World Journal of Advanced Engineering Technology and Sciences
eISSN: 2582-8266
Cross Ref DOI: 10.30574/wjaets
Journal homepage: https://wjaets.com/

(Review Article)

A review of emission standards of some Asian countries

Vu Minh Dien *

Center for Automotive Technology and Driving Training, Hanoi University of Industry, Vietnam.

World Journal of Advanced Engineering Technology and Sciences, 2024, 12(01), 489–494

Publication history: Received on 02 May 2024; revised on 07 June 2024; accepted on 10 June 2024

Article DOI: https://doi.org/10.30574/wjaets.2024.12.1.0285

Abstract

The overall air quality has deteriorated in Vietnam over the last several decades, particularly in metropolitan regions. Vehicle emissions significantly contribute to the decline in air quality in these places. This article aims to evaluate the automobile emission requirements of Asia countries and compare them to Vietnam's emission regulations. Nevertheless, there are many disparities in the current emission limits implemented by various nations. For example, the emission rules in Korea are not biased towards any certain kind of fuel, and there is no distinct classification based on weight for light-duty vehicles (LDVs). Vietnam, Thailand, and Korea have distinct weight classifications and emission limitations for both petrol and diesel cars. Therefore, it is essential to do a more comprehensive study on the development of universally applicable emission standards that may be implemented globally. This will ensure consistency in the information and policies accessible to the general public.

Keywords: Vehicle emissions standard; Environmental pollution; Asia countries; Driving cycle; Fuel standard

1. Introduction

The emissions of air pollutants in East Asia make up a significant portion of the total world emissions. In their study, Cofala et al. found that East Asia is responsible for about 36%, 29%, and 36% of worldwide emissions of sulfur dioxide (SO2), nitrogen oxides (NOx), and particulate matter less than or equal to 2.5 µm (PM2.5), respectively [1]. These figures are much higher than the contributions of the United States and Europe. Furthermore, both computations of emissions and satellite measurements show that NOx emissions in China have significantly increased from 1995 to 2010, with yearly average growth rates ranging between 5.5% and 7% [2-3]. Consequently, emissions in East Asia have significantly deteriorated the air quality and visibility in the area al., 2012) and caused harm to human health [4-6]. Additionally, they impact air quality and climatic forcing beyond the local area because of the outflow that spreads across the Pacific. Given the circumstances, it is crucial to exercise authority over emissions in East Asia to enhance the regional and global atmospheric environment.

In order to enhance air quality and address climate change, East Asian nations such as China, Japan, and South Korea have implemented significant strategies to enhance energy efficiency and decrease air pollution emissions. These sanctions have often been strict and have been quickly intensified. From 2006 to 2010, China aimed to decrease energy consumption per unit of gross domestic product (GDP) and national sulfur dioxide (SO2) emissions by 20% and 10%, respectively, as stated by The State Council of the People's Republic of China in 2006. From 2011 to 2015, China aims to achieve further reductions of 16%, 10%, and 8% in energy usage per unit GDP, NOx emissions, and SO2 emissions, respectively, according to The State Council of the People's Republic of China (2011). Japan has implemented strategies to fulfill its obligations under the Kyoto Protocol, which stipulates that the country must reduce its yearly CO2 emissions by 6% compared to the levels recorded in 1990. The automobile emission rules in China, Japan, and South Korea have undergone many updates in the last decade. Several studies have examined the recent changes in emissions in East Asia, including specific countries in the region, as well as the impact of common control measures. For example, reductions

* Corresponding author: Vu Minh Dien.

in China's SO2 emissions since 2005 have been analyzed using satellite observations and estimates based on emission data.

2. Emission standards in Asia countries

Faced with the increase in traffic vehicles, accompanied by environmental pollution from these vehicles' emissions, countries worldwide have had roadmaps to reduce emissions following their economic and technological development. Fig.1 below shows the emission reduction roadmap for some Asian countries:

Country	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
European Union	E1	Euro 2					Euro 3				Euro 4			Euro 5					Euro 6	
Bangladesh[a]											Euro 2									
Bangladesh[b]											Euro 1									
Hong Kong, China	Euro 1		Euro 2				Euro 3					Euro 4			*Euro 5*					
India[c]							Euro 1				Euro 2					Euro 3				
India[d]					E1	Euro 2					Euro 3					Euro 4				
Indonesia											Euro 2									
Malaysia			Euro 1												*Euro 2*				*Euro 4*	
Nepal						Euro 1														
Pakistan	No conclusive information available																			
Philippines									Euro 1				Euro 2					*Euro 4*		
PRC[a]							Euro 1			Euro 2			Euro 3			Euro 4				
PRC[e]							Euro 1		Euro 2			Euro 3		Euro 4 Beijing only						
Singapore[a]	Euro 1						Euro 2													
Singapore[b]	Euro 1						Euro 2					Euro 4								
Sri Lanka									Euro 1				*Euro 2*[f]							
South Korea												Euro 4			Euro 5					
Taipei,					US Tier 1								US Tier 2 Bin 7[g]							
Thailand	Euro 1						Euro 2			Euro 3								Euro 4		
Viet Nam													Euro 2							

Source: CAI-Asia. 2008, Emission standards for new vehicles (light duty). Available: http://www.cleanairnet.org/caiasia/1412/articles-58969_resource_1.pdf

Figure 1 Emission standards of some countries around the world

The European Union has made the proper calculations and achieved the set goals. By 2014, the EURO will officially apply EURO VI standards. In some other countries, including Vietnam, using the standards proposed in the roadmap is still impossible for many reasons.

2.1. Thailand's emission standards

Thailand is a country whose economic and technological development situation is relatively similar to our country's situation. However, the Thai Government has also introduced stringent emission standards. The tables below show Thailand's emission standards:

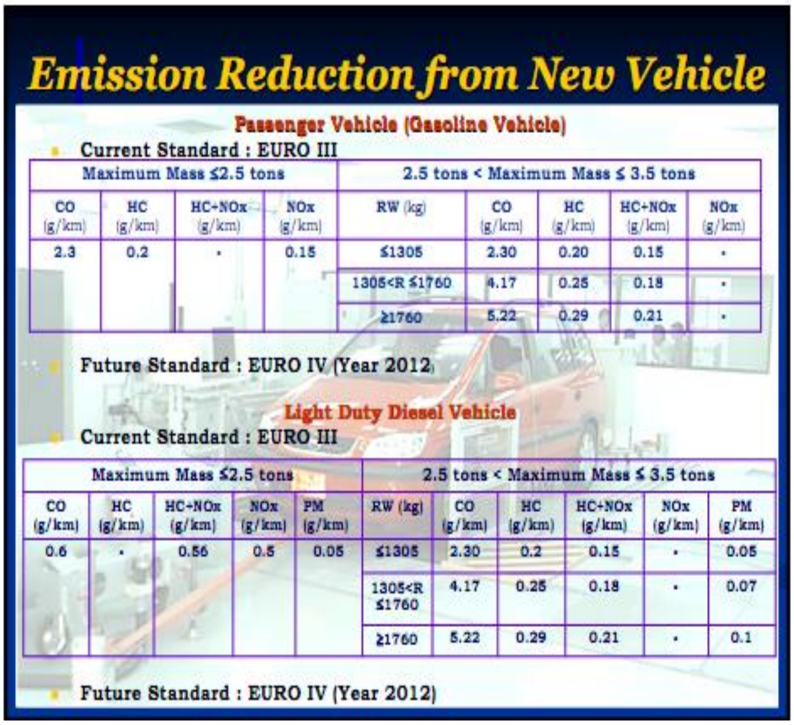

Figure 2 Thailand emission standards for light-duty vehicles

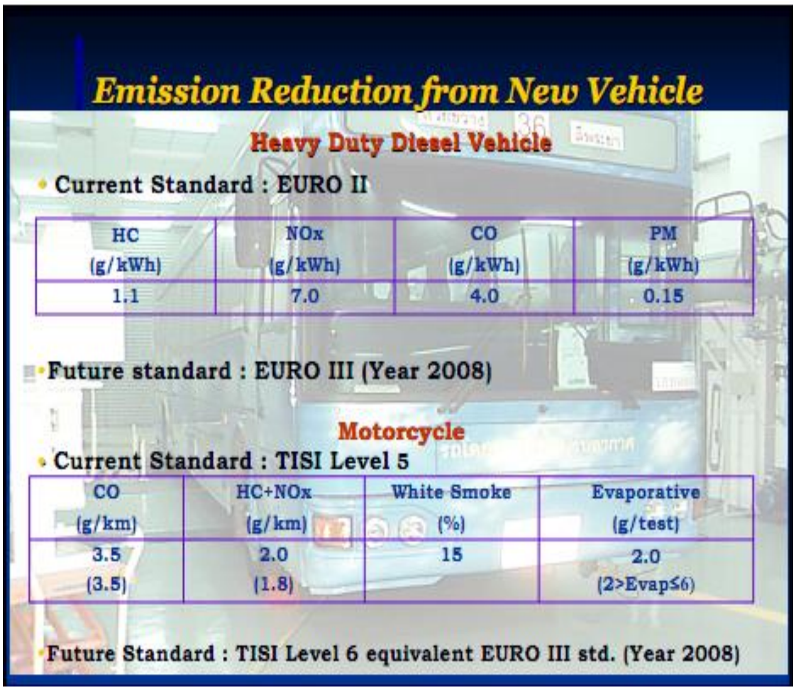

Figure 3 Thailand's emission standards for heavy-duty and motor vehicles

2.2. China's emission standards

China's emission standards follow European emission standards. Some large cities such as Beijing and Shanghai are always the first cities to be applied in the country given in Figure 4 and 5.

Reference	Date	Region	Comments
Euro 1	2000.01 (2000.07†)	Nationwide	
Euro 2	2002.08	Beijing	
	2003.03	Shanghai	
	gasoline: 2004.07[a] (2005.07†) diesel: 2003.09	Nationwide	
Euro 3	2005.12	Beijing	European OBD from 2006.12
	2006.10	Guangzhou	With European OBD
	2007.01	Shanghai	With European OBD
	2007.07	Nationwide	EOBD: Type 1 2008.07; Type 2 2010.07
Euro 4	gasoline: 2008.03 diesel: 2007.01	Beijing	
	2010.07	Nationwide	

Figure 4 Emission standards for cars and light trucks

Reference	Date	Comments
Euro I	2000.09	
Euro II	2003.09 (2004.09†)	
Euro III	2008.01	Beijing region: 2005.12
Euro IV	2010.01	Beijing region: 2008.01
Euro V	2012.01[a]	

Figure 5 Emission standards for heavy vehicle

Euro I and II standards are tested according to the ECE R49 13 mode cycle, and other standards are tested according to the ESC, ETC, and ELR cycles.

The required response time is generally shorter than the corresponding Euro standard: For vehicles with a mass of ≥ 3500 kg, it is 80,000km/5 years; for vehicles with a mass of ≤ 7500 kg, it is 100,000 km/5 years; for vehicles with a mass of ≥ 7500 kg is 250,000 km/6 years.

- The limit on sulfur content S ≤ 500 ppm has been applied throughout China since 2004. From January 2008, the limit in Beijing city is S ≤ 50 ppm.

2.3. Korean emission standards

Korea has a strong economy and a highly developed automobile industry. Therefore, Korea's emission standards are relatively strict. In Korea's emission regulations it follows both US and European standards:

Korea's emission standards for passenger cars (under six seats and mass <2,500 kg) are given in Figure 6 and 7. Standards for light trucks (<3,000 kg) are given in table (2.4).

FTP-75 cycle, and the emission unit is g/km:

Date	CO	HC	NMHC	NOx	PM	Smoke
-	g/km					%
1993.1.1	2.11	0.25	-	0.62	0.12	
1996.1.1	2.11	0.25	-	0.62	0.08	
1998.1.1	1.50	0.25	-	0.62	0.08	
2000.1.1	1.20	0.25	-	0.62	0.05	20%
2001.1.1	0.5	-	0.01	0.02	0.01	20%
2002.7.1	0.5	-	0.01	0.02	0.01	15%

Figure 6 Korean emission standards for cars running on diesel fuel

Date	CO	HC	NOx	PM
-	g/km			
1993-1997				
1993.1.1	980†	670†	350† IDI 750† DI	-
1996.1.1	6.21	0.50	1.43	0.31
1998 and later, LW<1,700 kg				
1998.1.1	2.11	0.25	1.40	0.14
2000.1.1	2.11	0.25	1.02	0.11
2004.1.1	1.27	0.21	0.64	0.06
1998 and later, LW>1,700 kg				
1998.1.1	2.11	0.50	1.40	0.25
2000.1.1	2.11	0.50	1.06	0.14
2004.1.1	1.52	0.33	0.71	0.08

Figure 7 Korean emission standards for light trucks using Diesel fuel

The Korean government will apply Euro IV standards for cars and light trucks using diesel fuel from January 2006 and California ULEV standards for gasoline vehicles.

Korean standards for heavy trucks using Diesel fuel (> 3000 kg) are given in Figure 7. Some truck types have additional smoke measurements that are not shown in Figure 7. Since 1996, the test cycle has been the Japanese cycle with 13 modes, and the emission unit is g/kWh in 2003 according to Euro III standards.

2.4. Vietnam's emission standards

More than 40 million motorbikes and over 1.5 million cars are in circulation, with fuel quality still low compared to other countries in the region and the world, causing emissions to affect the air, environment and health adversely.

To minimize the risks of environmental pollution, in addition to innovating vehicle quality, Vietnam needs to apply higher standards for gasoline quality in accordance with Euro III and Euro emission standards. IV in the period up to 2020. However, the roadmap to achieve this goal is not an easy problem.

Before 2000, the whole country used leaded gasoline for motor vehicles with a lead content of 0.15g/l and sulfur of 1500 ppm. Facing the risk of increasingly serious air pollution in big cities, the main cause is the amount of exhaust gas emitted by motor vehicles along with the trend of improving gasoline quality in the region and the world. From July 1, 2001, Vietnam started using unleaded gasoline RON 90, 92, and 95, according to TCVN 6776:2000.

Since 2005, to implement the roadmap to apply emission standards according to EURO 2, the Ministry of Science and Technology has published QCVN 1:2007/BKHCN on gasoline and diesel fuel to reduce toxic components in gasoline, especially sulfur, to ensure EURO II compliance.

Implementing the government's policy of developing biofuels, in 2007, the Ministry of Science and Technology successively announced National Standards TCVN 7717:2007 on denatured fuel Ethanol for mixing into unleaded gasoline; TCVN 7716:2007 base biodiesel fuel (B100) for mixing diesel fuel. On that basis, National Standards for E5 gasoline (TCVN 8063:2009) and B5 fuel (TCVN 8064: 2009) were also developed and announced. Up to now, the standards for gasoline, diesel, and biofuels have been uniformly announced by the Ministry of Science and Technology in QCVN 1:2009/BKHCN.

Since July 2007, fuel used for vehicles that meet EURO II emission standards has been applied in Vietnam with a sulfur content of 500 ppm for both gasoline and diesel. However, compared to other countries in the region, it is still very high, for example Thailand (150 ppm), Japan (50 ppm) for gasoline and Thailand (350 ppm) Japan (50 ppm) for diesel.

At the end of 2009, regulators emphasized that Vietnam needed to tighten petroleum quality further. If we do not change during this time, our country will face more difficulties in the future because when the economy truly integrates, Vietnam will be a market for high-quality motor vehicles. And therefore, the gap between Vietnam and other countries will be increasingly widened.

With the support of the United Nations Center for Regional Development (UNCRD), the Ministry of Natural Resources and Environment, together with the Ministry of Transport, implemented the project "supporting the development of a national strategy for sustainable and friendly transportation" with the environment" (ETS). One of the goals of ETS is that by 2020, Vietnam will apply EURO IV standards, and by 2024, EURO V will have sulfur content lower than 50 ppm and ten ppm.

3. Conclusion

Since vehicular emissions are one of the significant factors in the deteriorating ambient air quality of nations worldwide, the origin and evolution of vehicular emission standards came into existence. Due to differences in infrastructure, climatic conditions, and the quality of transportation, countries need to have appropriate emission standards to control emissions effectively.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Reference

[1] Supplemental Federal Test Procedure calculations, 40 CFR Ch. I (7–1–12 Edition), 86.164–08, United States Environmental Protection Agency, (2012.

[2] Costas Varotsos, Maria Efstathiou, Chris Tzanis and Despina Deligiorgi, On the limits of the air pollution predictability: the case of the surface ozone at Athens, Greece. Environmental Science and Pollution Research, 19 (2012) 295–300.

[3] Arthur P. Cracknell, and Costas A. Varotsos, New aspects of global climate-dynamics research and remote sensing, International Journal of Remote Sensing 32.3 (2011): 579-600.

[4] Watson, A.Y., Bates, R.R. and Kennedy, D., Asthma and Automotive Emissions, Air Pollution, the Automobile, and Public Health, National Academies Press (US), (1988).

[5] India Bharat Stage VI Emission Standards: Policy Updates. TheInternational Council on Clean Transportation. April 2016

[6] L. Contreras and C. Ferri, Wind-sensitive interpolation of urban air pollution forecasts. Procedia Computer Science, 80 (2016) 313–323.