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Research Article

Motor Vehicle Exhaust Emissions in Delhi

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Abstract

Delhi is a rapidly expanding mega city. Population and vehicle use continue to expand, with vehicles being the principal source of severe air pollution. In the present study, we attempt to resolve the complications of Delhi's transport sector, exploring what kind of a future is likely to be and how it may be altered to ensure minimum environmental pollution. In the ultimate analysis, we were able to come out with a conceptual strategy, which if implemented in its entire suggested framework, has the potential of bringing down the current environmental pollution levels drastically and promises to be commercially viable too. In this paper some novel approaches to mitigate the Delhi's vehicular pollution are discussed.

Keywords: *Public Transport, Vehicle Emissions, Environmental Pollution.*

1. Introduction

Delhi, the capital city of India, is very much plagued today by environmental degradation. Ever since its declaration as national Capital City in 1911, there has been a steady influx of people from every nook and corner of the country. Rise in population and growth in economic activities had led to increase in pollution in Delhi. Delhi is perhaps the only metropolitan city in India where the commuters are primarily dependent on a single mode of transport, i.e., the road. This has led to an enormous increase in the number of vehicle (Bose R. K., 1998). But recently under close supervision from the Indian Supreme Court, Government of Delhi has implemented a wide array of policies that are reported to have improved air quality in Delhi.

One study estimated that Delhi wastes $300,000 in fuel daily through vehicles idling at traffic lights. Air pollution levels often exceeded several folds the ambient standards set by the Central Pollution Control Board, and are increasing. Local experts, planners, policy makers, and environmental advocates indicate that a large share of the problem with the transportation system in Delhi is that too many organizations are making disjointed decisions. While a draft bill has been proposed to enable the establishment of a unified metropolitan transport authority, there appears to be no serious effort to overcome this institutional handicap.

In recent years, a series of initiatives have been launched in Delhi to reduce vehicular emissions like augment public transport; adhere to progressively strength standards for fuels and vehicles; scrap old buses, taxis and auto-rickshaws; establish inspection and maintenance of in-use vehicles; and promote use of clean alternative fuels.

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These initiatives have come not from the legislative or executive branches of government, but by the recommendations of the Supreme Court of India, to enforce a constitutional provision that warrants a certain quality of life to all the residents of India. Supreme Court heard several environmental lawsuits, a series of successful public interest litigation applications filed in 1996 and 1997 (Urvashi Narayan and Alan Krupnick, 2007). In response, the Indian Ministry of Environment and Forests created the Environment Pollution Prevention and Control Authority (EPCA) in January 1998. The EPCA's mission is to reduce pollution in the National Capital Region. (Bose R. K., Sperling and Daniel, October 2001). It recommended the following strategies for immediately improving air quality.

- Augment public transport
- Reduce vehicle emissions by setting standards for fuels and auto emissions
- Establish inspection and maintenance of in-use vehicles
- Use clean alternative fuel
- Improvement of road and flyover
- Increase of subsidies on public transport
- Improvement of police transport
- Use of high capacity buses
- Accelerating the metro plan
- Improve motor vehicle technologies.

Table 1 depicts the relative growth of vehicles with reference to other transport infrastructure. Table 2 gives the Average lifetime emissions of Advanced Technology Vehicles.

Table 1: Growth of motor Vehicles in Delhi (Base year 1971)

Year	Population (Million)	Vehicles (Million)	Road Length (Km)	Density (Veh/Km)	(Veh/1000person)
1971	4.07	0.18	8380	21.48	44.27
1981	6.22	0.52	14316	36.39	83.76
1991	9.42	1.81	21564	84.08	192.44
2001	13.78	3.46	28508	121.26	250.82
2011	~16.0	5.8	35084	146.34	334
Growth factor	4	34.21	4.4	7.65	8.67

Table 2: Average lifetime emissions of Advanced Technology Vehicles

Type of Emissions	SULEV, Near-Zero Evap., High Deterioration Rate	SULEV, Near-Zero Evap., Standard Deterioration Rate	PZEV	ATPZEV (GHEV)	BPEV
Tailpipe[a]					
NMOG	0.015	0.007	0.007	0.007	0
NOx	0.030	0.025	0.024	0.024	0
Evaporative[a]					
NMOG	0.032	0.032	0.020	0.020	0
Indirect[b]					
NMOG	0.031	0.031	0.031	0.021	0.002
NOx	0.016	0.016	0.016	0.011	0.003
Total					
NMOG	0.078	0.070	0.058	0.048	0.002
NOx	0.046	0.041	0.040	0.035	0.003
NMOG+NOx	0.124	0.111	0.098	0.083	0.005

[a]Estimates are from CARB, 2000b, pp. 134-137.
[b]Estimates are from Unnasch, Browning, and Montano, 1996.

2. Vehicle Emissions

- Motor vehicle exhaust emissions can be divided into three categories: tailpipe (or exhaust), evaporative and indirect (or fuel-cycle). Distribution (i.e. emissions from local fuel stations and from the process of vehicle refueling).

The components of the vehicular emissions of Delhi are shown in figure 1-5. Figure 1 shows the composition of the different pollutants vehicle sources. Highest is CO which is about 53% followed by NOx and HC which are 23% each.

Evaporative Emissions

Evaporative emission standards are set for diurnal, hot-soak, resting, and running-loss emissions. Diurnal emissions are associated with the diurnal breathing of the fuel tank as the ambient air temperature rises and falls. Hot-soak emissions occur when the fuel system is exposed to high under-hood temperatures after the vehicle is turned off. Resting losses occur when the vehicle is turned off and the hot-soak period has passed. Running losses occur when the vehicle is in operation.

Indirect Emissions

Indirect or fuel-cycle emissions are those produced during creation and distribution of the fuel that powers the vehicles. They comprise all emissions up to the point at which the fuel is in the vehicle, which means those emissions produced during

- Extraction (feedstock extraction and transport)
- Production (e.g., oil refining or electricity generation)
- Marketing (e.g., fuel bulk storage, transportation, transmission, gaseous fuel compression)

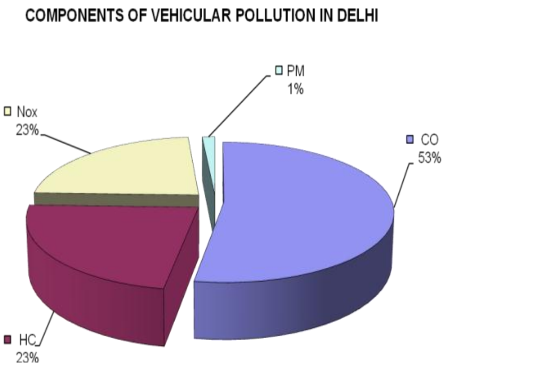

Figure 1: Composition of Vehicular exhausts Pollution in Delhi

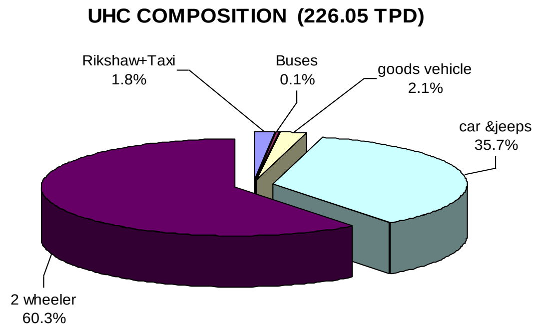

Figure 2: Composition of Vehicular Unburnt Hydrocarbon Pollution in Delhi

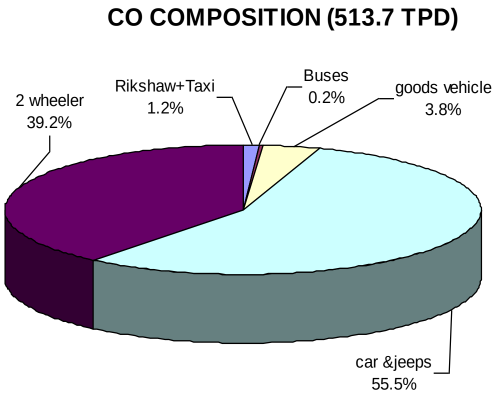

Figure 3: Composition of Vehicular Carbon MonoOxides Pollution in Delhi

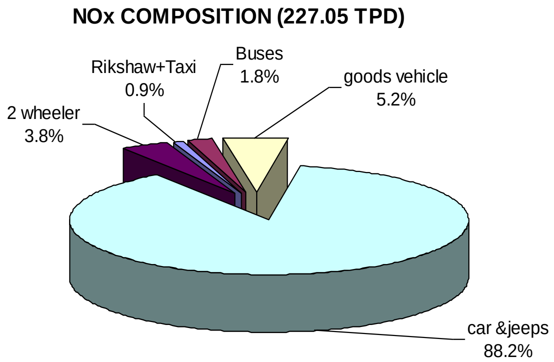

Figure 4: Composition of Vehicular Nitrogen Oxides Pollution in Delhi

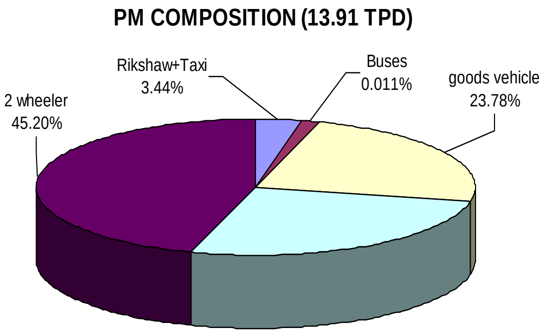

Figure 5: Composition of Vehicular Particulate Matter Pollution in Delhi

3. Main Strategic Control Options

In the ultimate analysis, we were able to come out with a conceptual strategy, which if implemented in its entire suggested framework, has the potential of bringing down the current environments pollution levels drastically and promises to be commercially viable too. Following are the appropriate actions needed for optimization of vehicle emissions in Delhi.

a. Improvement in public transport

This premised on strong local leadership that restrains vehicle use and creates a transportation system that is economically, environmentally, and socially sustainable for the long term. This is possible if ambitious initiatives are mounted in the near future to reduce vehicle and energy use.

The low emission level entails a shift away from current trends. It is a future of creativity, urban organization, efficient growth, and improved quality of life. Steps are taken to improve mass transit, in part to restrain the purchase of personal vehicles. If the planned bus ways and rail transit lines are completed on time in 2020-2021, ridership on high quality charter bus services expected to increases from 12 percent of total bus rider ship in 2000 to 18 percent in 2020, and continues to increase thereafter.

Innovative transport services are created to provide personalized transport services at less cost and greater system efficiency than cars. Ideally, they are linked to conventional transit services. Also an effort is needed to assure that vehicle owners pay their fair share of building and maintaining roads. These measures include an annual hike in registration fee tied to the size of the vehicle and engine efficiency of cleaner emissions.

b. CNG Conversion/ Vehicle Technology Improvement

The use of cleaner burning natural gas fuels by light duty vehicles is accelerated. All taxis and one-third of all personal cars are powered by CNG by 2005. By 2020, two-thirds of all cars run on CNG. All scooters switch from two-stroke to efficient four-stroke engines, and three-wheelers gradually shift to propane use (Sandhya Wakdikar,2002), (M N Karimi and B K Nath 2004). Advance vehicle technologies like CRDI, MPFI, VVT, DTSI etc. need to be used.

c. Increase the Subsidies on Public Transport

There are many ways to restrain the rapid growth in vehicle use in Delhi. Experience worldwide has shown that an approach aimed at both demand and supply is most effective. The demand approach discourages the use of personal vehicles and encourages the use of alternative modes. This can be accomplished by increasing the cost of driving to reflect the large infrastructure costs of accommodating vehicles and the costs they impose on the environment. Increased parking fees, fuel taxes, and registration fees and greater incentives for carpooling are options.

Creativity is needed in fashioning effective initiatives. One suggestion for mitigating opposition to new taxes and fees is a polluter-pays system that rewards environmentally friendly technologies and fuels while imposing charges on more polluting vehicles. Mass transit is often considered one of the best low-polluting alternatives to cars and motorcycles, and Delhi's investment in the multi-modal transit system of rail and bus ways enjoys strong support from policymakers.

d. Use of High Capacity Buses

Traffic management techniques such as downtown pedestrian zones, dedicated bus lanes, and traffic signals that favour buses could also be successful. Because earlier attempts at making downtown areas more pedestrian friendly have failed, future attempts would likely require education programs such as outreach to downtown shop owners. Traffic managers provide special dedicated lanes for private and public buses to increase their speed relative to personal vehicles.

e. Use of Non-Engined Systems

Use of Non-engined vehicles is encouraged to reduce pollution as well, mostly to serve the very poor who cannot afford even low-cost mass transit. Subsidies for bicycle use also slow the purchase and use of motorized vehicles by the more affluent. A network of protected lanes for bicycle use is provided, often separated from motorized vehicle roadways, to reduce congestion and increase the safety of bicycle riders. Subsidies for bicycle use also slow the purchase and use of motorized vehicles by the more affluent. A network of protected lanes for bicycle use is provided, often separated from motorized vehicle roadways, to reduce congestion and increase the safety of bicycle riders.

f. Promoting A/F vehicles

Compressed natural gas (CNG) and liquefied petroleum gases (LPG) and biodiesel, ethanol etc. are less expensive and environment friendly than diesel & gasoline. If vehicles are used intensively, the full lifecycle cost of owning and operating CNG and LPG vehicles will be less than for a comparable gasoline vehicle. However, the initial cost of a vehicle outfitted for these fuels, is somewhat greater due to the cost of the high-pressure tank needed to store the fuels.

g. Improvement of Roads and Flyovers

This has a special contribution to control vehicle emissions in Delhi. Improvement of roads and flyovers results in less traffic congestion, higher mileage and less time consumed in journey and hence lesser emissions. Though it requires a lot of funds and time but it will prove much more effective in long term.

Conclusions

Broadly speaking, the above mentioned policies if implemented fully in Delhi, certainly will lead to lower vehicle emissions. Similarly, the policy that led to the reduction in the sulfur content of fuel appears to have helped reduce air pollution by reducing PM_{10} and SO_2concentrations. The recent trend in Delhi toward an increase in the proportion of diesel-fueled cars also appears to be having somewhat of a mixed impact on air quality. While diesel-fueled cars have helped to reduce CO and SO_2, the latter because these cars are running on cleaner diesel, diesel cars also appear to be leading to an increase in PM_{10} and NO_2. Finally, we may conclude that no single strategy is applicable to Delhi, but an integrated approach including all above is the need of the hour.

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