Volume 8, Issue 3, July 2021 ISSN: 2348-8565 (Online)
International Journal of Modern Engineering and Research Technology
Website: http://www.ijmert.org Email: editor.ijmert@gmail.com

Coordinating Traffic Signals to Reduce Fuel Consumption and Vehicular Emissions in Jabalpur City

Dheeraj Shukla
M.Tech. Research Scholar
Energy Technology
Takshshila Institute of Engineering & Technology,
Jabalpur (M.P.), India
E-mail: dheerajshuklekar@gmail.com

Pramod Dubey
Assistant *Professor*
Department of Electrical & Electronics Engineering,
Takshshila Institute of Engineering & Technology,
Jabalpur (M.P.), India
E-mail: pramoddubey@takshshila.org

ABSTRACT

Understanding and quantifying the extra fuel consumption by motor vehicles on different traffic signals is important step towards quantifying wastage of fuel. The main problem today is limitation of fuel resources which demands saving of fuel. Taking this in consideration, we made a survey of different traffic signals and prepared data sheet of signal timings and number of vehicles in ON condition at the traffic signals. First of all mileage as been calculated with the help of a test kit (FP 213S detectors DF 210A flow meters supplied by M/s. Ono Sokki) for motorcycle - Bajaj CT-100, 125 cc Activa, & motorcycle, 150cc motorcycle and we have calculated the fuel consumed by a vehicle in milliliter per second, when the bike engine is ON and bike is not running. This gave us a factor in ml/sec to calculate the fuel consumed at the traffic signals for 100-CC motor-bikes. With the help of this we calculated factors for 150-CC and 1000-CC. This 1000-CC we have taken as for the four wheelers. This 100-CC and 150-CC and taken as an average number of two wheelers are of this kind. This calculation helped us to make the further calculations of extra fuel that is consumed at the traffic signals.

Keywords:— *Consumption Pattern, Factors Influencing, Fuel Wastage, CO2 Emission*

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 Jabalpur. Traffic signals have become an invaluable tool in ensuring smooth flow of motor vehicles at crossings. But where we gain in terms of orderly flow of traffic, we lose out in fuel wastage and pollution. This is because people often leave the engine of their vehicle running while waiting at signals. In this paper, we propose a system that targets this problem. By creating a channel of communication between the traffic signal and the vehicle, we can ensure that the engine is shut off automatically. Various parameters are taken into consideration during the controlling of the engine start-stop action. When these parameters are found to be within a given set of conditions, the engine is shut off. If any one of these parameters changes, the engine is turned on automatically, saving the driver the hassle of turning the engine on manually. Now a days the fuel consumption (wastage) in

traffic signal is most critical factor as the resources of fuel are near to exhaust, i.e. will not be for so long time, just up to 2025 as predicted. Growing concern about environmental protection and energy conservation has led the Clean Air Act Amendments and a number of regulations to increase fuel economy and reduce emissions. Since in most of the countries, fuel consumption is by the transportation sector (65.1%) and fuel consumed by vehicles is about 75% of all transportation energy use developing ways to reduce automobile fuel consumption in traffic systems has become an important task.

The consumption pattern of petroleum products in India:

According to PCRA-2012 On an average, the consumption pattern of petroleum products in India is as follows:

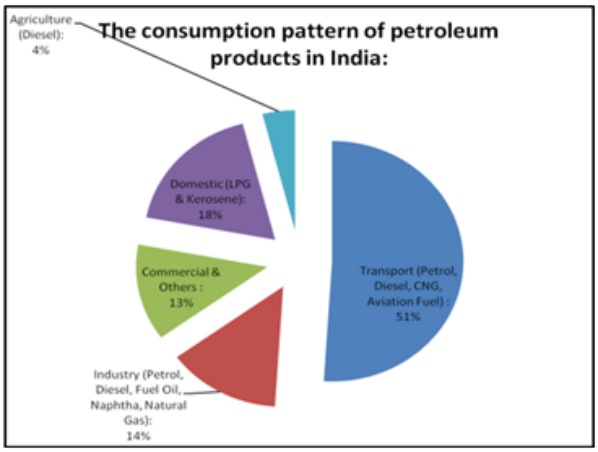

Figure 1: The Consumption pattern of petroleum products in India.

India spends maximum of its foreign earnings on importing crude oil for meeting its growing energy demand. On the other hand, Global warming is the looming concern today. CO2 is the largest contributor to the phenomenon of global warming and petroleum products are the largest source of CO2 emission into the environment. CO2 cannot be stopped being emitted from burning of petroleum products, but it certainly can be reduced to a great extent by way of efficient utilization of these products and that is where the role of PCRA critically comes into force.

Factors influencing the fuel wastage:

Driving Habits:

There are infinite variations that can affect the driving styles. Some factors that influence the driving techniques of the motorcyclist are

- Type of roads
- Weather Conditions; and
- Traffic flow

The type of roads and weather conditions are two things beyond the control of the motorcyclist. However, traffic flow can be improved and streamlined if the motorists, motorcyclists and pedestrians respect each other and avoid over speeding. Over speeding not only takes its toll in terms of fuel penalty but also increases risks for an accident.

Fuel can also be saved by strictly avoiding unnecessary

- Throttling
- Idling
- Use of clutch

Throttling: Frequent acceleration and braking consumes up to 50% extra fuel required to reach a particular destination if driving at a cruising speed of 45 km/hr. It causes excessive tyre wear and also reduces life of brake pads. Always accelerate gently and anticipate stops to avoid sudden braking.

Idling: Switch off motorcycle engine when not in use and avoid excessive throttling when waiting at traffic lights. Do not leave unattended motorcycle with engine idling, as this wastes fuel.

***Clutch**:* Using the clutch reduces a lot of useful power generated by engine and results in unnecessarily wasted fuel. Always use the clutch smoothly and only when necessary.

II. Test and Methodology

For estimating the fuel wastage at traffic signals in Jabalpur seven traffic signals of varying traffic congestion were selected, which were spatially distributed all over the city, out of which 1 were of heavy traffic, 3 medium traffic and 3 low traffic. The crossings have been recognized as low, medium and high with the criteria; low volume signal crossing <39,900 vehicles per day, medium Volume signal crossing 40,000 – 50,000 vehicles per day, and high volume signal crossing >50,000 vehicles per day. The crossing selected for the study were Damoh Naka signal crossing, Adhar Tal signal crossing, Malviya Chowk signal crossing, Medical signal crossing, Vijay Nager signal crossing, Rampur signal crossing, Bus Stand signal crossing. Adhar Tal chowk signal crossing, Malyiya chowk signal crossing, Rampur signal crossing counted as low volume signal crossing. Vijay Nagar signal crossing, Damoh Naka signal crossing, Medical signal crossing counted as medium volume signal crossing and Bus Stand signal crossing counted as high volume signal crossing.

A traffic volume count sheet was prepared including a detailed classification of vehicles. 11 motorized and 4 non-motorized vehicles were included in the study for the classified traffic volume count along with turning movements. The cars were classified into two category based on the fuel type and engine size fuel consumption. To know the direction wise traffic volume at the crossing a 12-hour classified traffic volume & turning movement survey was conducted at crossing. To assess the crossing with a motive of making people aware about the time left for signal to turn green and if the time is more than 12-15 seconds they can switch off their vehicles. This survey was conducted with an objective of estimating the effectiveness of Countdown Timers.

Test procedure for fuel wastage per unit time:

Fuel consumption investigations at idling flow measurement system comprising mileage calculating test kit (FP 213S detectors DF 210A flow meters supplied by M/s. Ono Sokki), Japan) has been employed for two wheelers including two stroke and four stroke engine. Whereas “Estimation of fuel loss during idling of vehicles at signalized intersections in Delhi: Mrs. Purnima Parida and S. Gangopadhyay” literature refer for fuel consumption studies of four wheelers, gaseous fuels like LPG and LPG (mostly LPG).

III. Results

Fuel wastage at traffic signals play an important role on environment, fuel crises, energy security and delay time in travel.

Estimation of Fuel Wastage in Jabalpur and MP:

Consider No. of traffic signal in Jabalpur = 25According to MP govt. report 2012, 50 numbers of districts has been formed including 10 division in MP (table 4.3). If consider the 25 traffic signals in Jabalpur, 45 traffic signals in Bhopal & Indore, 20 in Gwaliar, Narmada puram & Chambal, 15 in Ujjain, Itarsi & Sagar, 10 in Rewa & Shahdol, and remaining 39 district has at least 5 number of traffic signals. So, total number of congested traffic signals (traffic spot) in MP reached about = 435 (approx)

CO_2 emission from fuel wastage: in Jabalpur and MP

Table 1: Estimation of fuel wastage and fuel cost for Jabalpur and MP

Emission CO2	Petrol	Diesel	LPG
Fuel Wastage of Jabalpur of 25 square per Year(L)	207788L	133308L	91800kg
Emission CO2 in Kg	497028.9 Kg/year	351933.1 Kg/year	206733.6 Kg/year
Fuel Wastage in MP (435 Square) per Year (L)	3527964L	2317716L	1597320 Kg
Emission CO2 in Kg	8438889.8 Kg/year	618770.24 Kg/year	3597164.64 Kg/year

Table 2: Estimation of fuel wastage and fuel in Traffic Square for Jabalpur and MP

Traffic Square	Petrol	Diesel	LPG
Medical (Fire)	118.3	96.8	56.8
Vijay Nagar (Fire)	200.6	114.3	106.9
Bus Stand (Fire)	253.4	132.1	106.9
Rampur (Fire)	93.9	49.9	43.1
Adhartal (Fire)	114.6	108.5	55.9
Malviya Chowk (Fire)	171.9	93.2	73.8
Damoh Naka (Fire)	151.1	130.5	56.3
Total (7 Days Data) (Fires)	1103.8	725.5	499.8
Average (7 Days Data) (Fires)	157.7	103.6	71.4
Per day per square fuel wastage (fire)	22.5	14.5	10.2
Unit Rate	67	48	35
Total Cost 7 Days & 7 Square	73,954.6	34.824.2	17,493.1
1 Day Fires (7 Square)	157.7	103.6	71.4
Per day Fuel Cost Rs (7 Square)	10,566	4,973	2,499
For Jabalpur Per Month L (7Sq)	4,731	3,108	2,142
Per Month Fuel Cost Rs	3,16,977	1,49,184	74,970
Fuel Wastage of Jablpur 25 Sq per Day (L)	563.2	370.3	255
Fuel Wastage of Jabalpur of 25 Sq per Month (L)	16,899	11,109	7,650

Table 3: Estimation of fuel wastage and fuel Monthly and Yearly for Jabalpur and MP

Traffic Square	Petrol	Diesel	LPG
Fuel Wastage of Jabalpur of 25 square per Month in Rs	11,32,233	5,33,232	2,67,750
MP (435) Per Day L	9,799.9	6,438.1	4,437
MP (435) Per Month L	35,27,964	23,17,716	15,97,320
MP (435) Per Month Fuel Cost	1,96,97,799	92,70,864	46,58,850
MP (435) Per Year Fuel Cost	23,63,73,588	11,12,50,368	5,59,06,200

Table 4: Estimation of fuel wastage per week

TRAFFIC SQUARE	fuel wastage per week (in Litre)
MALYIYA CHOWK	338.89
DAMOH NAKA	337.89
MEDICAL	271.90
VIJAY NAGAR	492.427
BUS STAND	421.83
RAMPUR	186.9
ADHAR TAL	279.16
TOTAL	2329.0

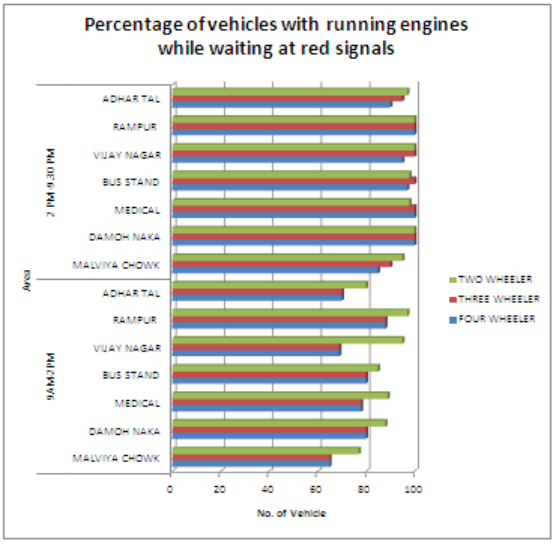

Figure 2: Percentage of vehicles with running engines while waiting at red signals

IV. CONCLUSIONS

The extra fuel consumption at the traffic signals because of the irresponsible behavior of the driver/rider is very much high. And also for starting the bike, fuel use as compared to that is much more less. So, the conclusion comes in mind that the rider should OFF his engine while at the traffic signals. Also, for less timing traffic signals i.e., of 10-15 seconds, the engine may be kept ON, but with-out unnecessary throttling. Because throttling consumes much more fuel. As also shown above about the emissions, there values are also much high. So, there should be an awareness of the pollutions caused and there stoppage. Mileage of a vehicle, very much depends upon habits of a person, who is driving / riding that vehicle. Smoother and controlled driving gives better results with mileage of vehicle. Driving habits, also very much effect the traffic flow. So the driving should be smooth and the traffic should be in a stream-line i.e., by maintained constant speeds and constant spacing between the adjacent vehicles, while driving.

REFERENCES:

[1] Esteban B, Baquero G, Puig R, Riba JR, Rius A. Is it environmentally advantage ousto use vegetable oil directly as biofuel instead of converting it to biodiesel?Biomass and Bioenergy 2011;35:1317e28.

[2] Agarwal AK. Biofuels (alcohols and biodiesel) applications as fuels for internal combustion engines. Progress in Energy and Combustion Science 2007;33:233e71.

[3] Bryant L. The development of the diesel engine. In: Technology and culture, vol. 17. The Johns Hopkins University Press; 1976. p. 432e46.

[4] Srivastava A, Prasad R. Triglycerides-based diesel fuels. Renewable & Sustainable Energy Reviews 2000;4:111e33.

[5] Wander PR, Altafini CR, Moresco AL, Colombo AL, Lusa D. Performance analysis of a mono-cylinder diesel engine using soy straight vegetable oil as fuel with varying temperature and injection angle. Biomass and Bioenergy 2011;35:3995e4000.

[6] Agarwal D, Agarwal AK. Performance and emissions characteristics of Jatrophaoil (preheated and blends) in a direct injection compression ignition engine.Applied Thermal Engineering 2007;27:2314e23.

[7] Purushothaman K, Nagarajan G. Performance, emission and combustion characteristics of a compression ignition engine operating on neat orange oil. Renewable Energy 2009;34:242e5.

[8] Devan PK, Mahalakshmi NV. A study of the performance, emission and combustion characteristics of a compression ignition engine using methylester of paradise oileeucalyptus oil blends. Applied Energy 2009;86:675e80.

[9] Agarwal AK, Dhar A. Comparative performance, emission and combustion characteristics of rice-bran oil and its biodiesel in a transportation diesel engine. Journal of Engineering for Gas Turbines and Power, Transactions of ASME 2010;132:064503-1e064503-4.

[10] Agarwal AK, Dhar A. Experimental investigation of preheated Jatropha oil fuelled direct injection compression

ignition engine: Part I, performance, emission and combustion characteristics. Journal of ASTM International 2010;7:1e13.

* * * * *