

EVALUATION OF THE USE OF ELECTRIC VEHICLE TIRES AND THEIR ECOLOGICAL IMPACT INDICATORS IN IMPROVING TRAFFIC SAFETY

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Abstract: This article discusses the environmental impact of the production and use of electric vehicles, environmental protection, analysis of defects and types of tires, and problems of utilization of electric vehicle tires. It summarizes the results of the state of the regenerative braking system of electric vehicles and the composition of fine particles emitted from tires, and provides recommendations for developing measures to eliminate the ecological and environmental damage and defects of electric vehicle tires.

Key words: Electric car, electricity, energy, power, engine, automobile, transportation, battery, tire, brake, movement, safety, fuel, construction, ecology, environmental.

Introduction. Currently, along with production in the automotive industry, the demands placed on them are also increasing. As a result, the production of environmentally friendly cars with high capabilities is being launched. In this regard, effective results are also being achieved in our republic. Compared to the statistics of previous years, the number of electric cars has increased 10 times. In 2023, 35 percent of imported cars were electric and hybrid cars. As of 2024, this will be 50 percent [1]. Good results have also been achieved in our country in this regard, and the hybrid and electric cars being produced have begun to meet the demands of the local population.

The design of electric vehicles currently being produced and their running gear also requires consideration of a number of factors related to the rapid wear of tires. These factors include the weight of the electric vehicle, the size of the batteries, the braking system, the quality of the tires, and the driving area. The following formula also provides key indicators for taking into account the speed of tire failure of an electric vehicle and some design problems. The rapid wear of electric vehicle tires depends on a number of factors, including its weight, tire material, and other technical characteristics.

The materials used in the production of tires have a greater environmental impact. The production processes using synthetic rubber and carbon compounds are not only environmentally damaging, but also consume a lot of energy and natural resources [2]. Since electric vehicle tires do not last long, they also require more tire production and generate less waste. The diagram below compares the mass of particulate matter (g/km) generated by tire wear between electric vehicles and internal combustion engine vehicles (Figure 1). Statistics show that electric vehicles have slightly higher tire wear rates, which is due to their greater weight and acceleration.

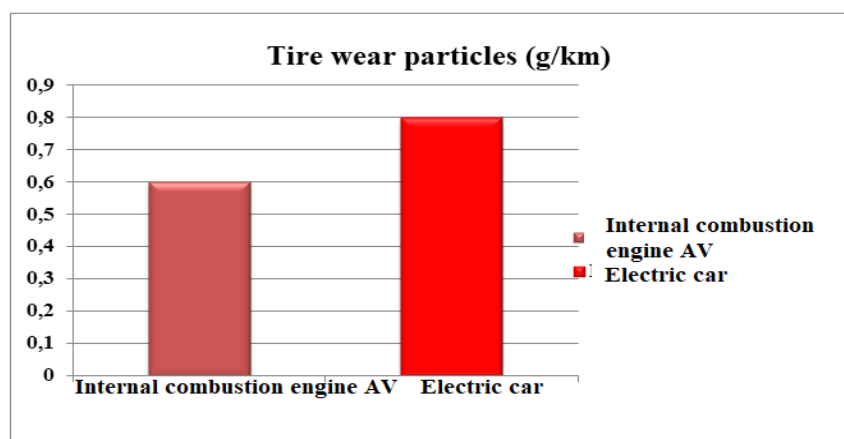


Figure 1. Tire wear diagram for electric vehicles and internal combustion engine vehicles

Tire wear not only causes mechanical wear, but also causes the release of microparticles that pose an environmental hazard. Due to the presence of natural and synthetic rubber, plasticizers, carbon black, metal oxides and other chemicals

in the tire material, particles are formed as a result of their decomposition. Each car emits 5-30 mg of tire particles onto the road or into the air on average per 1 km. Hundreds of grams of tiny particles are formed from the wear of one car tire per year. In electric vehicles, this figure can be 5-20% higher than in conventional vehicles, since their weight is greater. It enters the soil and water sources through rainwater and affects the flora and fauna .

One of the most important aspects of electric vehicle tire maintenance is tire wear. It affects the safe operation and efficiency of electric vehicles. Tires are the only point of contact between the vehicle and the road. Therefore, you should keep them in good condition and always be sure. It is also advisable to develop and implement some recommendations for tire maintenance.

- Check tire pressure regularly, at least three times a month, and adjust according to the manufacturer's specifications [8].

- Tires should be rotated every 10,000 km or as recommended by the manufacturer. This will ensure even tire wear and extend the life of the tires. Some electric vehicles have different tire sizes for the front and rear wheels. Therefore, it is important to follow the correct tire rotation schedule for your vehicle.

- Damage to tires such as cracks, bulges, punctures, and uneven wear can cause problems. If you encounter these problems, you should have your tires repaired or replaced as soon as possible. To ensure that the tires are parallel to each other and perpendicular to the road, the wheels are aligned every 10,000 and 150,000 km, or as recommended by the manufacturer. Incorrectly aligned wheels lead to uneven tire rotation, steering problems, and reduced electric power efficiency. The purpose of this dissertation is to review the general tire performance of the BYD SONG PLUS CHAMPION electric vehicle, a Chinese manufacturer. This is a modern electric vehicle manufactured by BYD (Build Your Dreams), which is characterized by high efficiency, safety, and environmental friendliness. The tires used in it directly affect the driving characteristics, economy, and safety of the electric vehicle.

BYD SONG PLUS CHAMPION electric car tire sizes

№	Model type	Front tires	Rear tires
1	Song Plus Champion electric car	235/50 R19	235/50 R19
2	Song Plus Champion DM-i (Hybrid)	235/55 R18 or 235/50 R19	235/55 R18 or 235/50 R19

235 mm – tire width; 50 – height to width ratio (i.e. 50%); R – radial type tire; – rim diameter (in inches). The tire load index of this electric vehicle is in the range of 99–103, which means that each tire can carry 775–875 kg of load. The total load of the four tires is 3100 to 3140 kg. The tires can withstand the maximum safe speed of the electric vehicle at around 240–270 km/h. The tires used in the BYD SONG PLUS CHAMPION electric vehicle are fuel-efficient and low-noise tire types. In order to improve the service quality of the tires, all-season tires are used. The recommended tire pressure is 2.4 bar (240–260 kPa) for the front wheels and 2.6 bar (240–260 kPa) for the rear wheels. When fully loaded, the tire pressure is slightly higher. In general, if the environmental damage of an electric vehicle is considered to be 100%, the tire damage for the BYD SONG PLUS CHAMPION model is around 20–25% [9,10]. As the number of electric vehicles increases, so does the demand for electricity. In our region, 70% of electricity is generated from natural gas, 15% from coal, and 15% from hydroelectric power plants. The combustion of these resources can also lead to environmental problems [12].

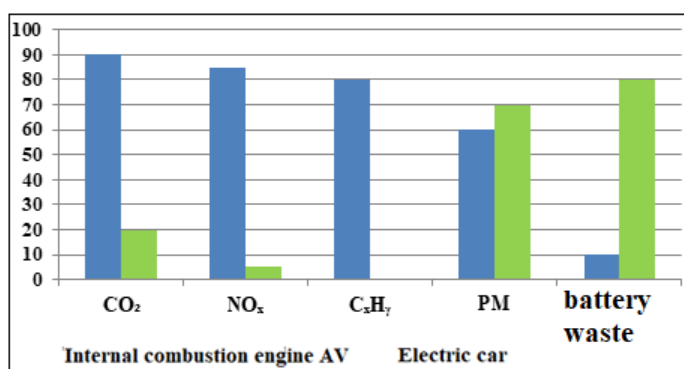


Figure 2. Comparative analysis of the amount of harmful substances emitted by internal combustion engines and electric vehicles

This figure shows the percentages of harmful substances emitted into the atmosphere: CO₂ (carbon dioxide), NO_x (nitrogen oxides), CH_y (hydrocarbons), PM (particulate matter, i.e. dust, tire, brake emissions), and battery waste (waste related to lithium, cobalt, and other metals) (Figure 2).

Conclusion. Improving the design of electric vehicles and ensuring long-term tire performance is environmentally and economically beneficial. Although electric vehicles are designed to be environmentally friendly vehicles, there are still a number of problems associated with their tread. The formulas cited above are also designed to help calculate the factors that affect the rapid failure of electric vehicle tires and design problems, and using them, it is possible to perform the necessary calculations.

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