

Research on the maintenance of new energy vehicles

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Abstract. New energy vehicles (EVs) require specialized maintenance practices due to their unique components and advanced technology. This paper explores the challenges associated with NEV maintenance, proposes solutions to overcome them, and emphasizes the significance of specialized training programs to address knowledge and skill gaps among mechanics and technicians. It also highlights the importance of increasing the availability of NEV parts and improving battery technology to enhance repair efficiency and reduce costs. User-friendly maintenance guides are recommended to empower NEV owners to perform basic maintenance tasks themselves. The development and expansion of charging infrastructure are crucial to overcoming range anxiety for NEV owners. Proper maintenance not only improves the performance and longevity of NEVs but also contributes to cost savings and environmental benefits. By addressing the challenges, implementing solutions, and promoting comprehensive maintenance practices, we can ensure the optimal performance and longevity of NEVs, supporting a greener and more sustainable transportation system.

Keywords: new energy vehicles (NEVs), electric vehicles maintenance, battery.

1. Introduction

The term "after-market" pertains to the range of services offered during the ownership and use of a car following its purchase. It encompasses all the necessary services that consumers may require after buying a car. Essentially, it involves a series of transactional activities that cater to the various after-sales needs and services that arise throughout the car's lifespan, from sale to end-of-life. Considering car ownership, the after-market holds significant potential. In 2022, the total number of motor vehicles in China will reach 417 million, including 319 million cars. The number of new energy vehicles in our country reached 13.1 million, with a year-on-year growth rate of 67.13%, showing a rapidly increasing trend [1].

However, despite the numerous advantages of NEVs, their maintenance requirements differ from those of traditional internal combustion engine vehicles. The unique characteristics of NEVs, such as advanced electric powertrains, high-voltage battery systems, and regenerative braking systems, pose new challenges and opportunities in terms of maintenance practices.

Additionally, this study aims to provide practical recommendations for the maintenance of NEVs, supporting the long-term sustainability and optimal performance of these vehicles. The article thoroughly examines the fundamental framework of major components in new energy vehicles, identifies the reasons for typical equipment and wiring malfunctions, and recommends practical solutions to enhance the durability of new energy vehicles.

2. Types of maintenance for different components of new energy vehicles

Battery maintenance is crucial for the longevity and efficiency of an electric vehicle. Regular maintenance is required to ensure optimal performance. EV owners are advised to follow the manufacturer's recommended maintenance schedule, which typically includes checking the battery's fluid levels and verifying the proper functioning of the cooling system. Additionally, keeping the battery clean and free from debris is essential.

Tire maintenance is vital for all vehicles, including EVs. Properly inflated tires contribute to improved fuel efficiency and extended tire life. It is recommended for EV owners to regularly check their tire pressure at least once a month and rotate their tires every 5,000 to 7,000 miles [2].

Brake maintenance is important for electric vehicles due to the use of regenerative braking, which helps recharge the battery while decelerating the vehicle. This results in less wear and tear on EV brakes compared to traditional brakes. Nevertheless, it is still essential to regularly inspect the brake system to ensure proper functionality.

Cooling system maintenance is important for electric vehicles, as they depend on it to maintain optimal temperatures for their batteries and other components. Ensuring the proper functioning of the cooling system is essential to preventing damage to the battery and other vital parts. Regular inspection and maintenance of the cooling system contribute to its longevity and efficiency. Maintenance of the electrical system is crucial for electric vehicles, and it is important to ensure its proper functionality. Regular inspections of the electrical system are helpful in identifying any issues and preventing potential problems. Additionally, it is important to keep the electrical components clean and free from corrosion.

3. Challenges in new energy vehicle maintenance

The most important issue in the maintenance of new energy vehicles is still the battery problem. NEVs have unique components that require specialized skills and training to maintain. For example, the high-voltage battery pack requires specialized training to handle it safely. This means that not all mechanics have the necessary skills to maintain NEVs, making it challenging to find qualified professionals to service these vehicles. The high-voltage battery pack is also a critical component of NEVs and is one of the most expensive parts to replace. While the batteries are designed to last for many years, they will eventually need to be replaced, which can be a significant expense [3].

At the same time, NEVs are more technologically advanced than traditional gasoline vehicles, making maintenance more complex. The high-tech components, such as the battery management system, require specialized diagnostic equipment to identify problems. This complexity can also make it difficult for owners to perform basic maintenance tasks themselves, leading to increased reliance on mechanics. Moreover, the complexity of the technology involved in NEVs can also pose challenges for mechanics and technicians. The high-tech components, such as the battery management system, require specialized diagnostic equipment to identify problems. This makes it difficult for traditional mechanics to diagnose and repair NEVs without the necessary training and equipment [4].

Another issue that people need to pay attention to is that because NEVs are still a relatively new technology, the availability of parts can be limited. This can make it difficult to obtain replacement parts when needed, leading to longer repair times and increased costs [5].

4. Advantages of new energy vehicle maintenance

Proper maintenance of a NEV can help improve its performance. Regular inspections and replacement of tires, brakes and batteries can ensure that the vehicle is running at the best level, and it can also make the vehicle longer life. Proper maintenance can also lead to cost savings [3]. NEVs require less maintenance than traditional gasoline vehicles, but regular maintenance can help prevent expensive repairs in the long run. Additionally, a well-maintained NEV can have a longer lifespan, reducing the need for frequent vehicle replacements. From a security perspective, proper maintenance is crucial for the safety of the driver and passengers. NEVs have unique components that require specialized maintenance, such as the high-voltage battery pack. Regular maintenance can ensure that these components are functioning safely and prevent potential hazards. In the meanwhile, NEVs are already environmentally friendly, but proper maintenance can further reduce their impact on the environment.

Regular maintenance can prevent leaks, reduce emissions, and ensure that the vehicle is operating at peak efficiency. This can lead to a reduction in greenhouse gas emissions and a positive impact on the environment. As more and more people switch to NEVs, it is important to understand the importance of regular maintenance to keep these vehicles functioning at their best.

5. Solutions to overcome the challenges in new energy vehicle maintenance

5.1. Develop specialized training programs: addressing knowledge and skill gaps

To address the lack of knowledge and skills among mechanics and technicians, specialized training programs should be developed. These programs should focus on the unique components and technology involved in NEVs, such as the high-voltage battery pack and electric motor. By investing in these programs, mechanics and technicians can receive the necessary training to maintain NEVs safely and effectively.

For example, the entire control of NEVs heavily depends on the circuit system, resulting in a highly complex electronic control system [6]. Hence, in the event of a malfunction, a precise diagnosis is essential to identify the issue. The electronic control system of the vehicle is powered by the battery and distributes energy to different components of the car. Therefore, if there is a malfunction in the electrical system, it can affect other interconnected parts of the vehicle as well. In the meanwhile, the electronic control system of cars has a limited capacity, and many vehicles may experience circuit failures as a result of overload. Compared with gasoline cars, NEVs are equipped with a higher number of electronic components, leading to a heavier circuit load and making circuit spontaneous combustion a more common occurrence. To diagnose faults in the electronic control system of a new energy vehicle, maintenance personnel should first insert a fault diagnosis instrument into the system to ensure it enters the circuit [7]. The vehicle should then be started, and the status of the ABS warning light observed. If the light flickers or stays on for an extended period, the electronic control system is likely malfunctioning [8]. If the ABS warning light is off after starting the car, the electronic control system is functioning normally. In the event of a fault, maintenance personnel should clarify the specific information related to the fault. This can be achieved by connecting the fault diagnosis instrument to the port and identifying the fault type through the fault code in the diagnostic instrument or by analyzing the frequency and number of ABS warning light flashes.

5.2. Increase availability of parts: improving repair efficiency and cost-effectiveness

The availability of NEV parts can be limited, which can lead to longer repair times and increased costs. To overcome this challenge, manufacturers and suppliers should work to increase the availability of parts. This can be achieved by investing in the production of NEV parts and developing efficient supply chains to ensure that parts are readily available when needed.

5.3. Improve battery technology: minimizing replacement costs and maintenance expenses

The high-voltage battery pack is a critical component of NEVs, and battery replacement costs can be significant. By improving battery technology, such as increasing the lifespan of batteries and reducing replacement costs, the overall maintenance costs of NEVs can be reduced [9]. Based on data gathered from technical experts, scientific papers, and internet sources, it is possible for battery costs to make up to a third of the total vehicle costs. However, with the cost of batteries decreasing, the overall cost of BEVs is becoming more affordable.

5.4. Develop user-friendly maintenance guides: Tuhu's initiative for enhanced service standards

NEVs are more technologically advanced than traditional gasoline vehicles, which can make maintenance more complex. To help owners perform basic maintenance tasks themselves, user-friendly maintenance guides should be developed. These guides should provide clear instructions on how to perform routine maintenance tasks, such as checking and topping up fluids, tire pressure, and battery condition.

As the internet continues to expand in China, numerous used car websites, car websites, and car communities have emerged. Among these communities, Tuhu stands out as one of the most prominent. In May 2019, Tuhu introduced the "Tuhu Car Care Workshop Shop Service Standardization Evaluation System." [10]. This system is comprised of four main components, including technical construction standardization, service process standardization, management and operation standardization, and offline supervision and feedback processes. It is continuously being upgraded to ensure its effectiveness. Tuhu has taken the initiative to organize and promote the "Pilot Project on Standardization of Car Aftermarket Services" under the guidance of relevant authorities. This project has developed teaching materials and corresponding courses, and established clear guidelines for operational processes, norms, and quality assessment to enhance service standards. For instance, in the case of tyre changing, the training is divided into numerous standardized steps, with specific details such as the need to change the valve during tyre replacement and the requirement for a torque spanner during dismantling clearly defined. These efforts aim to regulate the technicians' operations and enhance the level of service. Therefore, there are many high-quality ways available in the market now to maintain new energy vehicles for people to choose from.

5.5. Develop charging infrastructure: overcoming range anxiety for NEV owners

Range anxiety is a common concern among NEV owners. To overcome this, charging infrastructure should be developed and expanded. There are different types of charging infrastructure that can be developed, including residential, workplace, public, and fast charging stations.

Residential charging infrastructure allows EV owners to charge their vehicles at home using a dedicated charging station. Workplace charging stations can be installed in office parking lots, allowing employees to charge their EVs while they work. Public charging stations can be installed in public areas such as malls, supermarkets, and parking garages, providing a convenient way for EV owners to recharge their vehicles. Finally, fast charging stations are designed to quickly charge EVs, usually in less than an hour, making them suitable for long-distance travel.

6. Conclusion

In conclusion, the maintenance of new energy vehicles (NEVs) is of paramount importance for their longevity, efficiency, and the safety of their owners. Although NEVs require less maintenance compared to traditional combustion engine vehicles, their unique components and advanced technology present new challenges in maintenance practices. One of the key challenges in NEV maintenance is the high-voltage battery, which requires specialized skills and training to handle it safely. The availability of qualified professionals with the necessary expertise remains limited, making it essential to develop specialized training programs to address knowledge and skill gaps. Additionally, increasing the availability of NEV parts and improving battery technology can enhance repair efficiency, reduce costs, and minimize replacement expenses.

User-friendly maintenance guides can empower NEV owners to perform basic maintenance tasks themselves. Initiatives like Tuhu's Car Care Workshop Shop Service Standardization Evaluation System provide clear guidelines and enhance service standards, ensuring quality maintenance practices.

Furthermore, the development and expansion of charging infrastructure play a crucial role in overcoming range anxiety for NEV owners. Residential, workplace, public, and fast charging stations should be established to provide convenient and accessible charging options for EV owners.

Proper maintenance not only improves the performance and longevity of NEVs but also contributes to cost savings and environmental benefits. Regular maintenance ensures optimal functioning, reduces emissions, and enhances safety. As the popularity of NEVs continues to grow, it is essential to recognize the significance of specialized maintenance practices and invest in training, infrastructure, and technological advancements to support the sustainable future of transportation.

In conclusion, by addressing the challenges, implementing solutions, and promoting comprehensive maintenance practices, we can ensure the optimal performance and longevity of new energy vehicles, contributing to a greener and more sustainable transportation system.

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