Analysis of the Integration of Renewable Energies in Hybrid Vehicles

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Introduction

Born more than one hundred years ago, the automobile occupies our daily universe. It is a very original invention that has become over the years a place as a transport instrument, an object of high technology, a good consumption and representation of our social behavior. The future of the automobile for years is an important topic. In the current energy context, hydrocarbons (oil and gas) count 60% of the global energy supply, [1].

Transport dominates the energy balance and the majority of fuels used in this sector are liquid petroleum fuels. According to [1], the transport sector counts 27% of the final consumption of energy produced, of which 65% is based on fossil fuels. This sector contributes 23% of global greenhouse gas emissions and 74% of this contribution belongs to road transport [2]. Experts at Exxon and the International Energy Agency predict 70% increase in fossil fuel demand by the road transport sector by 2040, [3].

To reduce these emissions, many policies have been implemented to improve the energy efficiency of combustion engines. It is in this context that car manufacturers are orienting their research and development work towards the electrification of traction chains. Hybrid vehicles combining electric motor and heat engine are a good alternative to increase the efficiency of the traction chains. Motor vehicles are converted to hybrid and electric versions using large energy storage batteries and contribute in reducing the use of fossil fuels that emits less greenhouse gases [4,5].

On the other hand, the real technological breakthrough is only possible with all electric motors using renewable energy sources [6]. Extensive research is being conducted on these sources of energy to reduce dependence of automobile vehicles on fossil fuels and increase their autonomy. For example, a feasibility study combining the use of wind energy and electric cars in 2020 in the Netherlands was made. This study shows that in 2020, the electric system should be able to withstand one million electric vehicles and 10 GW of wind power, prouving that they are loaded with a load management system that levels the night demand for electricity [7]. The evaluation of the aerodynamic performance of a moving vehicle accommodated with a vertical axis Savonius wind turbine has been made by some authors. Using numerical simulations performed with the ANSYS FLUENT software, because this configuration gives 0.39 as aerodynamic coefficient identical with that of the vehicle alone compared to 0.45 for the wind turbine mounted on the bonnet and 0.51 for that mounted on the roof [8].

Other work consisted in designing and installing a three-bladed wind turbine with horizontal axis on an automobile vehicle as is the case of a pick-up. Mounted at the rear, the model could generate a maximum rotor speed of 400 rpm and approximately 150 to 200 W of electric power for a vehicle speed of 80 mph [9]. Another approach was made to a preliminary survey of electricity generation using micro-wind turbines placed on the tailgate of a car. Experimental approaches and CFD simulations have confirmed the negligible effect of drag force on vehicle performance in terms of fuel consumption and changes in drag coefficient values. A voltage and a maximum current of 3.5 V and 0.8 A respectively was generated by each micro-wind turbine obtained at speeds of 50 to 80 mph on motorways. Interestingly from this study, it was observed that the drag force decreased slightly from 798.8 N to 580.5 N for the single vehicle and the micro-powered vehicle, respectively, and the authors believe that the configuration may have acted in the same way as a rear spoiler, in
which the effects of drag would be reduced. These studies clearly demonstrate the possibility of varying the voltage and current of micro-wind turbines, indicating the possibility of using wind power on high-speed cars [10].

A numerical analysis of the aerodynamic effects on a passenger car model furnished with two horizontal axis savonius turbines, one of which has straight generators and the other side mounted generators on the roof was made. The authors note that with CFD simulations of SolidWorks Flow Simulation; a drag coefficient of 0.3148705 is obtained for the vehicle alone while the model with right generator had 0.4613440 and that with side generator 0.4779705. It emerges from their work that the model with the least aerodynamic effects is the one furnished with straight generators [11].

Solar energy has been the subject of many researches, such as the modeling and thermal analysis of a hybrid thermoelectric hybrid vortex tube generator. The model consists of a module of 3042 thermoelectric elements installed on the roof of the vehicle and a vortex tube that produces cold air and hot air. The system can produce for a solar flux of 178.59W/m², a cold air fraction adjustment of 0.9 and a vehicle of 55.5 m/s a power of 147.3 W and an electric current of 1.49 A [12].

In view of all the above, we can conclude that there is a very encouraging level of current work on the part of the scientific community. On the other hand, the future challenges lie in the creation of wind turbines capable of integrating into the body of the vehicle without, however, degrading its aesthetic and aerodynamic appearance, and on the other hand creating new energy conversion materials. solar with high efficiency.

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References