

BS VI: Need in India

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Abstract— Rising air pollution is delivering perilous impacts on different territories like environment, wellbeing, and nature. Along these lines, there is a need to apply for preventive advances in most brief conceivable time. Thinking about this reality, the impacts of air pollution in the transportation area, Bharat Stage standards and impacts of updating from BS IV to BS VI we will confront are considered and discussed in this paper. This will make less demanding to comprehend the unpredictable innovation in straightforward dialect for individuals. What's more, the choice of government will be executed productively by all. Alongside this, we can guarantee that we will assist future age with breathing clean air.

Key words: BS Norms, Effects of BS VI, Air Pollution, Emission

I. INTRODUCTION

The growth rate of air pollution is very high all over the globe, causing a great destruction in ecological balance, human health, and climate change. WHO's an air quality guideline is not met by 98% of cities in low and middle-income countries while 56% in high-income countries. India has 33 cities out of 100 most polluted cities in the world, and 22 cities of top 50 most polluted ones.

Air pollution in India is distributed as Transportation Sector 14%, Buildings-Social Sector 6%, Energy Sector 25%, Agriculture Forestry Other Land Use & Waste Sector 21%, Industry Sector 21%, and Other Sector 13%. incomplete & inefficient combustion of fuel in vehicles, fuel adulteration, lack of broad roads & inefficient traffic control causing slow traffic, increase in the number of transport vehicles, non-maintenance of old transport vehicles, use of outdated combustion technology in vehicles, etc. [3]

The undesirable toxic substances in exhaust gases are hydrocarbons (HC) due to too rich or too lean mixture, operating temperatures below ignition, poor atomization, large fuel droplet size, and higher crevice volumes, carbon monoxide (CO) from incomplete combustion of carbon-containing fuels, inadequate oxygen availability and low cycle temperature, particulate matter (PM, mostly soot) due to sulphur in fuel aromatics and nitrogen oxides (NOx) from high temperature in combustion chamber i.e. more than 1300°C, excess air and poor combustion. [1]

Effects of air pollution vary from reduced visibility to cancers and death consists of increased mortality, morbidity and impaired pulmonary function, respiratory and cardiovascular diseases such as asthma, bronchitis, lung cancer, strokes and heart attacks. Lung function of Indians is 35% lower than Europeans. A fifth largest killer in India is air pollution. Health cost of air pollution takes out 3% from GDP of India. Ecology gets affected in Green House Effect which causes climatic disasters like climate change & imbalance, increase in global/local temperature, melting of polar ice, rising sea level, season shifts, droughts, ocean acidification, pests & diseases, etc.

Vehicles in Delhi are contributing 59%, 50% and 18% of overall emissions of CO, HC, and NOx respectively. On 19th Feb 2016 Ministry of road transport and highway, India issued notification of Bharat stage VI (BS-IV) which will be implemented from 1st April 2020 to address this serious issue. Compulsory usage of OBD in all kinds of vehicle, improved durability levels and requirements of fuel compatible with BS-VI are the key points in BS-VI.

II. THE JOURNEY OF BS NORMS

For first-time mass emission norms were enforced for petrol vehicles in 1991 and for diesel vehicles in 1992. The compulsion of the fitment of catalytic converters in petrol engine cars is done and thereby emission norms were tightened in 1996. Bharat Stage emission norms which are equivalent to Euro norms for all vehicles were first introduced in 2000. The maximum permissible emission limit for CO, HC, NOx, and PM is specified by these norms [3]

India is five years back in following the emission standards as compared to the European nations. From April 1, 2017 Sale and registration of vehicles which are not compliant with BS-IV emission norms have been banned across the country. Indian Government notified BS-I and BS-II (nearly equivalent to Euro I and Euro II norms) in 1999. Delhi had to follow BS-II while rest of India followed BS-I at that time. In April 2005, BS-III and BS-II fuel quality norms came into force for 13 major cities, and for the rest of the country respectively. BS-IV and BS-III fuel quality standards appeared from April 2010, in 13 noteworthy urban communities and whatever remains of India separately. BS-IV auto fuels are being provided as of now, all finished India.

A near timeline of incremental usage of emission standards in India, Europe, and China is displayed in Table 1.

Year	Europe	India	China
2000	Euro- 3	BS-I	China-I
2004			China-II
2005	Euro- 4	BS-II	
2007			China-III
2010	Euro- 5	BS- III	
2011			China-IV
2015	Euro- 6	BS- IV	
2018			China-V
2020		BS- V	
2024		BS- VI	

Table 1: Timeline of Incremental Implementation of Emission Standards in India, Europe and China [4]

III. BS VI NORMS

Upgrades on a step-by-step timeline have the potential to reduce vehicular PM and NOx emissions by 40% - 80%. India has been lagging behind in comparison with the other developing countries such as China, having already upgraded to the equivalent of Euro-5 emission norms a while ago. A strong case has been made by sector experts based on the measurement of in-use emissions data from Europe suggests

that Nox control in vehicles has been below design levels with Euro-5, and Euro-6 overcomes this as a superior performing standard. A subsequent investment of Rs 30,000 – 40,000 crore and 3-4 years of time for each stage of the upgrade is required for the staged upgrade of refineries' technologies. Considering all of these facts, the government finally concluded that transitioning directly to BS-VI from BS-IV is a better option than the incremental upgrade to BS-VI emission standards. Leapfrogging to BS-VI would position India ahead in the race for investments too.

So, on 6th January 2016, the Indian Ministry of Road Transport and Highways (MoRTH) decided to skip BS-V emission norms altogether and leapfrog directly from BS-IV to BS-VI norms by 1st April 2020 and will be applicable for each vehicle type, category, and sub-classes manufactured on or after 1st April 2020. BS-VI standards apply to light & heavy duty vehicles, as well as two & three-wheeled vehicles.

The expansion of type approval and in-service conformity test requirements for LDVs and HDVs is provided in BS-VI emission standard. Emission overall performance confirmed in laboratory testing is likewise maintained below actual-world driving situations will be ensured by using it.

For LDVs, world harmonized light-duty vehicles test procedure (WLTP) is adopted, for HDVs, the European Stationary Cycle (ESC) and European Transient Cycle (ETC) used for BS-IV type approval are replaced with the World Harmonized Steady-State Cycle (WHSC) and World Harmonized Transient Cycle (WHTC) respectively because the WLTP, WHSC, and WHTC are more delegates of certifiable driving conditions and better catch driving modes in which pollutant emissions can be raised. For LDVs and HDVs fitted with gasoline direct injection (GDI) and compression ignition (CI) engines particle number (PN) limits have been introduced, which makes the norms further more stringent. Inclusion of more enhanced on-board diagnostic (OBD) requirements and durability requirements for each vehicle type, category and subclasses therein are noteworthy points in BS-VI. At a minimum, 10% of the vehicle operating time OBD system monitors will be required to operate. The durability mileage for LDVs is set at 160,000 km in the BS-VI, which is a large increase from the 80,000 km requirement included in the BS-IV. The OBD system will ensure the efficient working of an engine by continuously monitoring and correcting the emission control devices. Durability will ensure the reliable & stable operation of the engine at its specification standard throughout its declared lifetime.

A table below is depicting the BS-IV and BS-VI emission standards for Light-Duty Vehicles.

Emission Standards for Light-Duty Vehicles								
Diesel Vehicle	Units	BS-IV Norms			BS-VI Norms			
		M & N1 Class	N1 Class II	N1 Class III	M & N1 Class	N1 Class II	N1 Class III	
CO	g/km	0.50	0.63	0.74	0.50	0.63	0.74	
HC	g/km	-	-	-	-	-	-	
HC+NO _x	g/km	0.30	0.39	0.46	0.17	0.195	0.215	
NOx	g/km	0.25	0.33	0.39	0.08	0.105	0.125	
PM	g/km	0.025	0.04	0.06	0.0045	0.0045	0.0045	
PN	#/km	-	-	-	6x10 ¹¹	6x10 ¹¹	6x10 ¹¹	

Petrol Vehicle	Units	BS-IV Norms			BS-VI Norms		
		M & N1 Class	N1 Class II	N1 Class III	M & N1 Class	N1 Class II	N1 Class III
CO	g/km	1.00	1.81	2.27	1.00	1.81	2.27
HC	g/km	0.10	0.13	0.16	0.10 ^a	0.13 ^b	0.16 ^c
HC+NO _x	g/km	-	-	-	-	-	-
NOx	g/km	0.08	0.10	0.11	0.06	0.075	0.082
PM	g/km	-	-	-	0.0045 ^d	0.0045	0.0045
PN	#/km	-	-	-	6x10 ^{11e}	6x10 ¹¹	6x10 ¹¹

Table 2: BS-VI standards for Light-Duty Vehicles [3]

The BS-VI emission standards for 2 and 3-wheeled vehicles are orchestrated for this present reality emission testing cycle and the meaning of bike classes with the UNECE Global Technical Regulation-2 (GTR-2) are furnished with independent limits for each class. Worldwide Harmonized Motorcycle Test Cycle (WMTC) would test the emissions. BS-VI norms for 2 wheeled vehicles are more stringent. Therefore, on per kilometer driven basis, 2-wheeled vehicles will be as clean as BS-VI gasoline passenger vehicles. With first-ever OBD specifications for 2 & 3-wheeled vehicles, there is enhanced OBD requirements for all vehicle classes. The durability mileage for 2 & 3-wheeled vehicles is set at 35,000 km in the BS-VI standards, which is a moderate increase from the 30,000 km requirement included in the BS-IV. The OBD system will ensure the efficient working of an engine by continuously monitoring the emission control devices and rectifying the associated problems. Durability (reliability) of pollution control devices will ensure the efficient working of an engine during its life tenure.

A table below is depicting the BS-IV and BS-VI emission standards for 2 and 3- wheeled vehicle.

Emission Standards for Two and Three Wheeler Vehicles					
CI Engine Vehicles	Units	BS-IV Norms		BS-VI Norms	
		Two Wheeler	Three Wheeler	Two Wheeler	Three Wheeler
CO	g/km	0.38	0.38	0.50	0.22
HC	g/km	-	-	0.10	0.10
NMHC	g/km	-	-	0.068	-
NOx	g/km	-	-	0.09	0.10
HC+NOx	g/km	0.38	0.38	-	-
PM	g/km	0.0425	0.0425	0.0045	0.025

SI Engine Vehicles	Units	BS-IV Norms		BS-VI Norms	
		Class 112-112-213-113-2	Class 112-112-213-113-2	Class 112-112-213-113-2	Class 112-112-213-113-2
CO	g/km	1.403/1.970/1.97	0.94	1.00	0.44
HC	g/km	-	-	0.10	0.35
NMHC	g/km	-	-	0.068	-
NOx	g/km	0.39/0.34/0.20	-	0.06	0.085
HC+NOx (Op1)	g/km	0.79/0.67/0.40	0.94	-	-
HC+NOx (Op2)	g/km	0.59/0.47/0.20	0.74	-	-
PM	g/km	-	-	0.0045 ^f	-

Table 3: BS-VI Standards for 2 and 3- Wheeled Vehicle [3]

Distinguished specification of reference and commercial gasoline and diesel fuels is required while transitioning from BS-IV to BS-VI. The maximum sulfur content of gasoline and diesel fuels is the most important parameter defined in the fuel quality specifications. Sulfur content is limited to a maximum of 10 ppm in the proposed BS-VI in both cases. Gasoline fuel must be having minimum Research Octane Number (RON) of 91/95, minimum Motor

Octane Number (MON) of 81/85, minimum Anti-Knock Index (AKI) of $AKI = (RON+MON)/2$ and maximum Olefins Volume of 21/18%, and diesel fuel must be having minimum Cetane Number of 51, Density at 15 deg of 820-860 kg/m³, 95% Distillation Boiling Point of 370 deg, maximum Polycyclic Aromatic Hydrocarbon (PAH) mass of 11% and minimum Flash Point, Abel of 35 deg. [3]

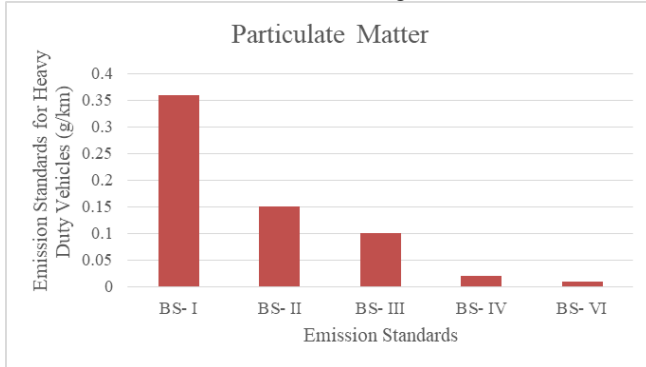


Fig 1: PM Emission Computation in Emission Standards [9]

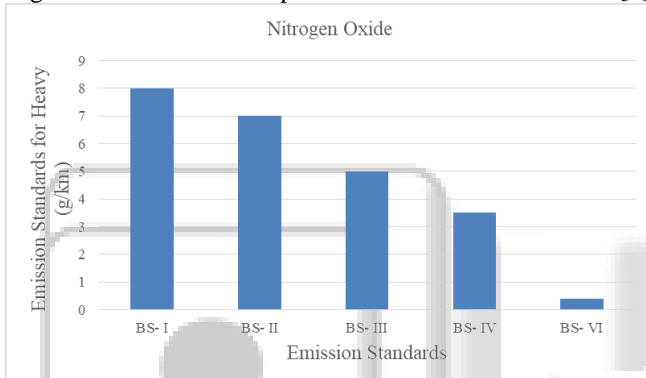


Fig 2: NO_x Emission Computation in Emission Standards [9]

IV. EFFECTS OF BS VI

According to the CSE, in case of cars, the particulate matter (PM) norm will reduce by 82% and nitrogen oxide (NO_x) by 68%; PM and NO_x emissions from two-wheelers will reduce by 89% and 76%, respectively; and PM and NO_x emissions from trucks and buses will drop by 50% and 89%, respectively in BS norms. [5, 7]

BS VI standards will chop down sulfur content to 10 sections for every million (ppm) from 50 ppm. Sulfur in the fuel adds to fine particulate matter emissions. High sulphur content in the fuel also leads to corrosion and wear of the automobile engine. BS VI standards will diminish the level of certain hurtful hydrocarbons in the discharges that are delivered because of the deficient burning of fuel. [6]

A. Advantages of BS VI over BS IV

This new emission standard will address one noteworthy downside in the Euro VI standard that permits outflow of higher PM (particulate issue) in diesel engines.

B. Major benefits of Bharat Stage VI norms

- OBD will be mandatory for every vehicle and it will help monitor the pollution caused by the vehicle in real time.

- RDE (Real Driving Emission) will be introduced for the first time that will measure the emission in real-world conditions and not just under test conditions.
- The way a particulate issue is estimated will be changed. It will now be estimated by number standard rather than the mass standard in this manner, controlling the fine particulate issue too.

The explanation for making OBD obligatory is to ensure that the emission control part work at its optimum efficiency consistently. OBD port will distinguish the glitch with the assistance of the error codes sent by the failing component. [9]

V. CONCLUSION

It is discovered that air pollution will be a noteworthy reason for death in India if not controlled in time. In this viewpoint, the legislature is taking endeavors since 2000 by actualizing BS standards. The choice of jumping BS V and executing of BS VI after BS IV will get a reduction in the harmful gases and the emissions can be controlled all the more precisely. It will likewise bring the change in automobile and fuel industry, which will be a test to procure changes inside a predefined time constraint given by the legislature

VI. FUTURE WORK

The investigation of BS VI fuels and after treatment gadgets incorporated into it can be the future work. Likewise, the impacts of BS VI on the vehicle business and the difficulties it will face can be examined in future.

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