

Estimation of Delay and Fuel loss during Idling of Vehicles at Signalised Intersection in Ahmedabad City

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Abstract— The consumption of fuel is on the increase in metropolitan cities due to enhanced trip lengths, shift of modal share towards personalized modes of travel and congested intersections. When the vehicles are waiting for their turn to clear the intersection, the drivers normally keep the engines of their vehicle on and this result in extra fuel consumption. Small amount of fuel wasted, aggregated over number of cycles per day, number of days per year and number of signalized intersections in a huge quantity of fuel. Swastik cross road intersection has been selected in this study to ascertain fuel loss during idling of vehicles. It is found that 63.53 liters of petrol, 33 liters of diesel and 73.30 kg of CNG is being wastage everyday due to idling of vehicles at Swastik intersection. Convert it in to monetary terms shows that at only this one intersection fuel of around Rs. 9000 lost per four hour of day. If extent this figure up to whole year than it comes out that around Rs. 3.25 million lost due to idling of vehicles at swastik intersection. After the estimation of remedial measures, A total fuel of Rs. 3.11 million can save annually.

Index Terms— Signalised Intersection, Traffic congestion, Delay, Fuel loss

I. INTRODUCTION

In developing countries like India, rapid urbanization and industrialization coupled with rapid population growth has led to explosion in the number of vehicles in recent years. At the same time our roads infrastructure and our traffic management system has not been designed to cope with such a heavy vehicular load, leading to heavy traffic congestion at busy signal points in big cities as Ahmedabad. The fuel consumption of the vehicles is increasing day by day as a result of enhanced trip lengths, personal mode of transport and congested intersections. When the vehicles are waiting for their turn to cross the intersection at signals, the drivers normally keep their

vehicle's engine on and as a result of this extra fuel is consumed. This small amount of fuel wasted is aggregated over a number of cycles per day, number of days per year and number of signalized intersections resulting in a loss of huge quantity of fuel.

Ahmedabad, commercial capital of Gujarat, is one of the emerging urban centers of India. The exponential increase in the number of vehicles in the city has resulted in congestion at intersections. This has in-turn resulted in the need to install traffic signals. However, the ever increasing vehicular flow is found to cause heavy delays at intersections due to stoppage of vehicles during the red-phases of the signals. The wastage of fuel at these junctions result in a huge amount of valuable fuel resources. So a study is needed with respect to vehicular delay and fuel loss at signalized intersection to suggest the necessary improvement of the city. This paper explains a recent vehicular delay and fuel loss study on one important signalized intersections at Ahmedabad city.

II. STUDY AREA AND METHODOLOGY

The geographical location of Ahmedabad is 23.03 North Latitude and 72.58 East Latitude. It is the largest city of Gujarat state. Ahmedabad has an area of 466sq.km. (year 2006). Ahmedabad is located 25 kilometers away from the state capital, Gandhinagar. This observational study was conducted at Swastik cross road, busy traffic point of CG road. The four lanes at this cross road, Commerce six road to swastika cross road, Navarangpura to Swastik cross road, Zaveri crossing to Swastik cross road and Incometax intersection to Swastik cross road.

(1) Volume count survey

A traffic volume count proforma was prepared including a detailed classification of vehicles. Motorized and non-motorized vehicles were included in the study for the classified traffic volume count. The cars were classified into three category based on the fuel type. To know the direction wise traffic volume at the intersections a 4-hour classified traffic volume & turning movement survey was conducted at Swastik cross road intersection.

Table 1 Volume at different leg of intersection

Approach	2W	3W	Car	Vehicles per hour
Commerce six road	63%	12%	22%	2172
Navarangpura	62%	17%	17%	1745
Zaveri	61%	18%	17%	1683
Incometax	56%	19%	20%	1373

(2) Delay Measurement

A sample worksheet used for recording retrieved data is included in appendix. The survey period should begin at the start of the red phase of the study approach, ideally when there is no overflow queue from the previous green period. A person had kept records of the category wise vehicles stop at the intersection for every 15 second. The counting of vehicles had carried out till completion of the red phase. The counting period will vary with red time period of the approach. Similar way, the counting procedure was followed for the all approach of the intersection.

Table 2 Summary of Delay Analysis

Approach	Green time (s)	Cycle time (s)	Observed	HCM
			Delay /Veh (s)	Delay/ Veh (s)
Commerce six road	45	135	53.73	59.87
Navarangpura	30	135	59.91	68.18
Zaveri	31	135	60.22	64.39

Incometax	29	135	58.58	63.34
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Here, the green time indicates aggregate of green and amber time. The observed delay at each approach for both the intersection is given here. The same is calculated from the equations given in the HCM 2010, and results are mentioned here. It is seen that the observed delay is comparatively near with the calculated one.

(3) Switching off behavior survey

During the observation facts were come that about 98% of four wheelers found idle during morning and evening peak hours of survey time. Great number of three wheelers was in idle condition at all crossing. About 96% of three wheel vehicles were in starting condition while waiting for green signals because many were not having self-start and remaining impatience drivers were looking for a chance to escape even when the signal is red. in the survey it is found that 82% of two wheelers do not switch off vehicle engine during red time. All light commercial vehicles, heavy commercial vehicles and buses were found in idle condition.

(4) Idling fuel consumption rate

For measuring fuel consumption at idling condition for each category vehicle, studies were carried out by attaching fuel consumption test bottle with vehicle and then the engines run at idling condition. Study also carried out by filling fuel tank and then engine were run at idle condition. The idling fuel consumption in ml/hour and gm/hour of different type of vehicle is given in table. The revenue loss of fuel for each vehicle was calculated by multiplying fuel loss with the prevailing cost of fuel. The price of petrol, diesel and CNG were taken as Rs.61.96/liter, Rs. 49.64/liter and Rs. 45.60/kg. respectively in the month of October, 2015 at ahmedabad city. Fuel consumption rate of LCV, HCV and bus is taken from Mrs. Purnima Parida, S. Gangopadhyay, 2009..

Table 3 Fuel Consumption Rate (in ml/hr, gm/hr)

Sr no.	Vehicle type	Fuel consumption	Remark
1	Two wheeler	197	Petrol
2	Three wheeler	677	CNG
3	Car	706	Petrol
4	Car	649	Diesel
5	Car	989	CNG
6	LCV	690	Diesel
7	HCV	920	Diesel
8	Bus	930	Diesel
9	Bus	3610	CNG

(5) Estimation of fuel loss at intersection

As per the discuss above 98% of four wheelers, 96% of three wheelers and 82% of two wheelers do not switch of their vehicle engine while waiting at signal. So fuel loss occurs at the intersection. Computational tables have been made and estimated fuel consumption been calculated with the help of data collected by survey. Fuel wastage by the type of fuel (petrol, diesel and CNG) was estimated. The loss of fuel wastage per vehicle is determined for each of the signals crossing separately. Fuel wastage is calculated for survey period of 4 hour per day. For estimation of fuel loss, following self-generated formula have been used i.e. Amount of fuel wastage = (no. of vehicles) X (time of red signal) X (idle fuel consumption factor in ml/sec or gm/sec). The monetary loss of fuel for each vehicle has been calculated by multiplying fuel loss with the normal cost of fuel.the prise of petrol, diesel and CNG were taken as Rs. 61.96/liter, Rs. 49.67/liter and Rs. 45.6/kg respectively (cost of petrol, diesel and CNG in the month of October 2015)

Table 4 Fuel loss at intersection

Approach	Petrol	Diesel	CNG
Total fuel loss daily	63.5 lt	33.06 lt	73.3 kg
Rate of fuel Rs/lt	61.96	49.64	45.60
Fuel loss daily	3936 Rs.	1641 Rs.	3342 Rs.
Fuel loss annually	14.3 MRs	5.99 MRs	12.2 MRs
Total loss annually	3256174.68 Rs.		

Fuel wastage at the swastik intersection is calculated in above table. It is found that 63.53 liters of petrol, 33 liters of diesel and 73.30 kg of CNG is being wastage everyday due to idling of vehicles at swastik intersection. Convert it in to monetary terms shows that at only this one intersection fuel of around Rs. 9000 lost per four hour of day. If extent this figure up to whole year than it comes out that around Rs. 3.25 million lost every year due to idling of vehicles at swastik intersection.

(6) Remedial measure and fuel saving

The extra fuel consumption at the traffic signals is much higher because of the irresponsible behavior of the driver/rider and lack of determination towards stopping the wastage of fuel. It has already been published by CRRRI PCRA that less fuel required starting the vehicle than idling of vehicle. So, on the basis of observations it is suggested that rider should OFF engine while waiting for green signals. Further, the engine may be kept ON for 10-15 seconds without throttling. If all the drivers follow this truth and switch off their vehicles during waiting time than Rs. 3.11 million can save every year.

Table 5 Fuel save at intersection

Approach	Petrol	Diesel	CNG
Total fuel save daily	60.91 lt	31.81 lt	69.96 Kg
Rate of fuel Rs./Lit	61.96	49.64	45.60

Fuel save daily	3774 Rs.	1576 Rs.	3190 Rs.
Fuel save annually	13.77 M Rs	5.7 M Rs	11.6 M Rs
Total save annually	3118501.93 Rs.		

III. CONCLUSION

Congestion on roads has been increasing due to a very rapid growth in the use of personalized vehicles leading to high consumption of fossil fuels. The numbers of signalized intersections have increased manifolds resulting in wastage of fuel during idling. Swastik cross road intersection has been selected and classified traffic volume counts, delay survey, switching off behavior survey and idling fuel consumption experiment have been conducted to ascertain the fuel loss during idling of vehicles at signalized intersection.

The results of switching-off behavior survey revealed that almost 98 per cent of the four wheelers, 96% of three wheelers and 82% of two wheelers do not switch off the engines of their vehicles while waiting for the signal to turn green. This is in spite of (PCRA) continuous awareness program through print and electronic media to switch off the engines of vehicles if the waiting time is more than 14 seconds. It is found that 63.53 liters of petrol, 33 liters of diesel and 73.30 kg of CNG is being wastage everyday due to idling of vehicles at Swastik intersection. Convert it in to monetary terms shows that at only this one intersection fuel of around Rs. 9000 lost per four hour of day. If extent this figure up to whole year than it comes out that around Rs. 3.25 million lost due to idling of vehicles at swastik intersection.

On the basis of observations it is suggested that rider should OFF engine while waiting for green signals. Further, the engine may be kept ON for 10-15 seconds without throttling. If all the drivers follow this truth and switch off their vehicles during waiting time than Rs. 3.11 million can save every year. Besides of this traffic education is a very important tool in achieving the traffic discipline. Traffic education needs to be imparted at school level so that the habit of following rules and discipline is inculcated at a very tender age.

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