the precipitate is filtered off or centrifuged from the solution, washed, and then dried in a drying cabinet. The nickel hydroxide after the filtration or centrifugation and the washing and prior to the drying is in the form of a thick slurry or filter cake
- 30 containing 50 to 90% by weight of water.

- Drying has hitherto been carried out in a draught at a temperature of up to 80°C since it was known that high drying temperatures impair the capacity of the electrodes formed from the active mass.
- 40 An object of the invention is to carry out the further treatment of the precipitated $\text{Ni}(\text{OH})_2$ in such a manner that a positive electrode for an alkaline storage battery or cell and incorporating the nickel hydroxide as active mass has, in combination, a capacity and a swelling tendency more favourable than hitherto.

- In accordance with the present invention, there is provided a method for preparing nickel hydroxide for use as active mass for positive electrodes in
- 50 alkaline storage batteries or cells, wherein nickel hydroxide ($\text{Ni}(\text{OH})_2$) is precipitated from a nickel salt solution, the nickel hydroxide is dried in a first stage at a temperature of less than 80°C to a predetermined residual moisture content and is then dried in
- 55 a second stage at a temperature above 100°C.

- The drying temperature in the first stage is preferably in the range 40 to 60°C. Preferably the residual moisture content after the first drying stage is 5 to 20% by weight, more preferably 10% by
- 60 weight.

- Preferably the second drying stage is carried out at a temperature between 100 and 160°C.

- The first and second drying stages may be carried out in a common drying cabinet.

- 65 The resultant nickel hydroxide prepared by the

method of the invention, when processed into a compressed powder electrode, is characterised by a high capacity and low swelling tendency.

- The desired criteria of high capacity and low swelling tendency are in the prior art found to be mutually conflicting.

- The method according to the invention enables a surprisingly favourable compromise to be reached between the capacity and the swelling tendency. In this connection, the first drying stage presumably determines the capacity and the swelling tendency of the nickel hydroxide after the second drying stage.

- One possible explanation of the results achieved by the invention is that at the low drying temperature of the first drying stage substantially no recrystallisation takes place within the moist nickel hydroxide, even though mother liquor is initially present in sufficient amount to act as recrystallisation medium. In order to produce an accelerated conversion of the
- 80 initially X-ray amorphous, fresh precipitation product into a well crystallised material, a higher temperature is necessary which however is undesirable because the recrystallisation would be accompanied by a reduction in surface area and thus a decrease in the activity of the nickel hydroxide.
- 85 Known drying methods which operate from the beginning at elevated temperature are subject to this disadvantage.

- However, in the first drying stage according to the
- 95 invention the water content of the moist nickel hydroxide is reduced, preferably to a residual value of approximately 10% by weight, whereby the ability for recrystallisation of the nickel hydroxide is removed by the consequent lack of mother liquor which would be necessary to provide sufficient paths for ion transportation. A temperature of greater than 100°C is then not able to cause recrystallization and accordingly the temperature may be increased in the second drying stage to 160°C.

- 100 As experimental tests have shown, the capacity of the nickel hydroxide dried in the first stage is not substantially reduced by drying at 160°C in the second stage. On the contrary, the second stage drying has the effect of reducing swelling by up to
- 105 50%.

The following example is given both to illustrate the invention and for comparison purposes.

Example

- 115 A filter cake of freshly precipitated nickel hydroxide, which had been thoroughly washed with hot water and of a thickness of approximately 1 cm, was divided into two portions, namely a first portion and a second portion, which were put into respective porcelain dishes. As described below the second portion, but not the first portion, was treated according to the invention.

- The first portion was dried overnight at 110°C in a drying cabinet. The second portion was dried in
- 125 another drying cabinet at 60°C. An exchange of fresh air with the interior of both drying cabinets was provided. After approximately twelve hours of drying at 60°C the residual moisture content of the second portion was less than 10% of its initial value.
- 130 The drying of the second portion was then continued

for a further two hours at 150°C.

- Both completely dry portions were then pulverized and admixed with an amount of conductive graphite. The resulting mixtures were pressed to form electrodes with a nickel web covering. The electrodes were subjected to a cyclic charge/discharge test. The electrode formed from the second portion of nickel hydroxide distinguished itself clearly by better utilization of material when the current lead was the same for both electrodes and by swelling to a less extent than the other electrode.

CLAIMS

1. A method for preparing nickel hydroxide for use as active mass for positive electrodes in alkaline storage batteries or cells, wherein nickel hydroxide ($\text{Ni}(\text{OH})_2$) is precipitated from a nickel salt solution, the nickel hydroxide is dried in a first stage at a temperature of less than 80°C to a predetermined residual moisture content and is then dried in a second stage at a temperature above 100°C.
2. A method according to claim 1, wherein the drying temperature in the second stage is between 100 and 160°C.
3. A method according to claim 1 or 2, wherein the drying temperature in the first stage is in the range 40 or 60°C.
4. A method according to any preceding claim, wherein the residual moisture content after the first drying stage is 5 to 20% by weight.
5. A method according to claim 4, wherein the residual moisture content after the first drying stage is approximately 10% by weight.

for a further two hours at 150°C.

Both completely dry portions were then pulverized and admixed with an amount of conductive graphite.

- The resulting mixtures were pressed to form electrodes with a nickel web covering. The electrodes were subjected to a cyclic charge/discharge test. The electrode formed from the second portion of nickel hydroxide distinguished itself clearly by better utilization of material when the current lead was the same for both electrodes and by swelling to a less extent than the other electrode.

CLAIMS

1. A method for preparing nickel hydroxide for use as active mass for positive electrodes in alkaline storage batteries or cells, wherein nickel hydroxide (Ni(OH)_2) is precipitated from a nickel salt solution, the nickel hydroxide is dried in a first stage at a temperature of less than 80°C to a predetermined residual moisture content and is then dried in a second stage at a temperature above 100°C.
2. A method according to claim 1, wherein the drying temperature in the second stage is between 100 and 160°C.
3. A method according to claim 1 or 2, wherein the drying temperature in the first stage is in the range 40 or 60°C.
4. A method according to any preceding claim, wherein the residual moisture content after the first drying stage is 5 to 20% by weight.
5. A method according to claim 4, wherein the residual moisture content after the first drying stage is approximately 10% by weight.

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