метою повного інформаційного поєднання між системами різних рівнів та для зручності, пропонується розширити структуру управління залізничного транспорту, додавши в її алгоритм спеціальні підрозділи у кожній структурній одиниці АТ Укрзалізниці. Удосконалені структурні підрозділи повинні мати високу готовність до надання послуг, які реалізуються з мінімальними витратами, а також поєднувати нові та існуючи системи та взаємодіяти з зовнішніми системами на всіх рівнях управління як далекого зарубіжжя, так і інших видів транспорту.

Список використаних джерел

1. Антоненко В. М. Сучасні інформаційні системи і технології: навч. посібник. / С.Д. Мамченко, Ю.В. Рогушина - Ірпінь: Нац. університет ДПС України, 2016. 212 с.

2. Анісімов А.В. Інформаційні системи та бази даних: навч. посібник для студентів факультету комп'ютерних наук та кібернетики. / А.В. Анісімов, П.П Кулябко – Київ. – 2017. – 110 с.

3. Гайфуллін Б.М. Автоматизовані системи управління підприємством / І.А. Обухів - Київ : Юрінком Інтер-фейс-Прес, 2005. 248 с.

4. Ломотько Д.В. Управління транспортними технологіями: Конспект лекцій / Г. О. Примаченко, Ю. В. Шульдінер, О. М. Харламова – Харків: УкрДУЗТ, 2020. – Ч. 1. – 48 с.

Buriak S. Yu., Candidate of Engineering Sciences, Associate Professor, Gololobova O. O., Candidate of Engineering Sciences, Assistant
(Ukrainian State University of Science and Technologies, Dnipro)

IMPACT OF DISCHARGE DEPTH ON LITHIUM-ION BATTERY LIFE

Lithium-ion batteries are reusable batteries designed for cyclic use in charge-discharge mode. Reversible chemical processes of oxidation and reduction take place inside them. The charge from the cathode to the anode and back is transferred by lithium ions, which are embedded in the crystal lattice of graphite and metal oxides, forming a chemical bond.

Lithium-ion batteries wear out over time. Factors that contribute to their degradation include elevated temperatures, increased voltage effects, large changes in the state of charge large current values during charge and discharge, and finally cycling frequency.

Depth of discharge refers to the capacity of the battery in a different range of states of charge. The upper and lower levels of charge degrees have a great influence on the resource. This is primarily due to the preliminary thesis that stress levels also have an effect.

Overcharging lithium-ion batteries results in irreversible degradation and reduced capacity and power. This is due to the fact that when the negative electrode is recharged, lithium metal is deposited on it. Too much excess lithium due to an unbalanced initial ratio of positive and negative masses of the electrodes is the main cause of deposition. The potential of the positive electrode, as a result of the same imbalance, does not reach its optimal state.

Another reason for overcharging the negative electrode is the forced charge, which leads, in some cases, to excessive polarization of the electrode. Lithium deposited on carbon quickly reacts with the solvent and forms a film on the surface of the electrode, covered with a layer of salt and other products. The film, by blocking the pores in the carbon, reduces the size of its working surface, which leads to a decrease in the activity of the electrode and degradation of the capacity.

For lithium-ion batteries, the charge level is one of the factors affecting the service life. An increase in resource can be achieved by reducing the depth of discharge, as well as achieving the same level of charge degree. At the same time, operation in the middle ranges improves the service life, in contrast to operation in high ranges of state of charge, that is, an incomplete charge of the battery also increases the maximum number of cycles.

Despite the low voltage level, the range between 5% and 15% reduces battery life. A single battery cycling in the 40-60% range contains minimal reduction in battery capacity. The range of 60-80% reduces the resource, equivalent to the lower range, which is explained by the high voltage level.

Thus, taking into account the above, it is possible to artificially extend the lifespan of a lithium-ion battery by avoiding operating it at extreme temperatures, over-discharging, over-charging, over-voltage, large change in state of charge, too much current during charge and discharge, as well as high cyclic switching frequency.

References

1. Rahman, A.; Lin, X. Li-ion battery individual electrode state of charge and degradation monitoring using battery casing through auto curve matching for standard CCCV charging profile. Appl. Energy 2022, 321, 119367.

2. Ma, Y.; Zhou, X.; Li, B.; Chen, H. Fractional modeling and SOC estimation of lithium-ion battery. IEEE/CAA J. Autom. Sin. 2016, 3, 281-287.

3. Hu, X., Xu, L., Lin, X., Pecht, M. Battery Lifetime Prognostics. Joule 2020, 4, 310-346.