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Technical Difficulties in Moving From BS-IV to BS-VI

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ABSTRACT:Automobiles emit a variety of exhaust gases and contaminants. The bulk of these gases are nitrogen (N₂), water vapor (H₂O), and carbon dioxide (CO₂) which are poisonous. Pollutants are referred to as harmful gases, i.e. carbon monoxide (CO) produced as a result of incomplete combustion, nitrogen oxides (NO_x) produced at high temperatures, hydrocarbons (HC) acquired from unburned hydrocarbons, particulate matter (PM, mostly soot) and sulfur oxides (SO_x) as a result of the sulfur content in fuel. India's Emission Policy was introduced in 1991 and has today entered a clear shift from BS IV standards to BS VI. This leapfrog fuel quality move has succeeded in undermining oil and car industry. The challenges faced by these industries for this transformation are addressed in this paper, based on technical understanding. The diesel particulate filter for diesel engines is critically evaluated for moving to BS V and the Selective Catalytic Reduction for BS VI. Systems likely to be commercialized for S.I engines that will help vehicles reach BS VI requirements are clarified. By this year an expenditure of Rs. 1.5 lakh crore by the automotive industry and Rs 80,000 crore by oil refineries will have to be made for upgrading to BS VI.

KEYWORDS:Bharat Stage Emission Norms, Diesel Particulate Filter, Oil Refineries, Particulate Matter, Selective Catalytic Reduction.

I. INTRODUCTION

At the backdrop of increasing industrial and motor vehicle air pollution, air quality is a global social problem. Although pollution originates from many different sources, vehicle emissions is a significant source of environmental air pollution there is an immediate need to monitor the level of vehicle pollution, particularly as there is and is likely to remain to be a substantial increase in the country's road vehicle traffic stock[1]. Throughout India, air pollution rates rose dramatically between 2000 and 2018. The government's decision to skip the Bharat Stage (BS) V standard and move directly to the BS-VI standard has disrupted the economies of two major industries, i.e. oil and automotive production[2]. Clearly, the world will financially benefit from this, and the finances of these two industries will decline. BS Emissions standards conceived 17 years down the line were intended to regulate air pollution from generators and diesels. The Central Pollution Control Board is the BS standards management body which has taken European legislation as its base point. BS IV pan-India's deadline was April 2017 and this deadline has been successfully achieved by both industries. According to the EPCA study, air pollution will become inevitable if more automobiles with poor quality fuels and technology are on the road. Under BS VI regulations, future engines will emit far less harmful emissions; they will be fuel-efficient and therefore cause no harm to the earth[3]. Throughout this paper methods that will be needed to shift to BS VI norms are discussed with the challenges facing the oil and automotive sector that will act as agents of change throughout the process.

II. BS EMISSION NORMS

Bharat Stage emission standards are guidelines that are developed by the Indian government to monitor the air pollutant rates from combustion engines. India has been adopting emission standards for five years compared to the European

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nations. Vehicles which do not comply with BS-IV emission standards have been banned from sale and registration throughout the country since 1 April 2017. Currently refineries provide BS VI fuel in India[4]. In 1991 India emission standards were introduced which were further upgraded in 1996. Because of this gradient most auto manufacturers had to implement changes to technology such as catalytic converters to reduce exhaust emissions. Considering the climate, fuel requirements were informed in April 1996 and were to be implemented by the year 2000. They were known by BIS 2000 model. In 1999, the Indian Government was notified on orders of the Supreme Court BS-I and Bharat Stage-II. Those norms were almost similar to Euro I and Euro II norms[5]. National Capital Region (NCR) at that time had to follow BS-II while the rest of India followed BS-I. For 13 major cities, BS-III and BS-II fuel quality standards came into force, and for the rest of the nation in April 2005, respectively, those action plans were in line with the 2013 Auto fuel policy. There after the implementation of BS-IV and BS-III fuel quality standards in 13 major cities and the rest of India from April 2010. BS-IV auto fuels are currently being supplied in India. Because of the exponential increase in air pollution leading to the risky life of the common man, the government decided that the country would shift from BS-IV directly to BS-VI fuel norms by April 1, 2020. Consequently, a draft notice amending the Central Motor Vehicle Rules 1989 was submitted for publication in the Gazette of India to the Government of India Press on 22.02.2016, giving the public 30 days ' time, inviting suggestions / comments on the notice before completing the notification. For the first time two-wheelers and three-wheelers were notified of particulate matter requirements in the notice. Because such, small particulate emissions will accumulate into a large particulate charge in big cities due to the large number of two wheelers[6]. A comparable timeframe is given in Fig. 1 for gradual adoption of emission standards in India, Europe and China.

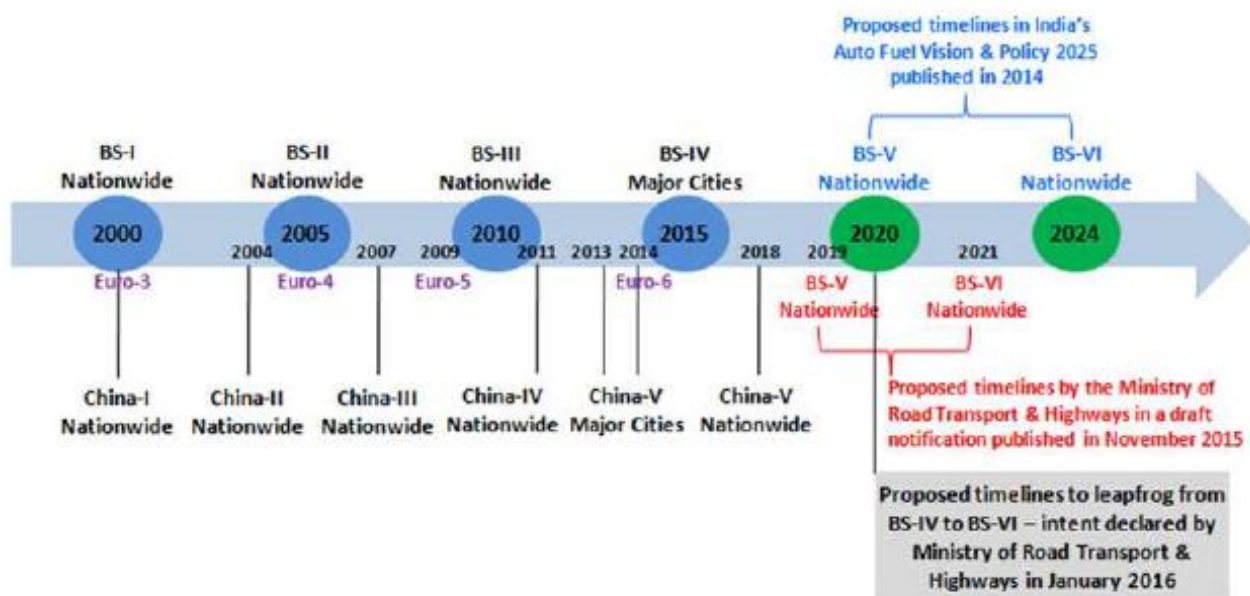


Fig. 1: Comparative Timeline of Incremental Implementation of Emission Standards

Tables 1 and 2 outlining the BS-IV and BS-VI emission standards for petrol and diesel vehicles presented a comparative view.



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Table 1: Petrol Engine Emissions in G/Km

Emission norm	CO	HC	NOx	PM
BS-III	2.3	0.2	0.15	na
BS-IV	1	0.1	0.08	na
BS-VI	1	0.1	0.06	$6 \times 10^{11\#}$

Number of particles per Km

Table 2: Diesel engine emissions in g/km

Emission norm	CO	HC	NOx	HC + NOx	PM
BS-III	0.64	na	0.5	0.56	0.05
BS-IV	0.5	na	0.25	0.3	0.025
BS-VI	0.5	na	0.06	0.17	$6 \times 10^{11\#}$

Analyzing the table, it is observed that there is no shift in the CO and HC emission values but the NOx and PM values for BS VI standards are on the lower side. NOx, HC + NOx and PM for BS VI requirements are reduced equally in diesel engine emissions. The NOx, HC + NOx and PM for BS VI standards are also reduced in diesel engine emissions. The data presented is for GVW<3.5 tons of M&N category vehicles. For BS VI standards Particulate matter is determined by the number of particles emitted per kilometer.

III. IMPROVEMENTS IN FUELS AND ADOPTED TECHNOLOGY

Emissions standards for Euro 5 and Euro 6 need to be enforced as soon as possible as diesel emissions close the gap with petrol emissions only at Euro 6 level to resolve the danger risk as per the Environment Pollution (Prevention and Control) Authority (EPCA) report. In BS IV and BS VI, the sulfur content is much lower than in BS III. In diesel, the sulfur content is gradually lowered from 350 ppm (parts per million) in BS III to 50 ppm in BS IV and 10 ppm in BS VI. In petrol, the sulfur level is reduced from 150 ppm to 50 ppm to 10 ppm[7].

Technology Involved:

Seven or eight different streams with content sulfur tend to range from 0 to 500 ppm are available in the diesel refineries. These streams are mixed in various ratios that add additional properties to make the final diesel components. So, all the streams will have to be hydro-treated when diesel with 50 ppm or petrol with 10 ppm is to be prepared. Sulfur has to be separated from various streams. This method of hydro-treatment is an established process of refinery to reduce sulfur and nitrogen[8]. A comparison chart compares proposed requirements for Indian gasoline to those of Euro 6 standards. Octane number and olefin quality, requirements for premium grade BS VI gasoline suit Euro 6 standards, for the criteria discussed here. Parameters of diesel fuel for which BS VI specifications vary from Euro VI requirements involve density, a boiling point of 95 percent distillation, and PAH content. Fig.2 shows the chart for diesel content.



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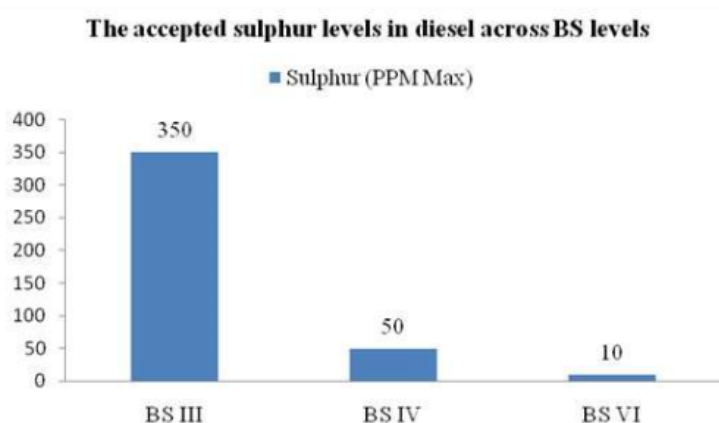


Fig. 2: Chart for Diesel Content

IV. CHALLENGES

- A) Octane 95 to 91 is preferred by automakers as it enables engines to give power. Major automaker Maruti Suzuki has also made repeated requests to parity refineries in Euro and BS standards for increased power and performance of engines[9].
- B) The Euro 6-compliant engines should be checked first in Indian conditions.
- C) According to the oil industry Euro VI cannot be blindly accepted because consequently LPG & Diesel demand will be brought down. Small changes from the Euro requirements could however mean an increase in domestic diesel production.
- D) Customers purchase vehicles from areas where BS IV is not acceptable as they carry and operate them in cities where BS IV is introduced so that BS II and BS III vehicles are still operating in urban areas i.e. where BS IV is in force. The solution to this is in government and authorities have to adopt a scrapping strategy to phase out vehicles that have engines with lower BS standards.
- E) Implementation at ground level: The implementing agencies will randomly select a vehicle from a dealer to comply with the revised standards and check the claim of the manufacturers. Emissions can be monitored in real time using portable pollution monitoring (PEMS) devices. It will help track the real running data on road vehicle emissions under approved limits.
- F) The Government should create maintenance and inspection centers to track vehicle roadworthiness.

V. ISSUES RELATING TO TECHNOLOGY UPGRADES FOR AUTOMOTIVE COMPANIES

- A) Agreements concerning engine technology have to be reviewed since few companies pay maintenance for engine technology. For some car companies, there are environmental problems.
- B) To engineering teams, there is a large increase in the workload which will have to work on critical issues relevant to stricter standards.
- C) Upgrade in vehicle dimension: The conversion would involve two new DPF and SCR equipment for which vehicle dimensions need to be modified. The move may result in higher taxes on the vehicles, as taxes are lower on cars that are less than 4 meters long. According to the BS VI standard, vehicles may need to cross a 4 meter mark which will resist the auto industry.
- D) Confirmation concerns as per Indian conditions: Vehicles must be fitted with a diesel particulate filter in BS-V, which needs to be configured for Indian roads. Phase VI involves the optimization of selective catalytic reduction technology. The technology would have to be validated over six lakh to seven lakh km at each point. These technologies can be optimized in series only, and not simultaneously, given the complexity of the process[10].



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VI. BENEFITS

When BSVI is adopted, a reduction of 89 per cent will be observed in the emissions of particulate matter from two-wheelers. Emissions of NO_x will also be decreased by 76%. For vehicles, it is estimated that 82 per cent of PM emissions and 68 per cent of NO_x emissions be reduced.

VII. CONCLUSION

From the study it can be inferred that both the emission-reducing technologies DPF and SCR need to be installed in the four-wheelers simultaneously in addition to skipping BS-V and moving directly to BS-VI, which is a time-consuming and money-consuming operation but has associated environmental advantages. Shifting straight to BS-VI within the prescribed time period is a major challenge for India's automotive and oil companies. In place of the old Carburetor system, the two and three wheelers will also have been fitted with Electronic Fuel Injection system to meet the BS-VI requirements. Technology updating, certification and consumer assimilation of this technology are some of the major challenges affecting the automotive industry. The major challenges facing the oil refineries are shortened time lines, selection of appropriate technology for refining, revamping of existing units and simultaneous delivery of two types of oil.

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