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A3 3 Clarkson's Chernobyl Incident

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Abstract

This paper investigates the effectiveness of Jeremy Clarkson's method of opening his car boot to run out of fuel before arriving in Chernobyl. We use air resistance and power equations to find that with the boot open, the car uses 6.83 l/hr when travelling at 110 km/hr. This is an approximate 85% increase to the normal efficiency of the car.

Introduction

In this article, the fuel efficiency of a petrol fuelled car is investigated when its boot is open. This is inspired by the Top Gear episode within which Jeremy Clarkson (and his co-hosts) try to use as much fuel up as possible to avoid arriving in Chernobyl. To investigate this, we consider the increased air resistance due to the open boot, how this affects the cars' required power output, and finally the impact this has on the fuel efficiency. We make the assumption that the vehicle, a Volkswagen Golf GT2, acts as a generic petrol fuelled car as the information regarding efficiency is not easily available. Further assumptions made to complete these calculations are listed throughout the method as they become relevant.

Method

The primary equation used within this investigation is the 'power due to aerodynamic drag' [1] as shown below in Equation 1.

$$P_D = \frac{1}{2}\rho v^3 C_D A_F \tag{1}$$

Where P is power, ρ is the density of air, v is velocity of the car, A_F is the frontal area of the car and C_D is the drag coefficient. The aerodynamics and mathematics of this situation would be very complicated so we make the following assumptions within this paper. We take the car to have the same drag coefficient as a cylinder, C_D = 0.82 [2]. The velocity of the car is assumed to be 110 km/hr as that is the national speed limit of rural areas in Ukraine [3]. The air density is taken to be 1.293 kg/m^3 [4] meaning only A_F was the only variable which needed to be found before computing Equation 1. A_F (frontal area) is found from Equation 2 below.

$$A_F = w \cdot (h + h \cdot sin(45)), \tag{2}$$

Where w is the width of the car and h is the height of the car. Equation 2 finds the frontal area by multiplying the width of the car by the height of the car plus the vertical component of the open boot (which we assume opens at a 45-degree angle). Once all the values from Equation 1 have been found, the results can be used in Equation 3 below to find the fuel used per unit time.

$$V_S = \frac{P}{E_F}, \tag{3}$$

Where V_S is the volume of fuel used per second, P is power (from Equation 1) and E_F is the efficient energy output per unit volume. The efficiency of the engine is already accounted for in E_F and so does not need to be included in this equation.

Results and Discussion

Our results find that lifting the boot of the car increases the petrol used per unit time by approximately 85%. The vehicle has a fuel consumption of 3.69 l/hr when the boot is closed compared to 6.83 l/hr when open (when travelling at a velocity of 110km/hr). This is a significant increase in petrol consumption and shows that opening the boot to increase air resistance is an effective method of decreasing fuel efficiency. In reality, the aerodynamics of this situation would be much more complex, especially when considering the drag coefficient of the car. Furthermore, more accurate efficiency values specific to the car used in the episode would benefit the calculations and we recommend that this is done if further study is undertaken. However, this article gives a useful result with regards to the comparison between the fuel efficiency with the boot open and closed.

Conclusion

To conclude, this article finds that opening the boot to decrease fuel efficiency is an effective method with it increasing the fuel used per unit time by 85%. Further work which has more detailed aerodynamics and more information specific to the vehicle is needed to improve on this result.

References

[1] https://airshaper.com/blog/how-does-aerodynamics-affect-speed [Accessed 23 October 2023]

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