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PROCESSING OF WASTE LITHIUM-ION BATTERY CATHODE

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Abstract

This study introduces the current status of recycling technology for waste lithium-ion batteries, with a focus on analyzing the environmental impact pathways during the recycling process of waste lithium-ion battery cathode materials. Corresponding pollution prevention and control methods are proposed to provide reference for preventing environmental pollution during the recycling process of waste lithium-ion battery cathode materials.

Keywords: waste battery, positive electrode material, lithium-ion battery.

Introduction

Due to the rapid development of industry, the irrational exploitation and use of fossil energy has led to increasingly serious environmental pollution [1]. Because of their high energy density, high operating voltage, long cycle life, and high safety [2]. Lithium-ion batteries are widely used in 3C products [3], electric vehicles [4], stationary energy storage wells and other fields [5]. With the rapid development of the new energy automobile industry, a large number of used batteries will be produced after the decommissioning of power vehicles [6], so the disposal plan for decommissioning batteries has gradually become the focus of research in the lithium battery industry. After the power battery is retired, there are different ways to place it according to its capacity retention rate, waste lithium-ion batteries with a capacity retention rate of about 80% are generally converted to energy storage batteries for echelon utilization, and the capacity retention rate of 45–60% can be used for auxiliary frequency modulation of thermal power generation.

Results

The recycling and utilization of waste lithium-ion battery cathode materials has significant environmental benefits, but the emissions of pollutants during the recycling process also have adverse effects on the external environment. Therefore, it is necessary to analyze the pollution sources and take practical and feasible pollution prevention and control measures to reduce their impact on the external environment [7].

Gaseous pollutants in the process of positive electrode materials recycling can be divided into dust containing gases, acidic gases, and organic gases. Dust containing waste gas is mainly treated using cyclone dust collectors, bag filters, or water spray towers and their combination processes. Acidic waste gas is mainly treated using alkaline spray towers. According to the concentration of pollutants in acidic waste gas and emission control requirements, single stage, second stage, or even third stage alkaline spray towers can be used. Organic waste gas can be treated using adsorption or catalytic combustion processes, and the selection of organic waste gas treatment measures should be determined comprehensively based on the amount of waste gas, pollutant concentration, and other factors.

The wastewater is generated mainly from the discharge pretreatment and positive electrode material recovery processes. The pollutant composition in the wastewater generated is relatively simple, mainly composed of salts such as sodium sulfate, and the organic content is relatively low. Considering the characteristics of wastewater generation, three-effect evaporation or Mechanical Vapor Recompression (MVR) evaporator is generally used for desalination treatment [8]. After desalination treatment, the water can be reused as pulping water, and the wastewater is not discharged.

Conclusion

In this study, the pollution caused by the recovery of cathode materials in the wet recovery process of waste lithium ion batteries and its influence on various environmental factors were analyzed. Lithium-ion battery recycling has been industrialized, but there are still many problems to be solved. taking into account the impact of environment, safety, resources, economy and other aspects, efficient and environmentally friendly waste lithium-ion battery recycling is the most important issue at present. With the development of the new energy vehicle industry, the application of lithium-ion batteries in electric vehicles has increased

sharply, and the recycling of waste lithium-ion power batteries has become an important environmental protection and resource sustainability issue.

REFERENCES

1. Wang H.M, Wang G.Q., Qi J.C. et al. Scarcity-weighted fossil fuel footprint of China at the provincial level. Applied Energy, 2020, 258:114081.

2. Li Y., Zhang J.W., Chen Q.G. et al. Emerging of Heterostructure Materials in Energy Storage: A Review. Advanced Materials, 2021, 33(27): 2100855.

3. Zhang N., Deng T., Zhang S.Q. et al. Critical Review on Low-Temperature Li-Ion/Metal Batteries. Advanced Materials, 2022, 34(15): 2107899.

4. Schmuch R., Wagner R., Horpel G. et al. Performance and cost of materials for lithium-based rechargeable automotive batteries. Nature Energy, 2018, 3(4): 267-78.

5. Zhu G.L., Wen K.C., Lv W.Q. et al. Materials insights into low-temperature performances of lithium-ion batteries. Journal of Power Sources, 2015, 300: 29-40.

6. Zeng S.H. Analysis of the recycling of power batteries of new energy vehicles based on the perspective of circular economy. Comprehensive Utilization of Chinese Resources, 2022, 40(12): 94-6.

7. Ai K. Prospective power battery recycling market. Automobiles and Accessories, 2023, (2): 54-7.

8. Yuan S., Lu L., Zhang N. et al. Recovery and high-value utilization of cobalt in cathode materials of waste lithium-ion batteries. Chinese Science and Technology Paper, 2020, 15(12): 1359-63.

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