REDUCTION IN VEHICULAR POLLUTIONS BY THE USE OF CLEAN FUEL CNG IN BANGALORE MUNICIPAL TRANSPORT CORPORATION BUSES

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ABSTRACT

In this study the exhaust emissions emitted by the Diesel buses of Bangalore Municipal Transport Corporation have been calculated and suggested that the emission levels can be reduced drastically by the use of an alternative clean fuel CNG. The pollution loads have been calculated and compared by considering usage of the Compressed Natural Gas (CNG) in place of conventional diesel buses.

To carry out this study, the Bangalore Municipal Transport Corporation was considered and collected the required information such as the total number of buses, daily kilometres operated by the BMTC buses. Total diesel consumption every day was also collected. The BMTC buses use the diesel fuel and are responsible for largest amount of lead emissions and various other pollutants. These emissions are destroying the conducive Climatical conditions of the Bangalore city. The pollution loads have been calculated on the basis of information collected from the Central Pollution Control Board (CPCB), Environment Protection Agency and previous studies carried out in this regard by various important agencies. The use of CNG shows tremendous reduction in various pollutants in gm/km. By the use of CNG we can find 84% reduction in CO, 58% reduction in NOx and 97% reduction in PM. We can conclude that in Bangalore city (India) we can reduce CO to 9401.67 tons/year, NOx to 56797.44 tons/year and PM to 1729.917 tons/year.

Key Words: Pollutants, CNG, BMTC, Central Pollution Control Board, Emission.

I. INTRODUCTION

Bangalore is the capital city of Karnataka, one of the southern states of India, has recently emerged as the city of future India. It houses 5.8 million people (Census, 2011) in 600 sq.km. However, the rapid growth of the city during last two decades has crippled its infrastructure and polluted its air, water and soil. The air pollutants in the city of future are critically high (>90g/m^3) exposing the 5.7 million people living in this city to unhealthy levels. It is learnt from studies that in South Asia alone, it is estimated that every year 800000 people die prematurely from lung cancer, cardiovascular and respiratory diseases caused by outdoor air pollution, and 150000 of these deaths occur (Cohen et al. 2003). Proportionately, about 630 peoples in Bangalore die prematurely every year due to outdoor air pollution. There are total of 6122 Buses of Bangalore Municipal Transport Corporation running every day about 1288000 km with diesel fuel adding much more pollution to Bangalore air.

Apparently, serious efforts are needed to create awareness among the consumers to make their vehicles eco–friendly to reduce emissions in Bangalore city. There is also a need to exploit propane and other cleaner fuels and bio–diesel etc. Mainly the management of BMTC should introduce CNG as an alternative to Diesel fuel in their buses because of its many advantages which are as given below.

II. BENEFITS OF CNG

Urban smog reduction

It's safe and lighter-than-air; CNG is non-toxic and disperses quickly. It has a higher ignition temperature than gasoline and diesel fuel, which reduces the chances of accidental ignition.

Cost effective. Natural gas as a vehicle fuel actually costs less today than conventional gasoline

CNG burns cleaner and produces lower levels of harmful pollutants than gasoline or diesel vehicles

CNG vehicles reduce emissions of carbon monoxide and reactive hydrocarbons

CNG contains no particulates such as those associated with diesel fuel, and also reduces emissions of carbon dioxide - the principal "greenhouse" gas

Vehicle emissions are lower with natural gas than with gasoline because ignition temperatures are higher and combustion is more efficient

Engine maintenance cost can be reduced by extending time between oil changes because the particulate materials that are produced during the combustion cycle of gasoline engines and cause the engine oil to get dirty are not present in the CNG engine

Fewer environmental hazards compared to other fuels

It's the most practical. Natural gas is the most efficient feedstock for the production of hydrogen. It's part of an infrastructure that's convertible to hydrogen. CNG stations can easily be converted to hydrogen delivery due to their common properties.

III. NEED OF STUDY

Bangalore is the Capital city of the Karnataka State very much plagued today by environmental degradation. Particularly air pollution is alarming because of the high growth in vehicle population. Bangalore is the metropolitan city where commuters are primarily dependent on a road transport system. This has led to an enormous increase in the number of vehicles with the associated problems of traffic-congestion and an alarming increase in air pollution.

Therefore it is very much essential to guide the Bangalorians to switch over to various alternative fuels or to easily available fuels such as C.N.G., Auto-L.P.G, and L.N.G. to minimize the air pollution of Bangalore city.

IV. OBJECTIVES OF STUDY

The principal objective of this study is to suggest strategies for minimizing vehicular pollution in Bangalore city and the specific objectives are

To carry out relevant literature review

Collection of information related to various alternative fuels and their emission factors.

Collection of traffic data, Number of buses of BMTC, average daily running kilometre of BMTC and emission factors for various categories of vehicles and fuels.

Comparison of emission level of diesel fuelled buses with the alternative clean fuel CNG.

V. METHODOLOGY

The following methodology has been adopted for conducting the present study.

- The details of number of buses in BMTC have been collected.
- The average daily running kilometre of various buses was collected from BMTC.
- The emission levels of various class vehicles have been collected from Central Pollution Control Board, New Delhi and from other reliable sources.

VI. COLLECTION OF DATA

The following data has been collected from Bangalore Municipal Transport Corporation.

Table 1 BMTC at a Glance as on 16-06-2011

Every Day Traffic Revenue	Rs. 3.50 Crores
No of Schedules	5884
No of Vehicles	6111
Daily Service kms	12.88 Lakhs
No of trips	78642
No of buses under PPP	37 Buses
Infrastructure established	
Depots	35
Bus stations	47
Staff Employed	32544
Daily Passengers Carried	Around 4.3 million
Bus Staff Ratio	5.3
Bus Day 4th of Every Month	

(Source: http://www.bmtcinfo.com/site/BSBmtcAtGlance.jsp)

Table 2 Number of buses in all the depots of BMTC

BMTC	Number of buses
35 Depots	6122 buses

From Table 2, it is seen that the number of buses in all the three depots of BMTC consists of 6122 buses. All the buses are using diesel fuel

Table 3 The average running kilometre per day of various buses in all depots of BMTC

Number of Depots	Number of Buses in all the Depots	Operated kms/day
35	6122	12.88 Lakhs kms

Table 3 shows various depot buses running kilometre per day. About 6122 buses run 12.88 lakh kilometres/day.

From Table 2 and 3 it is seen that the total number of Depots in BMTC is about 35, the total number buses in all the depots of BMTC is about 6122 buses. All the buses are using diesel fuel. Every day BMTC operates about 1288000 km/day.

Table 4 Emission Benefits of Replacing Conventional Diesel with CNG in Buses/Trucks

Pollution Parameter Fuel	CO Gm/km	NOx gm/km	PM gm/km
Diesel	2.4	21	0.38
CNG	0.4	8.9	0.012
% Reduction	84	58	97

Source: Frailey *et al.* (2000) as referred in World Bank (2001b: 2)

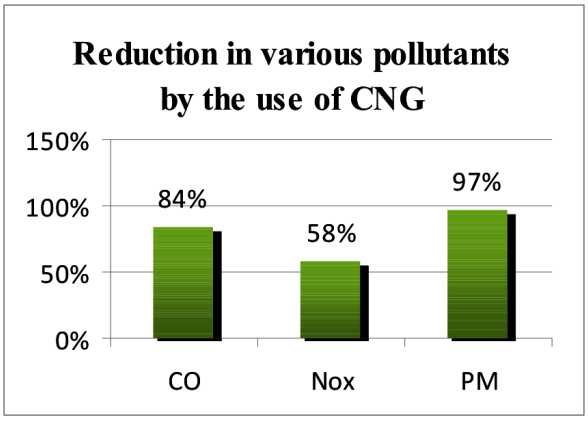

Fig. 1. Reduction in various pollutants by the use of CNG in place of Diesel fuel

VII. CALCULATION OF POLLUTION LOADS

This section describes the procedure for calculations of pollution loads. With the help of available data firstly the pollution load of CNG buses and diesel buses can be calculated for the Bangalore Municipal Transport Corporation. Now the calculation of pollution loads will be done on the basis of buses running km/day. All the calculated loads are as shown in the following tables.

Table 5 Comparative Pollution Load of Diesel and CNG Buses per day in Bangalore by BMTC

Pollution Parameter Fuel	CO in gm / 12.88 lakh km/day	NOx in gm / 12.88 lakh km/day	PM in gm / 12.88 lakh km/day
Diesel	2.4*1288000 = 3091200 = 3091.2 kg/day	21*1288000 =27048000 = 27048 kg/day	0.38*1288000 = 489440 = 489.4 kg/day
CNG	0.4*1288000 = 515200 = 515.2 kg/day	8.9*1288000 =11463200 =11463.2 kg/day	0.012*1288000 = 15456 = 15.45 kg/day

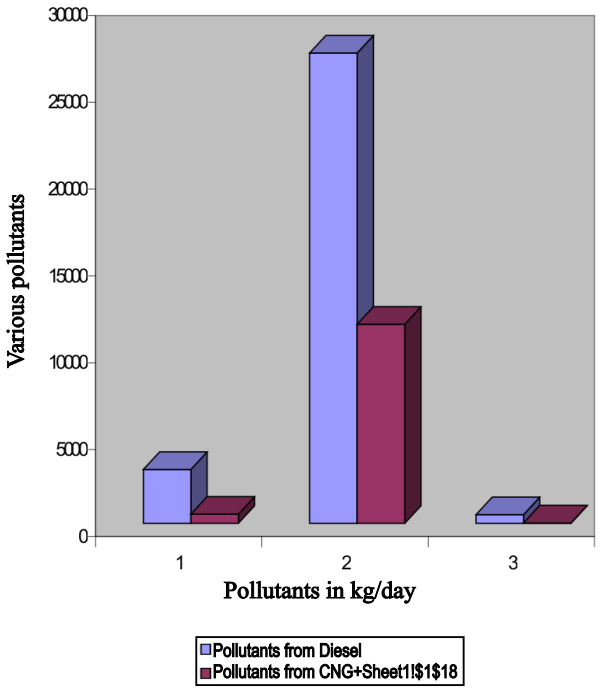

Fig. 2. Comparative reduction in pollutants of Diesel and CNG for 12.88 lakh km/day

Table 5 and Figure 2 shows Comparative Pollution load in kg/km of Diesel and CNG fuelled buses running 1288000 km/day. By referring table by the use of CNG in place of diesel fuel in BMTC buses we can say that we can reduce CO from 3091.2 kg/day to 515.2 kg/day, NOx can be reduced from 27048 kg/day to 11463.2kg/day and PM can be reduced from 489.4kg/day to as minimum as 15.45 kg/day.

Table 6 Comparative Pollution loads in ton/day of Diesel fuel and CNG fuelled buses of BMTC.

Pollution Parameter Fuel	CO in ton/day	NOx in ton/day	PM in ton/day
Diesel	3091.2 kg/day = 30.91 ton/day	27048 kg/day = 270.48 ton/day	489.4 kg/day = 4.894 ton/day
CNG	515.2 kg/day = 5.152 ton/day	11463.2 kg/day = 114.632 ton/day	15.45 kg/day = 0.1545 ton/day

By referring table 6 we can conclude that we can reduce CO to 25.79 tons/day, NOx to 155.85 tons/day and PM to 4.736 tons/day.

Table 7 Comparative Pollution loads in tons/year of Diesel fuel and CNG fuelled buses of BMTC.

Pollution Parameter Fuel	CO in ton/year	NOx in ton/day	PM in ton/day
Diesel	30.91*365 days = 11282.15	270.488*365 days = 98278.12	4.894*365 days = 1786.31
CNG	5.152*365 days = 1880.48	114.632*365 days = 41840.68	0.1545*365 days = 56.3925

By referring table 7 we can conclude that we can reduce CO to 9401.67 tons/year, NOx to 56797.44 tons/year and PM to 1729.917 tons/year.

VIII. CONCLUSION

1. By referring table 5 by the use of CNG in place of diesel fuel in BMTC buses it is concluded that we can reduce CO from 3091.2 kg/day to 515.2 kg/day, NOx can be reduced from 27048 kg/day to 11463.2kg/day and PM can be reduced from 489.4kg/day to as minimum as 15.45 kg/day.
2. By referring table 6 we can conclude that we can reduce CO to 25.79 tons/day, NOx to 155.85 tons/day and PM to 4.736 tons/day.
3. By referring table 7 we can conclude that we can reduce CO to 9401.67 tons/year, NOx to 56797.44 tons/year and PM to 1729.917 tons/year.

IX. RECOMMENDATIONS

This study gives in brief the causes of air pollution in Bangalore city by BMTC and suggests it to adopt CNG as an alternative fuel to curb the menace. From the instruments employed, it is evident that most developing countries including India have relied primarily on air pollution related regulatory instruments accordingly this has to be adopted by Bangalore city and BMTC. Recently, in many countries policy makers have initiated a shift from dedicated fuel efficiency and atmospheric pollution regulation to pure transport policies like road pricing, parking and collective transport. The shift has multi-facet benefit as it addresses both the pure transport related externalities like congestion; traffic accidents etc., and have a large beneficial impact on air pollution.

In fact, the containment of vehicular pollution requires an integrated approach, with following components:

(i) improvement of public transport system;

(ii) optimization of traffic and improvement in traffic management (e.g., area traffic control system, timers at intersection, no-traffic zone, green corridors, removal of encroachment on roads, regulation for digging of roads

(iii) comprehensive inspection and certification system for on-road vehicles;

(iv) phasing out of grossly polluting vehicles

(v) fuel quality improvement (e.g., use of benzene and aromatics in petrol, reduction of sulphur in diesel);

(vi) tightening of emission norms (e.g., EURO-IV);

(vii) improvement in vehicle technology (e.g., restriction on manufacturing of 2-stroke engines, emission warranty, on-board diagnostic system);

(viii) checking fuel adulteration; and

(ix) checking evaporative emissions from storage tanks and fuel distribution system.

Bangalore will have to get off the diesel route if the norms do not push application of clean diesel technologies and fuels. Eliminate economic incentives for owning and running diesel cars. Levy higher taxes on diesel to prevent use of cheap and poorer quality of diesel in cars, and persuade people to consider cleaner alternative fuel CNG. Apparently, serious efforts are needed to create awareness among the consumers to make their vehicles eco–friendly to reduce emissions. There is also need to exploit propane and other clean vehicle fuels & Bio–diesel etc.

An integrated transport policy should be implemented in a planned manner and projects like Bangalore metro to be fast tracked. As many as parents use car pools to drop their children at school, neighbours and office colleagues could do the same. People should walk to the neighbourhood market rather than driving elsewhere. Use pedal power-Cycle or a rickshaw- for short distances. Cars should be parked wherever one can hop on to the metro. Try to restrict the number of cars per household.

Significant number of old vehicles of Pre-Emission era are still on road, they are polluting more due to poor and improper maintenance. They should be replaced.

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