Analysis of Lithium Battery Recycling System of New Energy Vehicles under Low Carbon Background

Zhe Wang
Fuzhou University of International Studies and Trade, Fuzhou 350202, Fujian, China

Abstract. China's new energy vehicle sales exceeded 1 million units for two consecutive years in 2018 and 2019. China has actually become the world's largest new energy vehicle production and sales market. Batteries are the core components of new energy vehicles. The current research and development of power batteries mainly include lead-acid batteries, nickel metal batteries, lithium batteries, super capacitors, fuel cells, solar cells, etc. Among them, lithium batteries are one of the main application categories in the current market. Due to the limited life of lithium batteries, the earliest batch of new energy vehicle lithium batteries in the market is at the threshold of elimination. How to effectively recycle and use lithium batteries has become an unavoidable environmental and social issue. This paper first briefly introduces the current status of China's new energy vehicle and battery industry, then analyzes the problems of China's new energy vehicle battery recycling system, and finally, puts forward some suggestions based on China's national conditions and industry status.

Keywords: low carbon, new energy vehicles, lithium batteries, recycling system.

1. Introduction

According to the China Automobile Industry Association, the sales volume of the new energy vehicle market has shown a booming trend in recent years. The specific data is shown in the figure below. The overall national automobile sales in 2019 were 25.769 million units. Despite the decline in subsidies and other factors, the sales of new energy vehicles declined, but the sales volume in 2019 still exceeded 1 million units. The traditional fuel car is composed of four parts: engine, chassis, electrical equipment and body. The components of new energy vehicles can be divided into power system, chassis, electrical equipment and body. Among them, the core component of the power system is the battery. The power batteries developed in the current market mainly include lead-acid batteries, nickel metal batteries, lithium ion and lithium polymer batteries, super capacitors, fuel cells, solar cells, and so on. Lithium-ion and lithium polymer batteries are referred to as lithium batteries for short. Lithium batteries can be divided into three types: lithium iron phosphate, ternary lithium, and lithium manganate batteries.

Lithium batteries are a green power source. However, once used lithium batteries are not handled properly, they will cause serious pollution to the ecology. In addition, lithium batteries contain a large number of rare materials with high economic value, such as lithium, cobalt, nickel, positive electrodes, negative electrodes, separators, and the like. Therefore, the recycling and reuse of used lithium batteries cannot only fundamentally solve the environmental pollution caused by lithium batteries, but also bring...
certain economic benefits by recycling valuable metal elements such as lithium, nickel, cobalt, and manganese, thereby achieving economic benefits.

![Figure 1. New energy vehicle sales in recent years](image)

2. Development status of lithium battery recycling system

2.1. Industry status
Lithium batteries are mainly composed of a positive electrode material, a negative electrode material, a separator, and an electrolyte. The important raw materials required for the production of lithium batteries are lithium, cobalt and other metals. From the perspective of industrial structure, China’s lithium battery industry ranks first in the world. A large part of lithium battery raw materials and components depends on imports. Therefore, it is of great practical significance to establish and improve a system for recycling used lithium batteries. At this stage, waste lithium iron phosphate battery recycling technology and waste ternary battery recycling technology are more mature in the business community. According to public information, in terms of battery recycling technology, developed countries have started early. Foreign companies represented by Toxco and Inmetco can recycle lithium batteries on a large scale. Toxco can handle lithium batteries of different models and different chemical properties. Lately, there are fewer lithium battery manufacturers that can recycle on a large scale. In the recycling process, Toxco uses a wet process to first recycle the waste lithium ion battery through low-temperature crushing. Inmetco uses a fire process to treat it at high temperature in an electric arc furnace. Domestic companies such as Gem and Brunp generally use the wet process as the Lord. At present, the waste battery recycling industry in China has not been regulated, and many problems need to be faced and dealt with urgently.

2.2. Policy status
Whether the lithium battery recycling system is effective is related to whether the economy and society can truly achieve sustainable development. In order to build an efficient and reasonable waste battery recycling system, the government has stipulated in the 2006 guidance document “Automotive Product Recycling Technology Policy” that new energy automobile manufacturers are responsible for the recycling and utilization of used batteries. In 2009, China issued the “Regulations on the Management of the Recycling and Disposal of Waste Electrical and Electronic Products”, and established a waste electrical and electronic product disposal fund paid by producers. This is an important attempt by the
producer responsibility extension system in the field of electrical and electronic products. In recent years, with the vigorous development of the new energy vehicle market, the government has issued multiple guidance opinions or policy documents from the policy level almost every year in order to encourage and support various social entities to better recycle and utilize waste lithium batteries. According to public information, as shown in Table 1. For example, in January 2015, the “Regulations for the Comprehensive Utilization of New Energy Vehicle Waste Power Battery Industry” stipulates that comprehensive battery utilization companies should strive to improve the level of recycling and utilization of related elements in waste power batteries. In January 2017, the government promulgated the “Promotion Plan for Extended Producer Responsibility System”, which explicitly proposed the establishment of an electric vehicle power battery recycling system based on the implementation of the extended producer responsibility system. In January 2018, the government promulgated the “Interim Measures for the Management of the Recycling and Utilization of New Energy Vehicle Power Batteries”. The document encourages battery manufacturers to cooperate with comprehensive utilization companies to carry out multi-level and multi-purpose rational utilization of used power batteries. The successive release of power battery recycling policies has forced power battery recycling companies to further improve their technology and accelerate their deployment. On November 7, 2019, the Ministry of Industry and Information Technology issued the “Guide to the Construction and Operation of New Energy Vehicle Power Battery Recycling Service Outlets”. The document first requires that new energy vehicle production and step utilization companies need to build or authorize recycling service outlets; second, they require the company to strengthen the tracking of information during the disposal process of waste power batteries; finally, the recycling service outlets must do a good job of record filing.

| Time            | Policy name                                                                 |
|-----------------|-----------------------------------------------------------------------------|
| January 2017    | Implementation Plan of Extended Producer Responsibility System            |
| January 2018    | Interim Measures for the Management of the Recycling and Utilization of Power Batteries for New Energy Vehicles |
| July 2018       | New Energy Vehicle Power Battery Provisional Regulations on the Administration of Collection and Utilization Traceability |
| November 2019   | Guidelines for Construction and Operation of New Energy Vehicle Power Battery Recycling Service Outlets |

3. Problems

3.1. Defects in laws and regulations
At present, most of the policy documents promulgated in the field of waste battery recycling in China are regulations, administrative regulations of ministries and commissions under the State Council or local governments, or technical guidance that has no legal effect. These documents cover many aspects of the recycling process, with detailed regulations. Because these documents are not high-level in law and cannot meet the needs of the rapid development of the industry, they need to be further improved.

3.2. Recycling mode is still in the exploration stage
According to known information, the current lithium battery recycling process is relatively long, and there are many subjects involved in the recycling system. The main body of recycling can be divided into the following categories: First, the battery company as the main body undertakes the main waste battery recycling work. The second is that automobile manufacturers are responsible for recycling lithium batteries while producing new energy vehicles. Third, auto dealers are the main recyclers. Fourth, professional battery recycling companies are the main recycling companies. Fifth, the alliance formed by automobile manufacturers and battery manufacturers is responsible for lithium battery recycling.
Different modes have their own advantages and disadvantages. At present, the recycling mode of waste lithium batteries in China is still in the exploration stage, and many problems need to be solved.

3.3. Lithium battery recycling concepts and environmental awareness are insufficient
It takes a process for the public to cultivate a sense of consciousness. New energy vehicles have truly entered the public life for more than ten years, and the supporting facilities such as charging piles and battery recycling sites are not complete, resulting in people's enthusiasm for recycling used batteries. In addition, the government and the media have not done enough publicity and popularization work, and the public's awareness of battery recycling is not in place.

3.4. Deviation in policy implementation
Government departments formulate and implement a number of policies for recycling used batteries every year. As far as the policy objective is concerned, it is to raise the threshold for recycling used batteries, forcing market entities to increase capital and R & D investment, increase technological innovation, and improve business models in order On the basis of compliance with environmental protection, further reduce operating costs and enhance economic benefits. Due to the deviation in the implementation of the policy, some non-compliant companies will use special means to make a large amount of used batteries through low-cost advantages to earn more profits. Such behavior has discouraged the enthusiasm of formal enterprises and harmed the interests of law-abiding enterprises.

4. Countermeasures and suggestions

4.1. Make powerful laws
First, the state should raise the level of battery recycling laws and regulations and formulate a strong legal system. For example, the State Council can coordinate and coordinate the various ministries and commissions, drawing on the situation in various places and formulating unified administrative regulations. Secondly, laws and regulations should clarify the management authority and functions of ministries and local governments, and refine the responsibilities and obligations of each subject in the recycling process. Finally, when specifying the rights and responsibilities of different subjects, the legal norms should also specify the relevant punishment measures and their feasibility to avoid non-compliance.

4.2. Improve lithium battery recycling standards and improve supporting policies
First of all, the government regulates the management system of the battery scrapping link, ensures that scrapped new energy automobile lithium batteries flow to compliant companies, and prevents the illegal loss of used lithium batteries. Secondly, the administrative department should keep up with the speed of technological change and continuously adjust and improve the technical standards of production, transportation, storage, dismantling, and reuse in the lithium battery recycling process to meet the needs of industry development. Finally, the government should adjust and improve fiscal and taxation support policies; on the one hand, it regulates the short-term market behavior of recycling companies through fiscal subsidies; on the other hand, it encourages enterprises to innovate by using preferential tax policies.

4.3. Cultivate the whole society's waste battery recycling concept and environmental awareness
First of all, the government should do a good job of guiding the various subjects of society to carry out various tasks in an orderly manner. Secondly, the media can cooperate with popular science writers to promote publicity and popularize popular science work to raise public awareness. Thirdly, schools can do the daily popularization of relevant knowledge through teaching. Finally, communities can take advantage of the characteristics of close to life to fully develop peer-to-peer promotion.
4.4. **Strengthening government supervision and industry self-regulation**

First of all, the government should strengthen supervision to combat illegal resale of used lithium batteries and create a fair business environment for compliance companies. Secondly, refine and implement punishment measures for violations of laws and regulations, and maintain market fairness. Finally, industry associations, as self-regulatory organizations, should give full play to their autonomous functions.

5. **Conclusion**

Promoting the recycling of lithium batteries for new energy vehicles is an important part of ensuring the sustainable development of the new energy vehicle industry and building a low-carbon society. Achieving this goal requires not only the government's role in encouraging policy and tax support, but also the extensive participation and strong support of industry, enterprises, the media, and the public. At present, the battery recycling industry is an emerging industry, which involves a long industrial chain, and it is inevitable to face many unforeseen problems during the development process. How to improve the recycling efficiency of used lithium batteries will be a long-term process.

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