PERFORMANCE TEST OF HUB ENGINES OF AN ELECTRICAL CAR

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Abstract- In this paper joint performances of two hub motors that are designed for electrical motorcycles are investigated. For this aim the electrical car that is produced for a race is employed. The hub motors were 1.5kW power each. The motors are located at the back side of the car. The car was able to run using these engines separately. While the test, first the engine that is located to the right side of the car is run. Then the engine that is located at the left side is run. Finally both engines are run. The car is driven in a short distance and while drive the currents drawn by the engines are recorded using an energy meter. The results are compared and discussed.

I. INTRODUCTION

Electrical cars have a very recent technology but this technology is getting improved very fast. One of the fact that gets the researchers focused on such technology is the decrease on the fossil based fuels. Electrical cars are clean, useful and should be used in the cities efficiently. Many researchers developed different studies on the literature concerning the electrical cars. Some of them are summarized in this paper as follows: Bitar et al. are assessed the use of series DC motor in electric car with its rotation speed controller and evaluated its performances for different running cases of electric car with different loads. Swider et al. developed a testing device for electrical car networks. Pasaoglu et al. applied a survey in six European countries results of this study are a starting point for the estimation on energy demand profiles to assess how electrical energy supply can meet demand under the assumptions of a wide market share of Electrical Drive Vehicles. Purwadi et al. tested the performance of a 10 kW BLDC Motor and LiFePO4 Battery on an Electric Car Prototype. In a different study Bitar and Al Jabi tested the performance of induction motor in an Electrical car. Donateo at al proposed A method to predict the environmental impact of an electric city car. Besides these studies Peters investigated the design of battery systems for electrical cars. Ridder et al applied an activity based model to investigate the potential of Electrical vehicles in the smart grid. Vilet investigated Energy use, cost and CO2 emissions of electric cars. Holtsmark and Skonhoft investigated The Norwegian support and subsidy policy of electric cars. Dijk investigated the technological frames of car engines. It is obvious from the existing literature that Electrical cars are a hot topic and many researchers are focused on this topic from different perspectives. For this regard in this study performances of electrical motors located on a 430kg weighted electrical car are tested. The detail of the electrical car is proposed in Section 2. In Section 3 the experimental setup for testing is mentioned. Finally the test results are illustrated and discussed in Section 4.

II. ELECTRICAL CAR USED IN THIS STUDY

In this study to test the performances of the engines an electrical car that is attended to a race organized by TUBITAK (Scientific and Research Council of Turkey) is employed. The car was 430kg weight and was able to carry two persons in same time. TUBITAK started to organize such a race first time in this year. 42 teams are intended to attend the competition however 25 of them should pass the technical checks and could attend to the race. In the race joule meters are connected just before the batteries and the electricity consumptions of the batteries are recorded in such way. The race was in a 2km long racetrack and at least 30 tours were desired from the cars that are attended to the race. The ranking of the race is decided according to electricity consumptions. In this study the electrical car that is attended to this car is used to evaluate the performances of the hub motors. Tha car has two separate engines one is located at the left back whereas the second is located at the right back. The car is able to run either for one of the engines or both. The car has several electronic equipments such as battery administration, electronic differential, sped visualization equipments, high voltage and temperature protection equipments, telemetry etc. However in this paper it is aimed to focus to illustrate that the car is able to test different engines just the results of a small experiment is presented. The abilities of the car used in this study are summarized in Table 1.

Table 1. Properties of the Electrical Car

Properties	Unit	Value
Length	mm	3000
Width	mm	1700
Heigth	mm	1800
Number of Wheels	#	4
Frame	malzeme	Iron

Weight	kg	330
Shell	malzeme	Polyester
Break System	hidrolik, disk, pabuç, ön, arka, el freni	Hydrolical front-back disc break
Width of Front Wheel	mm	420
Width of Back Wheel	mm	100
Radius of Back Wheel	mm	400
Radius of Back Wheel	Mm	100
Telemetry	Existance	Exist; Speed, SOC, Temperature
Motor	Type	Brushless DC Motor (HUB) -2
Motor Driver	Existance	Exist
Motor Power	kW	2x1.5
Motor Efficiency	%	85
Motor Weight	Kg	10
Batteries	Type	Gel
Nominal Voltage	Volt	6 x 12
Maximum Voltajı	Volt	6 x 14.52
Nominal Battery Power	Wh	2880

III. EXPERIMENTAL SETUP

In electrical car production phase, generally high efficient specially designed engines are chosen. However these engines are expensive and not possible to obtain easily. On the other hand, It is possible to find simple hub engines commercially and it is possible to buy them easily.

In this study two outer rotor/HUB engines designed for electrical cycles are used to explore their performances in case they are used as the driver of an electrical car. By this way it is aimed to show that it is possible to use these engines for an individual electrical car design project.

Simple hub motors with 1500W power and 60V nominal voltage are chosen and tested. The dimensions of the wheels in which the hub motor is embedded is illustrated in Fig.1.

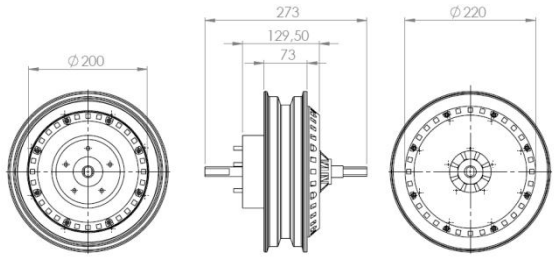


Fig. 1 Dimensions of the hub motor tested

To test the engines on the car a featured scope is employed. Current sensors are connected to the car and the battery currents, voltages and motor currents are measured and recorded. The test equipment is illustrated in Fig. 2.



Fig.2. Testing Equipment

IV. RESULTS AND DISCUSSIONS

The car is driven in a short distance with the engines run separately and combined. By this way there different test are performed. The car is driven by a 80kg weighted driver. The passenger seat was empty during the drive. The test equipment is suited at the passenger seat. The car is first driven by a single motor in this drive left engine is stopped. On the other hand in second drive right engine is stopped and again the car is driven using a single engine. Finally both engines are employed at the last drive. The currents driven by the engines during the drive are measured as given in Figs: 3-6.

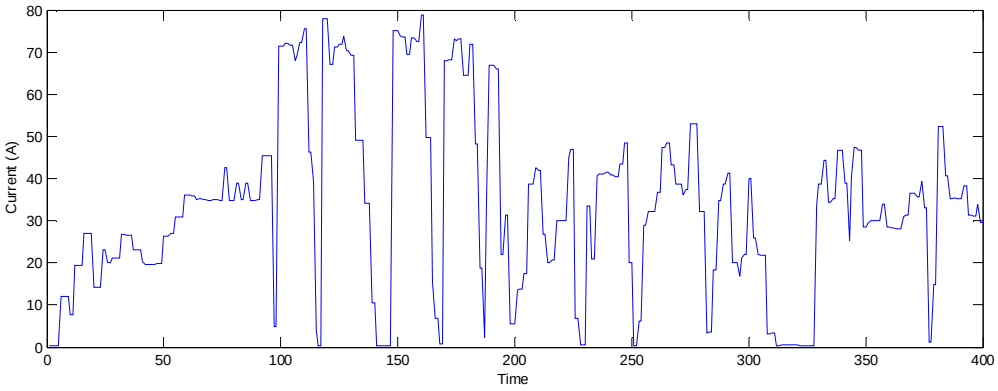


Fig. 3. Battery currents in case both engines are run

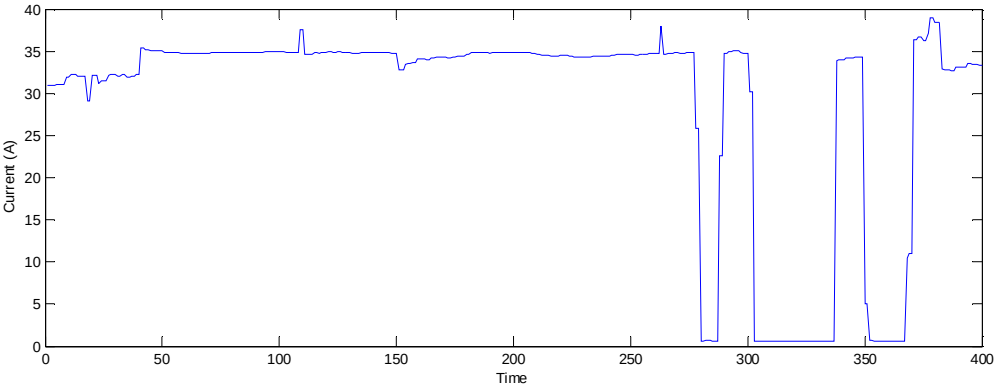


Fig. 4. Battery currents in case left engine is run

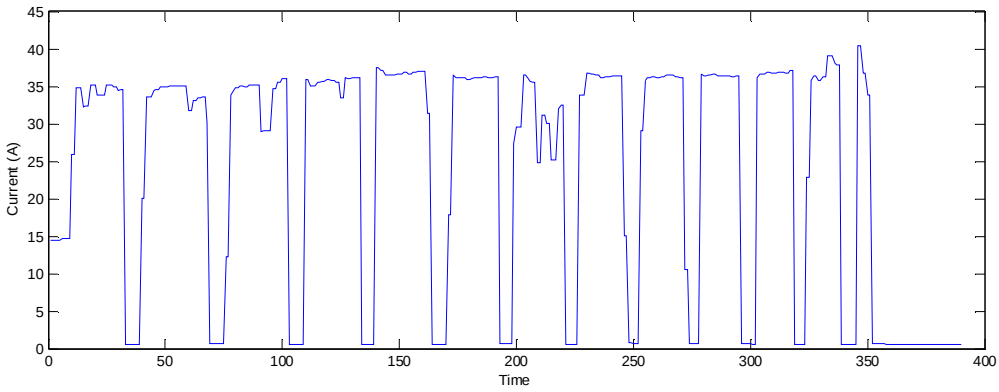


Fig. 5. Battery currents in case right engine is run

It is obvious from the figures that in case both engines are run the current drawn from the batteries are increased considerably. However after the engines started in a stable situation the currents are decreased. On the other hand by the help of second engine considerable increase in the speed is observed.

CONCLUSION

In this paper, the performances of electrical motorcycle engines in case they are used as the drivers of electrical cars are examined. For this aim a small test is performed. During the test the electrical car is driven in the same distance using two engines. In first stage of the test the engines are run separately, in the second test both engines are run and the car is driven in the same distance again. During the drives battery currents, voltages and motor currents are recorded. Among these data the currents driven from the engines are examined. The results show that even the efficiencies of motorcycle engines are low, they can be used as the drivers of electrical cars since they are cheap and can be found easily. One other important results obtained from this study is the usage of two engines instead of one engine it is possible to improve stability and speed of the car. It is obtained that two engine case is also much more convenient from the aspect of electricity consumption.

ACKNOWLEDGE

The authors acknowledge to Afyon Kocatepe University for the financial support to this work throughout the project number 14.Hız.Des.04.

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