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METHODS FOR REDUCING THE DISCHARGE OF BATTERIES BY CHANGING THE ELECTROLYTE PROPERTIES AND ELECTRODE COMPOSITION

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In the world, research is being conducted to improve and modernize the production processes of acid, alkaline, lithium-ion, and other primary energy sources of various sizes and energy capacities, including the following priority areas: optimizing the composition of positive and negative electrodes in batteries, producing separators with a porosity and shape that effectively protects the shape and composition of separators from short circuits and ensures relatively easy electrolyte flow, reducing the level of self-discharge, etc. [1].

To reduce the leakage of positive active mass, when using thickened electrolytes, we used a simple positive electrode consisting of an alloy of 1.7% Pb, 1.3% Sb, 97% Cd and a negative electrode consisting of 1.0% Pb and 99.0% Sb for experiments. In this case, the processes of coating the electrodes with active mass, drying, installing separators and other preparations were carried out based on the existing technologies of the enterprise. To prepare the thickened electrolyte, a thickener consisting of 6% pyrogenic silica ($SiO2$) was added, resulting in a gel electrolyte. This electrolyte was poured into a test battery and kept for a certain time for it to be absorbed by the separators, and for comparison, a battery assembled in the same design as the sample was filled with a simple electrolyte and left for a certain time for the electrolyte to be absorbed.

In both batteries, after the electrolyte was completely absorbed into the separator, experiments were conducted to compare the processes of leakage of the active mass from the separator in different electrolytes. The leakage of the electrolyte from the separators is mainly affected by the charging and discharging processes of the battery [2].

The experimental results showed that in the initial 20 cycles, the discharge capacities of both samples gave the same results. However, as the number of operating cycles increased, the difference between them in terms of discharge capacities began to be noticeable (Table 1).

(Table 1).

Experimental results of using thickened electrolytes to prevent active mass leakage

Operating cycle, times	Ordinary electrolyte battery, A*hour	Discharge capacity, %	Gel electrolyte battery, A*hour	Discharge capacity, %
1	60	92	60	91
3	60	95	60	93
5	60	100	60	100

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10	60	97	60	96
20	60	95	60	95
30	60	86	60	93
40	60	79	60	91
50	60	75	60	88
60	60	72	60	86
70	60	70	60	83
80	60	69	60	82
90	60	68	60	80
100	60	66	60	79

As can be seen from Table 1, when the charge-discharge process in the comparison battery with a simple electrolyte reached 50 cycles, the discharge capacity was 75% (according to the requirement, it should not be less than 80%), while in the same conditions, the discharge capacity in the sample battery with a gel electrolyte was 88%, and after 90 cycles, this figure was 80%, which allows them to increase their service life by 2 times.

After the experiment, when checking the battery electrolytes, it was observed that the active mass in the comparison battery was diluted and partially leaked, sludge formed at the bottom of the tank, and corrosion began on the current conductors. In the gel electrolyte battery, it was found that the positive active mass was preserved, there were no signs of leakage, and the positive current conductors were in satisfactory condition. The gel electrolyte increases the strength of the active mass in the pores of the electrode block, due to which its leakage is significantly reduced. In this case, since the electrolyte is in a liquid state throughout the battery, its internal resistance is low.

When studying the effect of temperature and electrode alloy on the self-discharge of rechargeable batteries, we not only studied the impact of negative factors on the self-discharge of rechargeable batteries and methods for reducing them, but also worked on reducing these factors by replacing lead-antimony electrodes with electrodes of other compositions. The rate of self-discharge of chemical power sources depends on their service life and type, i.e. whether they are serviced or non-serviced batteries [3]. In ordinary batteries, this process is normal when they are fully charged, in a clean state, stored in a dry state at $+10 \div -15^{0}$C. In this case, the voltage drop is different for new and used batteries, respectively. If a car battery has been used for a long time, then the self-discharge rate in these batteries is about 8-10%, while in new batteries this figure should not exceed 6%. In batteries that are not serviced, this figure does not exceed 1%. In conventional lead-acid batteries, power sources that have been in operation for less than 3 years will be completely discharged in 4-5 months, even if they are stored in conditions that meet the requirements.

As a result of the experiments, the dependence of the storage time of accumulator batteries on the storage temperature was studied. The self-discharge rate of new accumulators was insignificant in the first month, and this indicator changed with the passage of time and

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increasing temperature. Table 2 shows the self-discharge rates of a lead-acid accumulator with a capacity of 12 V, 60 A/h at temperatures of +100 ° C; +250 ° C and +400 ° C.

Table 2

Self-discharge rates of a lead-acid battery at different temperatures

№ s/n	Storage temperature $+10^0$C		Storage temperature $+25^0$C		Storage temperature $+40^0$C	
	Best before, month	Discharge rate, %	Best before, month	Discharge rate, %	Best before, month	Discharge rate, %
1	1	98	1	97	1	95
2	2	96	2	92	2	86
3	4	93	4	83	4	75
4	6	90	6	77	6	66
5	8	86	8	72	8	56
6	10	82	10	66	10	45
7	12	78	12	58	12	37
8	14	72	14	49	14	29
9	16	76	16	41	16	24
10	18	72	18	36	18	17

As can be seen from Table 2, the higher the storage temperature, the higher the self-discharge rate. If the batteries are discharged to 60%, they cannot be used without recharging, which means that new batteries can be stored in working condition for up to 12 months at $+10^0$C, up to 7 months at $+25^0$C, and up to 4 months at $+40^0$C.

In the production of conventional lead-acid batteries, 1.7% antimony is added to lead to prepare grid electrodes [4]. In our research, we used calcium, which is electronegative with respect to antimony, to reduce the self-discharge rate of the battery (standard potential of antimony E = -0.14 V, standard potential of calcium E = -1.87 V). The decrease in the rate of reversible processes can be explained by the absence of antimony, which negatively affects the process, and the relative electronegative nature of calcium.

The results of the experiments showed that replacing conventional electrodes with electrodes with such a composition significantly reduces the loss of electrolyte during operation and reduces the level of self-discharge (Table 3). Such batteries can be manufactured without a slot in the cover for adding electrolyte. According to the results obtained, it is possible to manufacture maintenance-free batteries based on electrodes prepared in this way. At the same

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time, such batteries require the installation of electrical equipment that accurately provides the set voltage.

3-Table

Self-discharge rate of a lead-calcium battery at different temperatures

s/n №	Storage temperature +10^{0}C		Storage temperature +25^{0}C		Storage temperature +40^{0}C	
	Best before, month	Discharge rate, %	Best before, month	Discharge rate, %	Best before, month	Discharge rate, %
1	1	99	1	98	0	97
2	2	98	2	96	2	94
3	4	97	4	94	4	92
4	6	96	6	93	6	89
5	8	95	8	91	8	87
6	10	94	10	89	10	84
7	12	93	12	88	12	81
8	14	92	14	86	14	79
9	16	91	16	84	16	76
10	18	90	18	81	18	72

Based on the results obtained by replacing the traditional electrode in the accumulator with an electrode of the new composition, it can be concluded that the new accumulator batteries can be stored in working condition for up to 18 months at +10^{0}C, up to 12 months at +25^{0}C, and up to 10 months at +40^{0}C. When replacing 1.7% antimony in the lead-antimony electrode with 0.1% calcium, which is relatively electronegative, the self-discharge rate decreased from 6% to 4% per month. The low self-discharge rate in such accumulators, due to the low loss of working fluid, allows the preparation of maintenance-free chemical power sources.

The self-discharge rate of chemical power sources should not exceed 6%. The self-discharge rate of batteries with lead-calcium electrodes of the new composition was negligible in the first month, and this indicator changed with time and temperature. The results of the experiments showed that replacing conventional electrodes with electrodes of this composition significantly reduces electrolyte loss during operation and reduces the level of self-discharge, the results of industrial tests are presented in Table 4.

4- Table

Self-discharge rate of a lead-calcium electrode battery at different temperatures in industrial test experiments

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s/n №	Storage temperature $+10^0C$		Storage temperature $+25^0C$		Storage temperature $+40^0C$	
	Best before, month	Discharge rate, %	Best before, month	Discharge rate, %	Best before, month	Discharge rate, %
1	1	99	1	98	0	96
2	2	97	2	95	2	95
3	4	95	4	93	4	93
4	6	94	6	91	6	87
5	8	93	8	89	8	85
6	10	92	10	88	10	82
7	12	91	12	86	12	80
8	14	90	14	83	14	75
9	16	88	16	81	16	71
10	18	86	18	78	18	69

In the conducted industrial tests, the self-discharge rate of accumulator batteries was studied and a decrease in this process was observed with a change in the composition of the electrode alloy.

Based on the results obtained as a result of replacing the traditional lead-based electrode alloy in chemical power sources with an electrode alloy of a new composition, it can be concluded that when the antimony in the lead-antimony electrode in new accumulator batteries was replaced with a relatively electronegative calcium, the self-discharge rate decreased by up to 2% per month and by 24% per year. The low self-discharge rate of such batteries, due to the low loss of working fluid, allows the preparation of maintenance-free chemical power sources.

It was explained that the self-discharge process in lead-acid batteries, in addition to various external factors, is inextricably linked to the composition of the alloys from which the electrodes are made.

In the production of chemical power sources, in particular, lead-acid batteries, if calcium metal is introduced instead of antimony in the lead-antimony alloy electrode, due to the high electronegativity of calcium, self-discharge was reduced from 6% to 4% per month, and a technology for preparing such an alloy was developed. As a result, the release of heavy metals such as antimony into the environment is prevented when disposing of such batteries that have expired, which is of great environmental and social importance.

List of used literature

1. R. Deshpande. Battery Cycle Life Prediction with Coupled Chemical Degradation and Fatigue Mechanics/Journal of The Electrochemical Society, 2012, - №159 (10), P 1730-1738.

pISSN:2349-5707 Volume:13,Issue 3, March -2026 eISSN:2349-5715

2. Bolun Xu, Modeling of Lithium-Ion Battery Degradation for Cell Life Assessment/Article in IEEE Transactions on Smart Grid June, № 8, 2016, P 118-125.

3. Юдилевич С.Р., Коликова Г.А., Кривченко Г.В. // Сб. трудов по хи-мич. источн. тока. С.-П.: Химиздат, 2004. - С. 56-68.

4. Юдилевич С.Р., Подалинский Ю.А., Коликова Г.А. // Электрохимическая энергетика.-2003.-Т.3, -№4, -С. 200-203.