

Exploring the Problem of New Energy Vehicle Battery

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Abstract. People are benefiting from technological advancements as society develops and advances, but the energy crisis is getting worse, making the creation of new energy vehicles one of the most important areas of research at the moment. New energy vehicles are also favored by more countries because of their low consumption. But at the same time, new energy vehicles still have many problems in battery safety, charging efficiency, etc. Based on this, the facts in this study are collected and analyzed on the battery issue with new energy cars. Propose reliable methods and strategies to promote the development of new energy vehicles in a better direction. It is envisaged that this will encourage the use of batteries in the future and the adoption of electric vehicles more generally. It is hoped to provide reference and new ideas for the improvement of the performance of new energy vehicles and the direction of future development.

Keywords: New energy vehicles, battery safety, charging efficiency.

1. Introduction

Nowadays, going green is becoming more and more important all over the world, and energy shortage is a very serious problem nowadays. As the number of cars increases day by day, the negative impact is also aggravated. The emergence of new energy vehicles will reduce the waste of resources and damage to the environment. Relevant data show that pure electric cars (PEV), plug-in hybrid electric vehicles (PHEV), and hybrid electric vehicles (HEV) only use 1%, 50%, and 71% of the turn-to-wheel process, respectively, compared to vehicles powered by internal combustion engines (ICEV) [1]. As the core component of new energy vehicles, the performance of the battery will directly affect the future use and development of new energy vehicles. In this paper, the safety, range and efficiency of batteries are studied and analyzed in order to promote the development of new energy vehicles.

2. New energy vehicle battery technology problems

2.1. New energy vehicle battery safety issues

As the primary source of power for new energy vehicles, more and more individuals are choosing to forego the usage of fuel-powered automobiles today, the safety of new energy vehicle batteries has become a top priority, the safety of the battery not only affects the driving performance of the car but also affects the safety of the car driver's life. Of course, there are many factors that affect the safety of the battery, such as the heating problem during the charging process, the collision problem during the driving process and the battery flooding and so on. At present, the batteries of new energy vehicles mainly consist of lithium batteries, phosphate batteries, titanate batteries, NiMH batteries and NiMH batteries. A lithium battery can be classified into three categories, based on its electrolyte state: a liquid lithium battery, a semisolid lithium battery, and a solid lithium-ion battery. With the increase in the degree of solidification of the electrolyte of lithium-ion batteries, the safety of lithium-ion batteries is also higher, but the technical difficulty and manufacturing costs are also higher [2]. Currently, the majority of electric cars are powered by lithium-ion batteries because to its high specific energy, long cycle life, and low self-discharge rate [3]. However, due to the frequent spontaneous combustion of trams, more people are also aware of their poor thermal stability and susceptibility to deflagration at high temperatures. In this regard, the production plants of new energy

vehicles and the R&D personnel should strengthen the research on their thermal runaway performance to reduce the accident rate of batteries

2.2. New energy vehicle battery lasting problems

At present, the automotive industry is also constantly seeking batteries with higher specific energy, and lithium-ion batteries are a step in this direction. The specific energy of lithium-ion batteries is over 200 Whkg⁻¹, and the energy density is 250 Whl⁻¹ based on data comparisons (see Figure 1) [4]. Different vehicle weights, ambient temperatures, and low battery energy densities can affect the range of the battery. An increase in vehicle weight necessarily requires more kinetic energy to be supplied resulting in an increase in electrical energy usage. Secondly, the influence of temperature is also not negligible reason. In winter, the temperature is lower, the actual discharge capacity of the lithium battery will be reduced accordingly, so the actual range will also be reduced. There is a test report, the best working temperature of new energy battery is 23°C to 26°C, suppose we take 24.5°C as the benchmark, for every 1°C decrease in the average temperature, the degradation of battery power will be more than 14%, if it is under the environment of -20°C in the north, the degradation rate of the battery will reach up to 55%, causing the range of new energy vehicles to drop up to 50% or more [5].

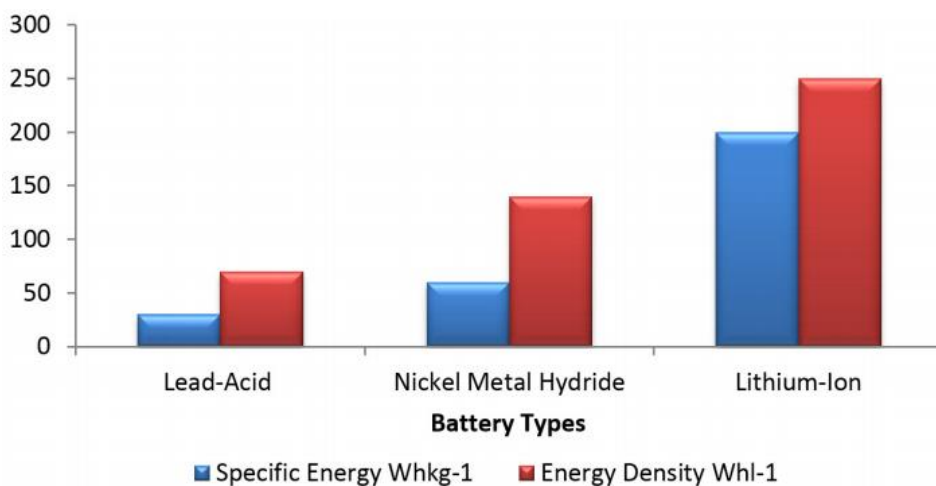


Figure 1. The characteristics of Lithium-Ion, NiMH, and Lead-Acid batteries for storing electricity

2.3. New energy vehicle battery charging efficiency

When comparing new energy vehicles with traditional fuel cars, the charging speed of new energy vehicles has been a weak point compared to the refueling speed of fuel cars. It often takes a lot of time to charge a new energy vehicle after it has traveled a certain mileage and to find a suitable charging pile. But with the development of charging technology, wireless charging is more often used in new energy vehicles. The biggest advantage of wireless charging is that there is no need to configure charging cables and charging interfaces. The development of wireless intelligent charging device can effectively solve the problem of short battery mileage of new energy vehicles, so as to enhance the development speed of new energy vehicles, and wireless intelligent charging device can achieve the function of small footprint and convenient charging through wireless transmission system, which can reduce the footprint to a certain extent. However, the efficiency of wireless charging device is not high. The current power transfer of wireless charging devices is mostly below 10kW, and there are defects such as slow charging in electric vehicles with wireless charging [6].

3. New energy vehicle development prospects and analysis

3.1. Improve the quality of battery production and reduce safety hazards

As seen from the perspective of existing new energy vehicle development, the performance of the battery still has a considerable gap compared to the engine. New energy vehicles from the perspective of their use, the power performance of the battery is continuously decaying during the whole life cycle of the vehicle or even during a single trip, but the power performance of the engine can remain unchanged. Moreover, under the influence of a large number of charge and discharge times, there will be different degrees of damage to the battery. This requires related companies and researchers to improve the battery charging and discharging system or use better materials to reduce the loss of battery energy. As a means of transportation, it is inevitable that a collision will occur during the journey, which, due to the collision, will cause a huge impact on the battery or even cause the battery to short-circuit, catch fire and lead to spontaneous combustion and explosion of the new energy vehicle. In this regard, researchers can optimize the battery material, choose a higher strength material as a protective shell for the battery. At present, as more and more car companies adopt the sliding plate battery pack chassis layout, although it can gain more benefits in terms of adjusting the position of the center of gravity, simplifying the battery pack structure, maximizing the available space and improving the driving range, it inevitably increases the probability of the battery pack being impacted by the bottom. Therefore, for battery packs with this structure, firstly, the battery cell itself is required to have a strong enough resistance to crushing and pinching; secondly, throughout the entirety of the product's life cycle, accumulated damage needs to be within the limits of the battery pack's ability to withstand, which may be one of the causes of battery spontaneous combustion; thirdly, the battery pack should be designed with reasonable protection strategies and alarm methods to effectively prevent cooling. Third, a reasonable protection strategy and alarm method should be designed in the battery pack to effectively prevent the fire accident caused by coolant leakage [7].

3.2. Increase battery power density to increase range

At present, the battery range problem still plagues the relevant enterprises and consumers. For new energy vehicles, the larger the capacity of the battery pack, the greater the energy storage capacity and range of the vehicle. However, the structure of most new energy vehicles today is very similar, for safety and space utilization considerations, the battery pack is concentrated under the cockpit, so the number left for the battery pack is limited, since this is the case, it is quite necessary to improve the energy density of the battery pack. The higher the energy density of a battery, the more power is stored per unit volume. The calculation method of battery energy density can be seen from the increase in the percentage of active material per unit mass or unit volume of the battery. Increasing the working voltage of the battery and developing high-capacity electrode materials are the most direct and effective ways to achieve the leapfrog development of energy density of lithium-ion batteries [8]. Secondly, different battery cathode and anode materials also have an impact on the battery energy density, and in the future, we can use more reasonable cathode and anode materials to make the battery performance improved. In addition, by using the formula of "lighter weight = lower energy consumption = smaller traction battery = lower vehicle cost". Each kilogram of vehicle weight reduction can cost an additional 10-15 euros without significantly increasing the cost of the vehicle. This could lead to breakthroughs in electric vehicle lightweight design, enabling new materials and technologies that are too expensive for conventional vehicles, even exotic carbon fiber [9]. The following chart compares the performance of different types of batteries, as shown in Table 1.

Table 1. Major properties of different types of rechargeable batteries. (Reproduced with permission from EUROBAT et al. 2014; Gondelach 2010; Cluzel and Douglas 2012)

	Lead-based	NiMH	NaNiCl ₂	Li-ion
Power density (W/kg)	180–500	150–1200	180	300–1800
Energy density (Wh/kg)	30–50	30–80	120–125	70–125
Energy density (Wh/L)	60–120	50–300	185–300	85–275
Self-discharge rate (% per month)	~3	~15–20	No self-discharge at cell level	~2–5
Optimal ambient T range (°C)	0 to +40	-10 to +45	-40 to +60 at battery level	-10 to +25
Operating ambient T range (°C)	-30 to +75	-10 to +45	270–350 at cell level	-10 to +55
Max operational lifetime (years)	3–8	8–10 (for HEV and active cooling)		~10
Number of cycles	500–4500	1350–2000	1000	1000–3500
Cost (EUR/kWh)	50–270	400–1400	500–700	300–1200
Energy efficiency (%)	70–82	60–70	92.5	80–90

No technology is perfect to all degrees. There are several advantages and disadvantages to all existing lithium-ion chemistries. Battery characteristics, cost, and safety must be compromised to achieve the best solution [10].

3.3. Improve battery production technology, increase policy support

Improving battery production technology may more strongly support the use of new energy cars in everyday life, which will help to foster the development of these vehicles. At present, Chinese and foreign new energy vehicle enterprises and battery suppliers are actively carrying out technical research and making efforts to develop power batteries and related products to narrow the performance distance with engines. When the performance of the battery is improved, it will bring huge economic benefits to the whole society. A series of support from the state and policies can allow enterprises to attract more high-level researchers and more research funds, so that they can do more experiments and tests in the usual exploration and research to improve the overall performance of new energy vehicles. Enterprises and enterprises can also strengthen cooperation and communication, exchange and discuss the research results of each enterprise, as well as the future development direction, so as to better promote the development of new energy vehicles.

4. Conclusion

Through research, this paper analyzes the problems of new energy vehicle batteries in terms of safety, durability and efficiency, and proposes to improve battery performance by improving battery production quality, increasing battery energy density and increasing policy support. Of course, the application of advanced technologies and techniques in the new energy vehicle battery requires a lot of efforts and attempts. In the future, the innovation of battery materials, the improvement of battery structure, and further improve the safety testing system, so that new energy vehicles will make a greater contribution to environmental protection!

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