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Evaluating the actual overall efficiency of the Car

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Abstract: Automobiles play a big part in the daily life of people everywhere. For the last 100 years the demand for fossil fuels has grown exponentially because of growing number of cars and buses. The general public is having a notion that the thermal efficiency of the engine is the actual efficiency of the car. Our paper shows that the actual overall efficiency of the car is much less than the thermal efficiency of the engine. This paper shows that the actual overall efficiency of the car is less than 3 percent. We have taken a sample of five different cars and the maximum overall efficiency comes out to be 2.57 percent for Maruti swift.

Keywords: Actual, Car, Mileage, Overall efficiency, Work done.

I. Introduction

These days a lot of research is being done to improve the mileage of the automobiles. The majority of people believe that the thermal efficiency of the engine is very close to the actual efficiency of the automobiles.

Our research is based on the following assumptions:

1. Entire car is a single entity and has been taken as engine.
2. The work done by car while running on roads is work done against friction.
3. The maximum mileage velocity has been used to calculate the maximum work done by the vehicle against friction.
4. It has been assumed that the vehicle is moving on highway at velocity which gives maximum mileage (45 kmph) and work is done against rolling friction. In this paper we are taking maximum mileage to calculate the frictional work done. The car gives maximum mileage when it runs on the highway. We are calculating the force of rolling friction. Then we are multiplying the force of rolling friction with the mileage of the car in kilometers. This gives the actual work done by the car against the force of rolling friction with consumption of 1 liter of petrol.

II. METHODOLOGY

Work done against friction = Frictional force × Distance moved

Frictional force = $\mu_r mg$

where, m = mass of the car,
g = acceleration due to gravity, and
μ_r = Coefficient of rolling friction

To calculate the rolling frictional force of car, we need to calculate the coefficient of rolling friction.

Coefficient of rolling friction has been calculated by the following formula:

$$\mu_r = 0.005 + 1/p\,(0.01 + 0.0095(v/100)^2)$$

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where

μ_r = rolling coefficient,
p = tyre pressure (bar), and
v = velocity (km/h)

The tyre pressure is 30 bars for all the vehicles. The velocity which gives maximum mileage has been taken as 45 kmph. At these values rolling friction coefficient is equal to

$$\mu_r = 0.005 + 1/30\,(0.01 + 0.0095(45/100)^2)$$

$$= 0.005397$$

To calculate the overall efficiency of the car, we are finding out the mileage at the highway roads. The frictional work done has been multiplied by the mileage so that we can find out the total frictional work done by the car at the cost of 1 liter of petrol.

The overall efficiency of the car has been calculated by dividing the net frictional work done per liter of petrol by calorific value of one liter of petrol.

The calorific value of petrol has been taken as 47300 kJ/kg.

The specific density of petrol is 0.835.

Hence the total calorific value of 1 liter of petrol = 0.835 × 47300 = 39495.5 kilojoules.

III. RESULTS AND DISCUSSIONS

TABLE I

S. No	**Car name**	**Kerb weight (kg)**	**Mileage (kmpl)**	**Frictional force** (μ_r mg) Newtons	**Net Frictional work per liter of petrol (Frictional force × mileage) kilojoules**	**Overall efficiency= Frictional work / Calorific value**
1	Maruti suzuki alto	800	18	42.355	762.401	0.0193
2	Maruti suzuki swift	1200	16	63.533	1016.528	0.0257
3	Maruti omni	800	18	42.355	762.401	0.0193
4	Maruti Suzuki ertiga	1150	15	60.886	912.990	0.0231
5	Tata nano	635	24	33.619	806.856	0.0204

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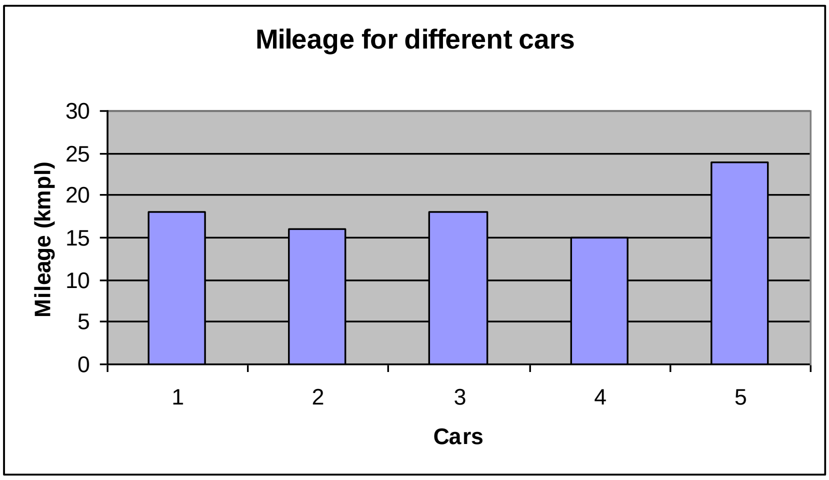

Fig. 1 Bar chart showing Mileage for different cars

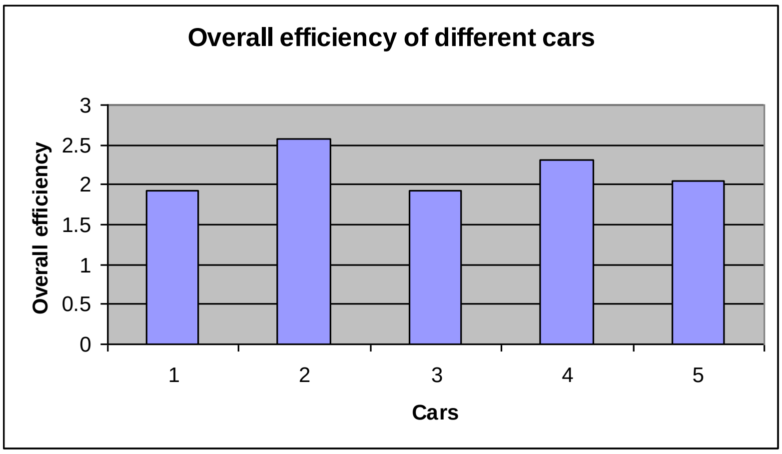

Fig. 2 Bar chart showing Overall efficiency for different cars

Thus, it is seen that most of the energy given by the fuel via engine is lost in internal frictional work and it is not converted into useful work. Usually the thermal efficiency of the engine of car is in the range of 20%-30 %. But it is found that the actual overall efficiency is only 1.9% to 2.57%. (Refer to the bar chart above). The energy given by the engine is lost because of the friction. If the friction loses in the transmission of power from engine to the tires are reduced, than the mileage of car can be increased by about 10 times.

IV. Conclusion

The paper proves that the frictional loses account for nearly 97% of energy generated by the engine and more research needs to be done so that mileage of car can be improved.

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BIOGRAPHY

S. V. A. R. Sastry was born in Kakinada on 10th of July, 1981. He got his B.Tech in Chemical Engg. from NIT Jalandhar, Punjab, India in 2002. After working for 6 months in a prestigious research organization, he got M.Tech in Process Engg. & Design from IIT Delhi, India in 2005. His major field of study is biodiesel production. He has more than seven years of work experience as a faculty member for imparting Engineering education. He is presently working as a Senior Asst. Professor, in the Chemical Engg. Dept. of MVGR College of Engg., Vizianagaram, AP, India, He has 18 papers in international and 2 papers in national peer reviewed journals. Besides, he has made over 100 presentations in various international and national conferences, including those conducted by IACSIT and IEEE. He has done extensive research in the field of Biodiesel Production and E- waste management. Presently he is trying to apply optimization techniques to his various works. Mr. Sastry is a Life Member of Indian Institute of Chemical Engineers, Institute of Engineers, Catalysis Society of India and International Association of Computer Science and Information Technology. He is also a reviewer of 10 International journals from US, Europe and Africa. He has authored 5 books, which are internationally read. He is also a member scientist of CORE GROUP of Scientists on Tree Borne Oil seeds for promotion, utilization and socioeconomic linkages in Southern India.

S.V.Y.Sastry was born in Kakinada on 23rd of October, 1983. He got his B.Tech in Mechanical Engg from NIT Jalandhar, Punjab, India in 2004. After working for one year and six months as Scientist-'B' in DRDO, he joined HAL as a Management Trainee. Presently he is working as an Assistant Professor in CIST, Madhavapatnam,Kakinada.