Computer Simulation Design of Electric Vehicle Dynamic Performance

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Abstract. New energy vehicles are mainly pure electric new energy vehicles. Pure electric vehicles are powered entirely by batteries, as well as power generators. With the improvement of economic level, scientific and technological progress, as well as the emphasis on energy conservation and emission reduction, the development of pure electric vehicles is more rapid, computer simulation design technology helps to adjust and optimize the dynamic performance of electric vehicles, in 2019, the output of pure electric vehicles reached 56,700, it is expected to reach about 100,000 by 2022. However, due to the limitation of battery technology, the average range of pure electric vehicles is about 200km. So it can only withstand short distances between cities.

Keywords: Electric Vehicle, Dynamic Performance, The Simulation Design

1. Introduction
From the perspective of consumer market, electric vehicles are mainly concentrated in coastal cities and some economically developed provincial capital cities, largely because of the implementation of national Sixth standard in some cities. However, as the country attaches great importance to energy saving, emission reduction and environmental protection, and vigorously develops new energy vehicles, pure electric vehicles will achieve rapid development in the transportation industry with its advantages of energy saving, pollution-free, noiseless, flexible and free from traffic restrictions [1].

2. Electric vehicle performance summary based on computer data analysis
As the main transport vehicle in the automobile market, the sales of cars are rising year after year. In the field of pure electric vehicles, so far there have been more than 30 enterprises research and development, production and sales of pure electric vehicles. (See Table 1).
Table 1. analyzes the distribution of ELECTRIC vehicle enterprises in China in 2017 from a regional perspective

| Place names | Beijing | jiangsu | hubei | chengdu | shandong | Shanghai |
|-------------|---------|---------|-------|---------|----------|----------|
| companies   | 2       | 7       | 4     | 3       | 3        | 2        |
| Place names | anhui   | guangdong | guangxi | henan   | jiangxi  | shaanxi  |
| companies   | 1       | 1       | 1     | 1       | 1        | 1        |

It can be seen that pure electric vehicle companies are mainly concentrated in economically developed areas such as coastal areas. The disparity of economic development is one of the main reasons for the uneven distribution of pure electric vehicles in China. As China attaches great importance to environmental management, pure electric vehicle as the main type of special vehicle of automobile logistics has also received attention [2-3].

The structure of pure electric vehicles is the front chassis and cargo box, but their cargo capacity is different due to different body types, which are mainly divided into the following six models. Classification of various types of pure electric vehicles and analysis of their enterprises and models (see Table 2).

Table 2. All types of pure electric vehicle manufacturers in 2017

| models          | Light trucks class | The micro card class | Ling's class | Minivan class | Sea lions class | MVP class |
|-----------------|---------------------|----------------------|--------------|---------------|----------------|-----------|
| companies       | 14                  | 12                   | 5            | 3             | 2              | 1         |

By comparison, it can be found that pure electric vehicles of light truck and micro truck are developing rapidly, which indirectly indicates the increasing demand for short-distance distribution in cities. China electric car market in 2020 will be gradually rise, especially fresh electricity and the rapid development of medical industry, some cities six countries five standards into standard upgrade requirements, especially COVID - 19 outbreak occurred in 2020, consumer demand for food safety as well as fresh and medical distribution will be greatly increased. Will directly or indirectly promote its market demand, but also greatly promote its technological innovation. The future development trend of pure electric vehicles will be in the direction of vehicle lightweight, model series, intelligent environmental protection, in order to meet the needs of the automobile transportation industry and consumers' high requirements for fresh food [4].

3. Second-class chassis selection for the dynamic performance of electric vehicles

3.1. Selection of class II chassis
When we choose the second class chassis to choose according to vehicle use, such as pure electric cars, choose the second class chassis should first consider the maximum carrying capacity, and the need to transport the goods type and loading capacity and drive traffic to the structure of chassis and its stability, and the electric chassis also need to consider its battery life and drive motor, in order to meet the transportation of goods. Computer simulation goods deterioration or damage mainly have the following conditions: computer simulation effect does not meet the requirements, the transportation process of vehicle turbulence caused by strong extrusion deterioration of goods. Although pure electric vehicles have energy equipment, they also have higher requirements for chassis structure and transportation road conditions. It should be ensured that items do not deteriorate due to turbulence under certain road conditions. Reduce losses accordingly [5-6].

3.2. Main chassis parameters
Main chassis parameters are shown in Table 3.
Table 3. Main parameters

| The quality of parameter (kg) | Chassis model: HFC1041KEV8 |
|------------------------------|---------------------------|
| Quality of vehicle equipment | 2620                      |
| Rated load quality           | 2000                      |
| Maximum gross mass           | 4500                      |
| Appearance, size (mm)        | long 5975                 |
|                              | wide 1860                 |
|                              | high 2220                 |
| The motor parameters         |                           |
| model                        | TZ260XSJHD                |
| Wheel base (mm)              | Before the wheel track 1455|
| power                        | 130 (kw)                  |
| Before the wheel track       | 1425                      |
| Maximum torque               | 1200(N. m)                |
| Hanging long (mm)            | Before hanging 1110       |
| Top speed                    | 90(km/h)                  |
| After the suspension         | 1505                      |
| Performance parameter        |                           |
| Ground clearance (mm)        | 185                       |
| Driving Angle (°)            | Close to the corner 22    |
| The wheelbase (mm)           | 1582/1485                 |
| Angle of departure           | Angle of departure 14     |
| life                         | 245km                     |
| Tire size                    | 7.00 R16 8 pr            |
| Battery parameters           |                           |
| type                         | Lithium iron phosphate battery |
| Battery capacity             | 94.62 KWH                |
| brand                        | Opengbach, Anhui Province |
| The energy density           | 122wh/kg                 |

3.3. Calculation of power balance and specific power

3.3.1. Power balance calculation. The driving power of a pure electric vehicle is the output power of the motor $P_m$(kW), that is to say, the transmission efficiency of the machine needs to be improved by overcoming certain driving resistance. The corresponding calculation formula is sorted out from the power consumption of special devices:

$$P_m = \frac{1}{\eta} \left( m_a g \frac{f}{3600} \nu_{max} + \frac{C_p A_D}{76140} \nu_{max}^3 \right) \frac{P_0}{\eta_0}$$

Where: -- Total vehicle mass (kg); $m_a$

$\eta$-- Mechanical efficiency of vehicle chassis transmission;

$C_p$-- Air resistance coefficient;

$A_D$-- Windward area of the vehicle (m2);

$\nu_{max}$-- Maximum speed (km/h);

$P_0$-- Power (kW) obtained by relevant professional working devices while the vehicle is running;

$\eta_0$-- Mechanical efficiency of special working device [1].

The power of the generator is specially reserved, and its load rate is generally between 75% and 90%. When calculating the external load or performance error required for vehicle operation, the lower limit
is usually 75%. When the external weight decreases or the error factor is less, the upper limit is usually 90%. Under normal circumstances, the load rate does not exceed 90%. Therefore, the total power $P$ required by the motor of pure electric vehicle is:

$$P = \frac{P_m}{(0.75-0.90)}$$

In the calculation of the formula, 80% of $\eta$ is more reasonable. The value of MA was set as 4500kg; $g$ the value obtained is 9.8; $f$ value is 0.015; $v_{\text{max}}$ indicates that the maximum speed is 90km/h; The value of CD is 0.7; The AD was 4.61.

$$P_m = + = 92.06kw$$

$$P = = 108.31kW$$

3.3.2. Specific power calculation. The concept of specific power $P_d$ (kW/kg) specifically refers to that the motor power of different vehicle total mass is different, and the calculation formula should be modified as follows without considering the wind resistance:

$$P_d \text{ Value} = \frac{P}{m_a}$$

By comparison, it can be found that the general range of specific power of special purpose vehicles is:

- When $m_a$ is less than $510 \times 3$, $P_d$ is 0.0150.021 kW/kg~
- When $m_a$ is greater than or equal to $510 \times 3$, $P_d$ is 0.00750.011 kW/kg~
- When $m_a$ is greater than $1910 \times 3$, $P_d$ is 0.004780.007 kW/kg~

4. Computer simulation design of electric vehicle dynamic performance

4.1. Comprehensive analysis of energy modes

Mechanical cooling of freezers is widely used and accounts for 75 to 80 percent of all computer-simulated cars. Both cooling methods are widely accepted, but neither is sufficient. Whatever cooling methods are used or associated with practice, they are complex. Whoever created the design decided it would be best to cool it with a cold plate, especially considering the following:

1. The cooling panel conforms to the intermediate route, short circuit and the design concept.
2. Cooling plates are relatively cheap and much easier to repair.
3. Easy installation of cold plates through independent cooling procedures. Coolers that can be "cooled" unaccompanied require "cooled" ground coolers. Therefore, the pure electric vehicle of this design uses non-independent cold plate energy.

Dynamic performance: it is composed of steam generator, compressor, condenser and expansion valve. As shown in (1) [7].
Expansion valve also belongs to the throttling part, in which the coolant through the expansion hole resistance, reduce the cost; Then the space expands, the pressure drops, some liquid absorbs heat, the temperature drops, and the hybrid enters the cold zone. It flows through the evaporator, absorbs heat, and moves. The expansion valve controls the evaporative pressure of the liquid within a certain range and maintains the temperature inside the carriage. Expansion valves may also be called regulating valves or throttling valves [8-9].

The selection of reasonable compressor is an important process of axial piston compressor, which is also divided into swinging plate compressor and swash plate compressor, different compressors are applied in different work categories. But on the whole, the spindle can effectively drive the rotation of the transmission plate, and pressure the center of the Mosaic plate to move. Cause the friction between the production plate and the plate shake, there is a tendency to turn the plate, after shaking a pair of bevel gear fixed limit, plate from the straight son rotation degree traction piston cylinder movement, complete the process of suction and exhaust. A screw has five pistons, and the spindle rotates five times a week for suction and exhaust.

Swash plate compressor has large displacement, and the main component of the swash plate compressor is the main shaft. The front and back spindles can be controlled by the flower key. The position of the swash plate can be adjusted by turning the spindle and moving.

4.2. Thermal calculation of car compartment

Thermal parameters refer to the total heat transfer coefficient \(K\), air leakage multiple \(L\), energy amount and temperature range of the car.

The thermodynamic parameters of the cooling thermostat mainly refer to the total heat transfer coefficient of car \(K\), the gas leakage coefficient in \(L\), the number of cooling devices (heating) and the internal temperature range [10].

\(K\) coefficient is a parameter used to evaluate automobile insulation index. Calculation formula:

\[
K = \frac{Q}{F \Delta T} \quad (6)
\]

In the formula, it means the heat passing through the carriage wall per unit time (); \(Q\) is the geometric average value of the interior and exterior surface area of the carriage (); \(m^2 \Delta T\) means the average temperature difference between inside and outside the carriage (); \(K\) means the total heat transfer coefficient of carriage \(1/0\) W m\(^2\) · K. **Figure 1.** Schematic diagram of steam compressor

1- evaporator; 2-expansion valve; 3-compressor; 4-condenser of 4 -
Table 4. Compartments classified by K value

| Type of container | A            | B            | C            |
|-------------------|--------------|--------------|--------------|
| The coefficient of heat transfer $K/(W\cdot m)^2\cdot k^{-1}$ | 0.4 or less  | >0.40.6~     | >0.60.9~     |

4.3. Multiple $L$ of carriage air leakage
Generally speaking, the air leakage multiple $L$ of the compartment refers to various performance indexes that can effectively evaluate the air tightness of the compartment:

$$L = \frac{V_L}{V_X}(5)$$

Type $V_L$ refers to the amount of air leakage in the carriage within 1h (m$^3$/h); $V_X$ is the compartment volume (m$^3$).

But in the actual process, according to the different air leakage multiple, to divide the car into A, B, C three categories, generally speaking, C car is not used.

4.4. Coefficient $K$ of chamber wall heat transfer
Calculation of heat transfer coefficient of chamber wall:

$$K = \frac{1}{\sum_{i=1}^{n} \frac{\alpha_i}{K_i} + \frac{1}{\alpha_w}}$$

In the formula, it means the heat transfer coefficient W/m without considering the influence of skeleton $K$.

$\alpha_w$ is the heat release coefficient of the overall exterior surface of the carriage. When the air velocity is less than or equal to 2.56 m/s, the value of is 29 W/m$^2$ $\alpha_w$. When the air velocity is greater than 2.56 m/s, the value of is $5.67 + 17.5 \cdot \sqrt{V}$ W/m$^2$ $\alpha_w$.

5. Conclusion
In this chapter, computer simulation design is carried out from the dynamic performance of electric vehicles. Energy mode analysis shows that the dynamic performance of pure electric vehicles is selected by non-independent cold plate energy, and the choice of energy devices is simply understood from the brief introduction of dynamic performance. Finally, the thermal engineering and thermal load of the car are calculated. As a whole, it is necessary to start with the selection of cold storage agent for the cold plate, and adopt different cold storage time and cold plate installation to verify. Thus the overall dynamic performance of the design.

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