Estimation of fuel loss due to idling of vehicles at a signalized intersection in Chennai, India

IOP Conf. Series: Materials Science and Engineering **263** (2017) 032028 doi:10.1088/1757-899X/263/3/032028

Estimation of fuel loss due to idling of vehicles at a signalized intersection in Chennai, India

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Abstract. The vehicles while waiting at signalized intersections are generally found to be in idling condition, i.e., not switching off their vehicles during red times. This phenomenon of idling of vehicles during red times at signalized intersections may lead to huge economic loss as lot of fuel is consumed by vehicles when they are in idling condition. The situation may even be worse in countries like India as different vehicle types consume varying amount of fuel. Only limited studies have been reported on estimation of fuel loss due to idling of vehicles in India. In the present study, one of the busy intersections in Chennai, namely, Tidel Park Junction in Rajiv Gandhi salai was considered. Data collection was carried out in one approach road of the intersection during morning and evening peak hours on a typical working day by manually noting down the red timings of each cycle and the corresponding number of two-wheelers, three-wheelers, passenger cars, light commercial vehicles (LCV) and heavy motorized vehicles (HMV) that were in idling mode. Using the fuel consumption values of various vehicles types suggested by Central Road Research Institute (CRRI), the total fuel loss during the study period was found to be Rs. 4,93,849/-. The installation of red timers, synchronization of signals, use of non-motorized transport for short trips and public awareness are some of the measures which government need to focus to save the fuel wasted at signalized intersections in major cities of India.

1. Introduction

The increase of personal vehicles on urban roads not only causes traffic congestion, but also leads to other issues such as increase in number of accidents, problems in vehicular parking, disturbance to pedestrian movement and problems related to environment such as air and noise pollution. One of the not much known effects of increase in number of vehicles in a city is the fuel loss estimation which occurs at signalized intersections during red times due to idling of vehicles, i.e., vehicles not switching off their engines during red times. There could be many possible reasons for vehicles being in idling condition. One of the major reasons is that the traffic signal at the intersection may not be equipped with digital timers to indicate the red times. Since the red times are unknown, the users of vehicles do not know how long to wait and hence they are maintaining the vehicle in idling condition without stopping their vehicle engines. Sometimes, the vehicles might have arrived just before the start of green time, and after seeing the long queue of vehicles in front, the driver may anticipate that the red is going to terminate soon and this expectation may lead to idling of his/her vehicle. In some cases, the drivers may think that, if the vehicle is switched off, then he/she has to spend some extra time in switching on their vehicles after the start of green time. During this extra time spent, the honking of vehicles behind, may takes place and in order to avoid such things, the driver prefer to put the vehicle

in idling mode. This phenomenon of idling of vehicles at signalized intersections due to various reasons as mentioned above may lead to huge economic loss as lot of fuel is consumed by vehicles when they are in idling condition. The situation may even be worse under heterogeneous traffic conditions as exist in India as different vehicle types consume varying amount of fuel. This particular topic of fuel loss estimation and measures to minimize them will be of great interest to policy makers in a developing country like India as it depends completely on other countries for fuel. Also, the increase/decrease of fuel price has significant effect on the price of consumer goods, vegetables, etc. in India. However only limited studies have been reported on this important topic of fuel loss estimation due to idling of vehicles [1-6]. A brief review of them is given below.

A study on fuel loss estimation at twelve intersections in Delhi by Parida and Gangopadhyay found that 98 per cent of the drivers do not switch off the engines of their vehicles while waiting for the signal to turn green [1]. The results showed that the total losses work out to be Rs.27.25 million per day and Rs.9944.5 million per annum. Goyal and Sood found that the monetary cost of fuel consumption due to idling of vehicles work out to be Rs.2.40 crores and Rs.2.43 crores for the two most congested signalized intersections in Chandigarh and the authors suggested synchronization of signals in the entire city to minimize the losses in future [2]. The study by Pal and Sarkar at five signalized intersections in Agartala revealed that almost 99% of the drivers do not switch off the engines of their vehicles while waiting for the Green signal [3]. They also found that around 389 litres of diesel and 810 litres of petrol is wasted everyday due to idling of vehicles at the selected intersections. A micro simulation study using VISSIM (Verkehr In Städten Simulation Model) was carried out by Sekhar et al. to estimate the total delay including idling delay and fuel loss at three intersections along a 2.9 km long stretch in Ahmedabad [4]. The authors concluded that the micro simulation is the most suited approach to estimate idling delay at intersections. Tiwari et al. found that 3,60,000 litres of petrol and 2,30,000 litres of diesel are wasted every year in Indore due to idling of vehicles when they wait at signalized intersections [5]. Bhandari et al. found that fuel loss per day is Rs 2.72 crores, Rs.0.59 crores and Rs.0.22 crores for heavy, medium and low volume intersections in New Delhi [6]. It can be seen from the above discussion that the fuel loss estimation due to idling of vehicles is an important topic as large amount of fuel are being wasted day by day which amounts to huge economic loss. However only limited studies have been reported on fuel loss estimation due to idling of vehicles in India. Hence the present study tries to explore this topic by selecting a case study intersection in Chennai, India and calculated the fuel loss in monetary terms due to idling of vehicles at one of the approach roads. The details about the selected intersection and the data collection procedure are explained in the following section.

2. Details of study area and data collection

The study area selected for the present study is Tidel Park intersection located in Rajiv Gandhi Salai of Chennai, India. The Google map view of the selected intersection is shown in Fig.1. The Rajiv Gandhi Salai is one of the busy arterial roads in Chennai and is also known as IT corridor or Old Mahabalipuram road. It is a 6 lane roadway, with 3 lanes in each direction. For the present study, the approach road from Siruseri was considered (Fig.2). The left most service road proceeding towards Tidel park was not taken into account as it is a free left road, i.e., there is no need for these vehicles to stop and proceed. The traffic flow at the intersection was controlled by the manually operated traffic signal in which no digital timers which can indicate the signal times was available. Hence most of the times, the vehicles used to be in idling condition without switching off their vehicle engines. The data collection for the present study was carried out on a typical working day between 7.15 am and 10.30 am in the morning and between 3.30 pm and 6.30 pm during evening hours. Three observers were manually noted down the red timings of each cycle using a stop watch and the corresponding number of two-wheelers, three-wheelers, passenger cars, light commercial vehicles (LCV) and heavy motorized vehicles (HMV) that were in idling mode. The observers were also noted down the vehicles which are in off mode to get an idea about the percentage of vehicles that are in idling condition, the results of which are explained in the following section.

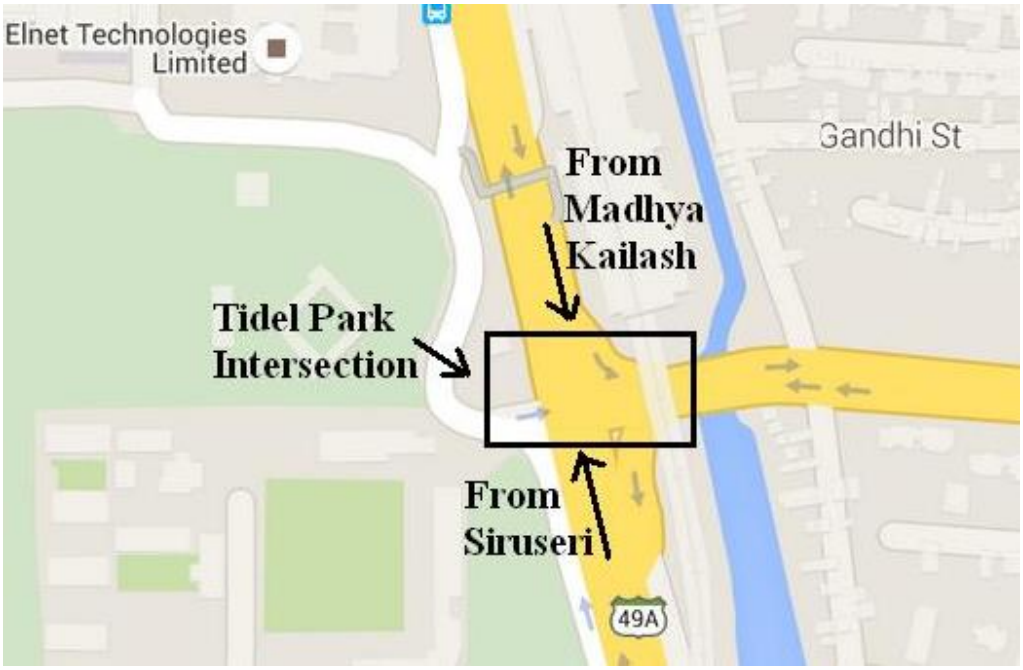

Figure 1. Google map view of the selected intersection

Figure 2. Photograph showing the approach road from Siruseri

3. Estimation of fuel consumption due to idling of vehicles

The class-wise number of vehicles that were ON and OFF during morning and evening periods at the selected approach road are shown in Fig.3. A total of 6669 vehicles were counted during the analysis period of six hours. It can be seen from Fig.3 that the number of vehicles that were ON were comparatively higher than that of vehicles that were OFF during both morning and evening periods. The percentage of vehicles that were in idling condition varies in the range of 88% to 94% for various vehicle types. This clearly shows that only 6 to 12% of the vehicles out of the total vehicles that pass through the approach road from Siruseri are switching off their vehicle engines and the remaining ones are in idling condition.

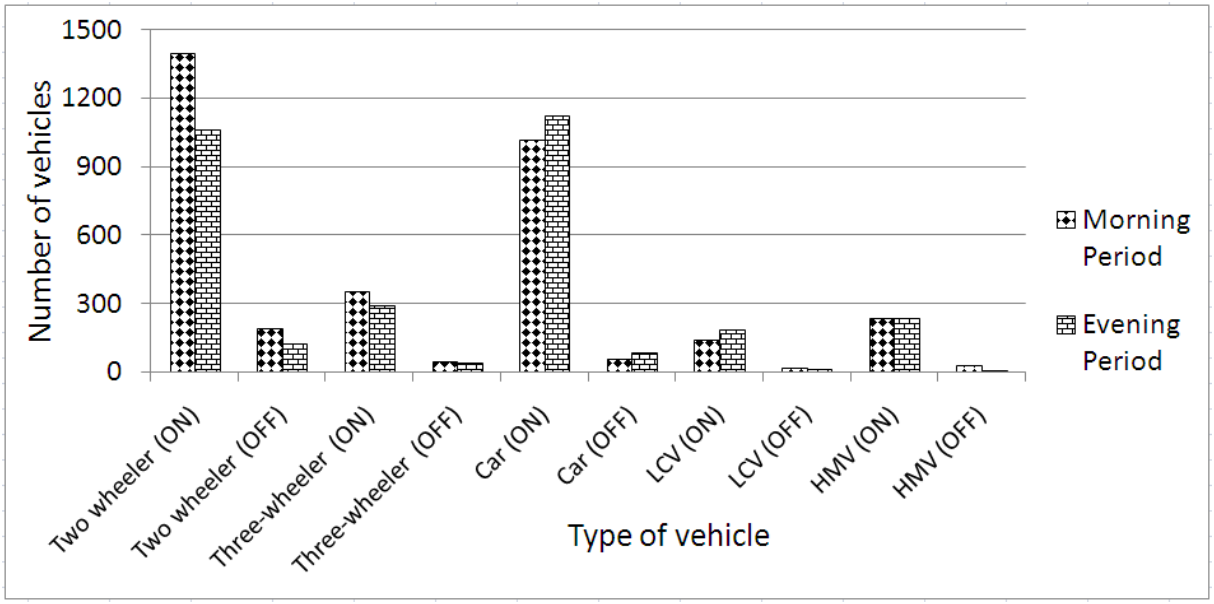

Figure 3. Class-wise number of vehicles that were ON and OFF during morning and evening periods

In order to calculate the amount of fuel lost by the idling of vehicles, it is required to first know the fuel consumption values of various vehicles types considered. Table 1 below shows the fuel consumption values obtained from Parida and Gangopadhyay [1], Sekhar et al. [4] and Pal and Sarkar [3]. As the present study does not differentiate between the vehicle models under each vehicle type category, an average of the fuel consumption values of various models was calculated and used in the present study.

Table 1 Fuel consumption values of vehicles. [1,3 and 4]

Vehicle type	Fuel consumption in ml/hr (vehicle type in bracket)	Value adopted in this study (average of values in column 2)
Two wheeler (scooter)	118 (Honda activa) and 216 (Bajaj scooter)	167
Two wheeler (bike)	166 (Pulsar Motor Cycle) and 129 (LML Motor Cycle)	147.5
Three wheeler	376 (Auto rickshaw)	376
Car (petrol)	692 (Maruti Van), 657 (Premier Padmini Car), 563 (Hyundai Santro), 740 (Esteem)	663
Car (diesel)	957 (Ambassador), 547 (Tata Indica)	752
LCV (diesel)	690	690
HMV (diesel)	920	920

During the data collection period of 6 hours, the total red time was found to be 3 hours 31 minutes. For calculating the fuel lost by idling of vehicles, only 75% of the total red time, i.e., 2 hours 38 minutes was taken into account. The reason for this is that all the vehicles may not have consumed the same red time as some vehicles might have arrived after the start of red. Since in the present study, data collection was carried out manually, it may not be possible to note it down at what time each vehicle has arrived after the start of red. If a simultaneous video data collection was carried out, then in that case, it may be possible to play the video and obtain the exact amount of utilization of the red time by each of the vehicles that have arrived. Also, in the present study, as the approach volume is high, it may not be possible to differentiate among the two-wheelers, i.e., whether it belongs to scooter

type or bike. Hence it was assumed that 30% of the two-wheelers were of scooter type and the remaining ones are bikes. The assumption is reasonable as most of the two-wheelers are of bike type only. Similarly for cars, 50% of them were assumed to be of petrol type and the remaining ones were assumed to be of diesel cars. Even with video data collection, it may be very difficult to find whether a particular car belongs to petrol or diesel type, as most of the popular car models in the market were looking alike in both of their petrol and diesel versions. The results of calculated fuel consumption of vehicles are shown in Table 2. The total fuel consumption for each vehicle type (column 4 of Table 2) was calculated using equation (1) as given below.

$$\text{Total fuel consumption in litres for a particular vehicle type} = [\text{Fuel consumption rate for one vehicle (ml/hr)} \times \text{Total red time (2.633 hr.)} \times \text{No. of idling vehicles}] \div 1000 \quad (1)$$

The number of vehicles in each category was multiplied by its fuel consumption rate (from Table 1) to calculate the total fuel consumed in 2 hours 38 minutes. The calculated total fuel consumption in litres for each vehicle type was then summed up to calculate the total fuel consumption of all vehicle types. It was found that the total fuel consumed by the idling vehicles is 7368 litres. The consumption of petrol and diesel was found to be 3504 and 3864 litres respectively. On the day of data collection, the petrol and diesel prices were Rs.71.55/lit. and Rs.62.92/lit respectively. Multiplying the amount of fuel consumed with the corresponding petrol and diesel prices, it was found that the total monetary loss is Rs.4,93,849/-. This amount of nearly 5 lakhs is only for one approach road and for data collection duration of six hours only. Considering all the approach roads in the selected intersection, the monetary loss will be high during a given day. In metropolitan cities like Chennai, there are hundreds of such intersections exist and if one calculates the fuel loss due to idling of vehicles at all these intersections, it will amount to crores of rupees in one day itself.

Table 2 Results of fuel consumption of vehicles.

Vehicle type	Number of vehicles	Fuel consumption rate (ml/hr)	Total fuel consumed in 2 hours 38 minutes (in lit.)
Two wheeler (scooter)	740	167	325.42
Two wheeler (bike)	1724	147.5	669.62
Three wheeler	642	376	635.65
Car (petrol)	1073	663	1873.32
Car (diesel)	1073	752	2124.79
LCV (diesel)	328	690	595.96
HMV (diesel)	472	920	1143.48

4. Conclusion

Rapid urbanization is a serious issue faced by most of the metropolitan cities in India. Many people are migrating from rural to urban areas and this urbanization results in the increase in number of vehicles plying on the road. One of the not much known effects of increase in number of vehicles in a city is the fuel loss estimation which occurs at signalized intersections during red times due to idling of vehicles. This may lead to huge economic loss as lot of fuel is consumed by vehicles when they are in idling condition. The situation may even be worse under heterogeneous traffic conditions as exist in India as different vehicle types consume varying amount of fuel. In the present study, Tidel Park intersection located in southern part of Chennai city was considered for fuel loss estimation at one of its approach roads. Data collection was carried out during morning and evening peak hours on a typical working day by manually noting down the red timings of each cycle and the corresponding

number of two-wheelers, three-wheelers, passenger cars, LCV and HMV that were in idling mode. The analysis of collected revealed that the percentage of vehicles that were in idling condition varies in the range of 88% to 94%. This clearly shows that only 6 to 12% of the vehicles out of the total vehicles that pass through the approach road from Siruseri are switching off their vehicle engines and the remaining ones are in idling condition. Using the fuel consumption values of various vehicles types suggested by CRRI, the total fuel loss during the study period was found to be Rs. 4,93,849/-. In a city with many intersections, the monetary loss due to the fuel consumed by the idling of vehicles will be very high in the order of crores of rupees in one single day itself. The installation of red timers, synchronization of signals, use of non-motorized transport for short trips and public awareness are some of the measures which government need to focus to save the fuel wasted at signalized intersections in major cities of India.

5. References

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