Analysis on the development level of Eco-Cars in China

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Abstract. This paper first analyzes the development environment of China's Eco-Cars from the government guidance and industry status quo, and points out that the Eco-Car has become the development trend. Secondly, it introduces the vehicle ecological and health performance indicators that the industry pays attention to. On this basis, it makes statistical analysis on the performance of the main ecological performance indicator. In addition, the proportion of vehicles with excellent ecological performance is analyzed. Finally, this paper expounds the development suggestions of the Eco-Car in China.

1. Introduction

With the increasingly prominent contradiction between limited resources and demand, the threat of environmental damage to human survival is becoming more and more obvious. The Chinese government has included the construction of ecological civilization in the Constitution. Green development has become an important part of ecological civilization construction\cite{1}. In recent years, ecological design is highly valued, and a number of regulations and policies have been issued to guide ecological design. In addition, the Chinese government actively promotes green consumption, propose to expand the consumption of green products and promote the formation of green production and consumption methods in the whole society.

Since the new crown epidemic, global government departments, mainstream media, industry organizations have continued to increase their publicity on ecology and health, "implanting" green environmental awareness to consumers to create a green consumption atmosphere\cite{2}. According to a survey by China Consumer Network, the epidemic has made air safety and health in the car a further consideration when buying a car. Vehicle manufacturers have also accelerated the investment in ecological and healthy vehicle products. Chang'an, SAIC and BYD have adopted the "vehicle specification grade cn95 high efficiency composite air conditioning filter element" to create "healthy cars". The enterprises represented by GAC also launched the "health car integrated with TCM Pharmacology". Eco-cars have become a development trend.

This paper will analyze the concept of vehicle ecological design, impact indicators, and statistical analysis of the performance of the main ecological performance, which includes the compliance of regulatory standards and the proportion of advanced level. The results provide a reference for the industry to understand the level of vehicle ecological performance.

2. Analysis of influencing factors of vehicle ecological performance

Eco-design\cite{3} integrates environmental factors into product design, which aims to improve the environmental performance of products in the whole life cycle, reduces their environmental impact, and achieves resource saving and pollution prevention from the source. In recent years, the focus on...
ecological vehicles has mainly focused on health, energy saving, and environmental protection. At the health level, the vehicle should achieve non-toxic materials, low noise, comfortable smell, low electromagnetic radiation to ensure the physical and mental health of consumers; at the level of energy saving, reduce energy consumption and reduce the cost of consumer vehicles; at the environmental level, reduce the generation of pollutants and discharge, protect the atmosphere, water and soil where consumers live. The vehicle ecological and health performance indicators mainly concerned by the industry [4-5] are shown in Table 1.

| Index category          | Traditional energy vehicle                     |
|-------------------------|-----------------------------------------------|
| Healthy                 | Interior air quality; Interior noise; Harmful substances |
| Energy conservation     | Fuel consumption                               |
| Environment protection  | Exhaust emission; Reusability and recyclability; Carbon emissions of LCA |

3. Analysis on the development of ecological vehicles

After years of development, the ecological performance level of China's vehicle products has been greatly improved. The lead content of the whole vehicle (excluding battery) decreased from 220 g per vehicle in 2014 to 117g per vehicle in 2019, and some parts exempted from hazardous substances met the standard ahead of time. For example, the application rate of lead-free solder in the control switch of electric swing window exceeded 70%. The average emission concentration of benzene in the air of the vehicle decreased from 93ug per m$^3$ in 2014 to 8ug per m$^3$ in 2018, and the average fuel consumption per 100 km decreased from 7.04 L in 2014 to 6.4 L in 2019. The level of reusability and recyclability increased from 91.5% and 92.6% in 2016 to 96.4% and 96.9% in 2019, respectively. The number of enterprises carry out research on LCA has increased from 0 in 2014 to 26 in 2019.

In this paper, the ecological performance level of traditional energy passenger vehicles is analyzed in detail as follows.

3.1. Comprehensive fuel consumption

In order to analyze the fuel consumption level of various models, this paper takes the limit requirements in "limits of fuel consumption of passenger cars" (GB 19578-2014) as the zero point benchmark, and the target value as the full score benchmark. The fuel consumption performance of passenger cars on sale in China in 2019 is shown in figure 1. It can be seen from the figure 1 that most models have gradually approached the target value, but the proportion of vehicles meeting the target value is still low. Under NEDC working conditions, the fuel consumption of European models is better, of which the British series performs best, followed by Japanese and American series, and the domestic independent brands are gradually improved. The results are demonstrated in figure 2.
3.2. Exhaust emission

Analyze each pollutant in the exhaust emissions of mainstream models sold in China, and each pollutant has basically reached the type I of "Limit Limits and Measurement Methods for Light Vehicle Pollutants (China Sixth Stage)" (GB18352.6-2016), the test emission limit (6b) is required in which. But about 76% of the PN models have reached the $6.0 \times 10^{11}$ limit in advance. Based on the analysis of the type I test emission limit (6b)*0.5 as the advanced level, N2O has basically reached the advanced level, but there are fewer models with advanced levels of NOx, THC, and CO.

3.3. Interior air quality

Refer to the "Guidelines for Air Quality Assessment in Passenger Cars" to analyze various pollutants in the vehicles, including benzene, toluene, ethylbenzene, xylene, styrene, formaldehyde, acetaldehyde, and acrolein. Some models have reached the limit requirements. Taking the limit of *0.1 as the excellent level of analysis, it can be seen from figure 4 that there are many models of ethylbenzene and acrolein that have reached the excellent level, but only a small number of models of formaldehyde and acetaldehyde perform well.
3.4. Interior noise

When the vehicle is running in the city, it is mainly low and medium speed. In this paper, the interior noise analysis of 60km/h constant speed driving (mainly divided into tire noise), the interior noise of some mainstream models is analyzed. As shown in figure 5, the average level has been reached around 55 dB (city class 1 environmental noise standard in China), and excellent models have achieved less than 52 dB, the NVH level of China's vehicles is gradually increasing.

4. Conclusions

From the above analysis, it can be seen that the ecological performance level of China's automobile has been gradually improved, but from the specific indicators, most of the automobile products are still based on meeting the requirements of regulations and standards, which is far from the advanced level of ecological vehicles. After years of high-speed growth, China's vehicle industry has entered a mature period of stable demand and return to the market. Green development has become the important way for high-quality development. In the process of green development of automobile industry, the government, vehicle production enterprises, industry organizations and media should cooperate with each other:

- The government should strengthen the guidance of ecological development of vehicle products, and give relevant incentive measures to encourage the production and use of ecological vehicle products.
- Automobile manufacturers should increase the research and development of ecological products and improve the market supply of ecological products.
• The news media should strengthen the propaganda of ecological concept and create ecological automobile consumption environment.
• Industry organizations should increase the research on ecological vehicles to achieve forward-looking guidance.

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