Euronorms-Developments

Kanchan Bala[1]
[1]Department of Applied Science
St. Andrews Institute of Technology & Management (Affiliated to M.D.U, Rohtak) ukhnagar, Gurgaon, Haryana, India

Abstract— This paper reviews the importance of Emission standards. These are requirements that set specific limits to the amount of pollutants that can be released into the environment. Many emissions standards focus on regulating pollutants released by automobiles (motor cars) and other powered vehicles by different countries, European norms one of it which is acceptable all over the world including India. Present paper reviews on development of these norms and what are the challenges being faced in the implementation of these norms and what improvements required going forward.

Keywords— Pollutants, automobiles

I. INTRODUCTION

European emission standards define the acceptable limits for exhaust emissions of new vehicles sold in EU member states. The emission standards are defined in a series of European Union directives staging the progressive introduction of increasingly stringent standards.[1-5] Currently, emissions of nitrogen oxides (NOx), total hydrocarbon (THC), non-methane hydrocarbons (NMHC), carbon monoxide (CO) and particulate matter (PM) are regulated for most vehicle types, including cars, lorries, trains, tractors and similar machinery, barges, but excluding seagoing ships and aeroplanes. For each vehicle type, different standards apply. Compliance is determined by running the engine at a standardised test cycle. Non-compliant vehicles cannot be sold in the EU, but new standards do not apply to vehicles already on the roads. No use of specific technologies is mandated to meet the standards, though available technology is considered when setting the standards. New models introduced must meet current or planned standards, but minor lifecycle model revisions may continue to be offered with pre-compliant engines .[6-7]

II. DEVELOPMENTS

A. *Emission standards for passenger cars*

Emission standards for passenger cars and light commercial vehicles are summarised in the following tables. Since the Euro 2 stage, EU regulations introduce different emission limits for diesel and petrol vehicles. Diesels have more stringent CO standards but are allowed higher NO_x emissions. Petrol-powered vehicles are exempted from particulate matter (PM) standards through to the Euro 4 stage, but vehicles with direct injection engines will be subject to a limit of 0.005 g/km for Euro 5 and Euro 6. A particulate number standard (P) or (PN) is part of Euro 5 and 6, but is not final. The standard is to be defined as soon as possible and at the latest upon entry into force of Euro 6.[8,15]

All dates listed in the tables refer to new type approvals. The EC Directives also specify a second date — one year later — which applies to first registration (entry into service) of existing, previously type-approved vehicle models.

*B. European emission standards for **passenger cars** (Category M*), g/km*

Tier	Date	CO	THC	NMHC	NO_x	HC+NO_x	PM	P***
Diesel								
Euro 1†	July 1992	2.72 (3.16)	-	-	-	0.97 (1.13)	0.14 (0.18)	-
Euro 2	January 1996	1.0	-	-	-	0.7	0.08	-
Euro 3	January 2000	0.64	-	-	0.50	0.56	0.05	-
Euro 4	January 2005	0.50	-	-	0.25	0.30	0.025	-
Euro 5	September 2009	0.50	-	-	0.180	0.230	0.005	-
Euro 6 (future)	September 2014	0.50	-	-	0.080	0.170	0.005	-
Petrol (Gasoline)								
Euro 1†	July 1992	2.72 (3.16)	-	-	-	0.97 (1.13)	-	-
Euro 2	January 1996	2.2	-	-	-	0.5	-	-
Euro 3	January 2000	2.3	0.20	-	0.15	-	-	-
Euro 4	January 2005	1.0	0.10	-	0.08	-	-	-

Euro 5	September 2009	1.0	0.10	0.068	0.060	-	0.005**	-
Euro 6 (future)	September 2014	1.0	0.10	0.068	0.060	-	0.005**	-

* Before Euro 5, passenger vehicles > 2500 kg were type approved as light commercial vehicles N_1-I
** Applies only to vehicles with direct injection engines
*** A number standard is to be defined as soon as possible and at the latest upon entry into force of Euro 6
† Values in brackets are conformity of production (COP) limits

Like wise different standard has been made for different types of vehicles such as lories,busesand light commercial vehicles,. Emission standards for light commercial vehicles

C. European emission standards for light commercial vehicles ≤1305 kg (Category N_1-I), g/km

Tier	Date	CO	THC	NMHC	NO_x	$HC+NO_x$	PM	P
Diesel								
Euro 1	October 1994	2.72	-	-	-	0.97	0.14	-
Euro 2	January 1998	1.0	-	-	-	0.7	0.08	-
Euro 3	January 2000	0.64	-	-	0.50	0.56	0.05	-
Euro 4	January 2005	0.50	-	-	0.25	0.30	0.025	-
Euro 5	September 2009	0.500	-	-	0.180	0.230	0.005	-
Euro 6	September 2014	0.500	-	-	0.080	0.170	0.005	-
Petrol (Gasoline)								
Euro 1	October 1994	2.72	-	-	-	0.97	-	-
Euro 2	January 1998	2.2	-	-	-	0.5	-	-
Euro 3	January 2000	2.3	0.20	-	0.15	-	-	-
Euro 4	January 2005	1.0	0.10	-	0.08	-	-	-
Euro 5	September 2009	1.000	0.100	0.068	0.060	-	0.005*	-
Euro 6	September 2014	1.000	0.100	0.068	0.060	-	0.005*	-

* Applies only to vehicles with direct injection engines

D. European emission standards for light commercial vehicles 1305 kg – 1760 kg (Category N_1-II), g/km

Tier	Date	CO	THC	NMHC	NO_x	$HC+NO_x$	PM	P
Diesel								
Euro 1	October 1994	5.17	-	-	-	1.4	0.19	-
Euro 2	January 1998	1.25	-	-	-	1.0	0.12	-
Euro 3	January 2001	0.80	-	-	0.65	0.72	0.07	-
Euro 4	January 2006	0.63	-	-	0.33	0.39	0.04	-
Euro 5	September 2010	0.630	-	-	0.235	0.295	0.005	-
Euro 6	September 2015	0.630	-	-	0.105	0.195	0.005	-
Petrol (Gasoline)								
Euro 1	October 1994	5.17	-	-	-	1.4	-	-
Euro 2	January 1998	4.0	-	-	-	0.6	-	-
Euro 3	January 2001	4.17	0.25	-	0.18	-	-	-
Euro 4	January 2006	1.81	0.13	-	0.10	-	-	-
Euro 5	September 2010	1.810	0.130	0.090	0.075	-	0.005*	-
Euro 6	September 2015	1.810	0.130	0.090	0.075	-	0.005*	-

* Applies only to vehicles with direct injection engines

E. European emission standards for light commercial vehicles >1760 kg max 3500 kg. (Category N_1-III & N_2), g/km

Tier	Date	CO	THC	NMHC	NO_x	$HC+NO_x$	PM	P
Diesel								

Euro 1	October 1994	6.9	-	-	-	1.7	0.25	-
Euro 2	January 1998	1.5	-	-	-	1.2	0.17	-
Euro 3	January 2001	0.95	-	-	0.78	0.86	0.10	-
Euro 4	January 2006	0.74	-	-	0.39	0.46	0.06	-
Euro 5	September 2010	0.740	-	-	0.280	0.350	0.0005	-
Euro 6	September 2015	0.740	-	-	0.125	0.215	0.0005	-
Petrol (Gasoline)								
Euro 1	October 1994	6.9	-	-	-	1.7	-	-
Euro 2	January 1998	5.0	-	-	-	0.7	-	-
Euro 3	January 2001	5.22	0.29	-	0.21	-	-	-
Euro 4	January 2006	2.27	0.16	-	0.11	-	-	-
Euro 5	September 2010	2.270	0.160	0.108	0.0082	-	0.005*	-
Euro 6	September 2015	2.270	0.160	0.108	0.0082	-	0.005*	-

* Applies only to vehicles with direct injection engines

F. Emission standards for lorries and buses

Whereas for passenger cars, the standards are defined by vehicle driving distance, g/km, for lorries (trucks) they are defined by engine energy output, g/kWh, and are therefore in no way comparable. The following table contains a summary of the emission standards and their implementation dates. Dates in the tables refer to new type approvals; the dates for all type approvals are in most cases one year later (EU type approvals are valid longer than one year). [9,10]

The official category name is heavy-duty diesel engines, which generally includes lorries and buses.

G. EU Emission Standards for HD Diesel Engines, g/kWh (smoke in m^{-1})

Tier	Date	Test cycle	CO	HC	NO_x	PM	Smoke
Euro I	1992, < 85 kW	ECE R-49	4.5	1.1	8.0	0.612	
	1992, > 85 kW		4.5	1.1	8.0	0.36	
Euro II	October 1996		4.0	1.1	7.0	0.25	
	October 1998		4.0	1.1	7.0	0.15	
Euro III	*October 1999 EEVs only*	*ESC & ELR*	*1.0*	*0.25*	*2.0*	*0.02*	*0.15*
	October 2000	ESC & ELR	2.1	0.66	5.0	0.10 0.13 *	0.8
Euro IV	October 2005		1.5	0.46	3.5	0.02	0.5
Euro V	October 2008		1.5	0.46	2.0	0.02	0.5
Euro VI	31 December 2013[19]		1.5	0.13	0.4	0.01	

* for engines of less than 0.75 dm^3 swept volume per cylinder and a rated power speed of more than 3,000 per minute. EEV is "Enhanced environmentally friendly vehicle".

H. Emission standards for Large Goods Vehicles

Euro norm emissions for category N3, EDC, (2000 and up)					
Standard	**Date**	**CO (g/kWh)**	**NO_x (g/kWh)**	**HC (g/kWh)**	**PM (g/kWh)**
Euro 0	1988 – 1992	12.3	15.8	2.6	none
Euro I	1992 – 1995	4.9	9.0	1.23	0.40
Euro II	1995 – 1999	4.0	7.0	1.1	0.15
Euro III	1999 – 2005	2.1	5.0	0.66	0.1
Euro IV	2005 – 2008	1.5	3.5	0.46	0.02
Euro V	2008 – 2012	1.5	2.0	0.46	0.02

Euro norm emissions for (older) ECE R49 cycle					
Standard	**Date**	**CO (g/kWh)**	**NO_x (g/kWh)**	**HC (g/kWh)**	**PM (g/kWh)**
Euro 0	1988 – 1992	11.2	14.4	2.4	none
Euro I	1992 – 1995	4.5	8.0	1.1	0.36
Euro II	1995 – 1999	4.0	7.0	1.1	0.15

I. What is India's role in reducing air emissions?

In India, the government adheres to Euro norms for available fuel quality and testing method. A Euro compliant car will focus on carburetor retuning, secondary air intake and exhaust gas recirculation. [11,12]The Automobile Research Institute (ARAI), Pune, issues a third party authenticity certificate guaranteeing the Euro norm compliance by the manufacturer. The Indian auto industry has been following the international standards for emission regulations. In order to combat environment issues and become a global export hub, the industry has adopted the EURO III for all the vehicles manufactured. Automobile majors are now preparing for Euro IV and Euro V norms as well.

J. The major emitters?

There have been arguments that reduction in greenhouse gas emissions depends largely on the per capita emissions in a country. According to the Human Development Report titled Fighting Climate Change: Human Solidarity in a Divided World developed countries should cut down on emissions to 20–30% by the year 2020. And the developing nations are suggested 20% cuts by 2050. Being the fourth-largest carbon emitter in the world, India's per capita emission is 1.2 tones of CO2. This is 17 times lesser than that of the United States. The need to control air pollution for a sustainable future has urged the Indian automobile industry to adhere to international emission norms. [13,15]T

K. The solution

Today, environment is a major concern across the globe. Automobiles cause pollution in the air through the emission of hydro-carbons, nitrogen oxides, carbon monoxides and carbon dioxides. All these pollutants affect the environment in different ways. Human beings are the immediate victims in such environmental disasters. The problems can range from a mild headache to brain and respiratory damages to cardiovascular deaths.

Air emissions caused by automobiles can be brought down by good care, cleaning of carbon deposits, regular inspection and maintenance and good emission worthy fuels. The solution also lies in good traffic conditions. India also needs to adopt Euro-standard traffic and roads. Unadulterated fuel is also of utmost importance. Automobile and oil companies should together recognize the perils of air emission and work together to get rid of this environmental nightmare. [16,19]T

With the automobile industry all geared up to launch around 60 new cars and SUVs, this year seems to offer plenty of Opportunities for the industry to reach great heights.

III. Research Efforts

The way which has received a wide acceptance in terms of Improving the quality of diesel fuel is to use additives for various functional purposes. The greatest practical importance possess cetane enhancing additives, greasing additives and additives improving low-temperature properties capable to provide stable work of diesel engines. Taking into consideration that fact, that now in Russia large-scale manufacture of additives to diesel fuels practically is absent, and the requirement for them is satisfied at the expense of purchases on import, working out of domestic technologies for reception of effective additives is now actual. It is spoken about features of manufacture of additives to the diesel fuel meeting modern and perspective requirements. [20-24]T

A. Result and discussion (Dopes to diesel fuel)

(1) Synthesis of the promoter of diesel fuel ignition on a basis alkylnitrate synthesised an additive ignition promoter by nitration of Technical product on a basis of aliphatic alcohols C8 + (DRBA), manufactured by JSC "Salavat-nefteorgsintez", by technical nitric acid. Nitration was done by gradual adding (during 2 hours) of nitrating mixes (63% nitric acid and 93 % sulfuric acid) to DRBA. These were mixed at temperature of 8-18 °C. Then the derived product was repeatedly washed and leached by NaOH. The derived product was given code CEA-1. The impact of CEA-1 additive on cetane number of diesel fuels The researchs of impact of the received product on cetane numbers of diesel fuel test were done. The results of research are shown that influence CEA-1 on cetane number diesel fuel there is the increase in cetane numbers of diesel fuel. The increase of cetane numbers by 6 points is observed at the content of 0,8 % of weights. With the further increase of CEA-1 additive content in diesel fuel the increase of cetane number considerably slows down.Further researches consist in concentration of active part of additive CEA-1 for the purpose of its specific flow reduction.. The impact of CEA-1 dditive on lubricating properties of diesel fuel It is known from literature that nitro compound can have negative impact ondiesel fuel lubricity. That's why the researches were conducted on the impact of developed ignition additive on diesel fuel lubricity. After the researches there was shown a possibility of synthesis of additive-promotor of ignition diesel fuel by the nitration of technical product on a basis of aliphatics pirits C8+. The additive received in laboratory conditions has shown high efficiency.

(2) Synthesis of wear-resistant additives on the basis of fatty acids represents a product containing a mix of pitch acids and naphthenic acids C17-C22.

(3) Synthesis of succinimide-based multifunctional additive Advantages of using succinimide additives in fuels[12-16]:
   (1) reduction of weight of adjournment in carburettors in average on 60 %;
   (2) reduction of weight of adjournment on intake valves on 70 %;
   (3) reduction of fuel consumption on 3 %;

IV. CONCLUSION

Receiving diesel fuel with the improved ecological and operational characteristics is connected with using the developed additives. The quality of emission gases can be improved by improving the quality of Fuels and this can be done by adding different additives, The other techniques are by using catalyst and so on, More research work is required for improving the quality of fuel and alternative to the "traditional diesel or gasoline fuel.

ACKNOWLEDGEMENTS

I would like to thank several colleagues and seniors at the Savera College of Institutions, Farukhnagar, Gurgoan for supporting this work. I would also like to recognize the inputs provided by Mr. Sunil Pandey, Director, CTS INDIA for providing insights in to the developments happening in automotive world with regard to the emission norms.

REFERENCES

[1] "IEA bioenergy". IEA bioenergy. http://www.ieabioenergy.com/IEABioenergy.aspx. Retrieved 2010-07-14.
[2] "Press Conference Launching International Biofuels Forum". United Nations Department of Public Information. 2007-03-02. http://www.un.org/News/briefings/docs/2007/070302_Biofuels.doc.htm. Retrieved 2008-01-15.
[3] Greenpeace - The Russian Forests
[4] "World's Largest Pellet Plant to Start by Year-End". *Moscow Times*
[5] UK falls short of biofuel targets for 2010/2011
[6] National Non-Food Crops Centre. "Advanced Biofuels: The Potential for a UK Industry, NNFCC 11-011", Retrieved on 2011-11-17
[7] "Mustard Hybrids for Low-Cost Biofuels and Organic Pesticides" (PDF). http://www1.eere.energy.gov/biomass/pdfs/mustard_hybrids.pdf. Retrieved 2010-03-15.
[8] Future Energies (2003-10-30). "PORT HUENEME, Calif: U.S. Navy to Produce its Own Biofuels :: Future Energies :: The future of energy". Future Energies. http://www.futureenergies.com/modules.php?op=modload&name=News&file=article&sid=770. Retrieved 2009-10-17.
[9] "Newsvine - Ecofasa turns waste to biofuels using bacteria". Lele.newsvine.com. 2008-10-18. http://lele.newsvine.com/_news/2008/10/18/2014473-ecofasa-turns-waste-to-biofuels-using-bacteria-. Retrieved 2009-10-17.
[10] thanol Research (2012-04-02). "National Corn-to-Ethanol Research Center (NCERC)". Ethanol Research. http://www.ethanolresearch.com/ethanolresearch/about.shtml. Retrieved 2012-04-02.
[11] American Coalition for Ethanol (2008-06-02). "Responses to Questions from Senator Bingaman". American Coalition for Ethanol. http://www.ethanol.org/pdf/contentmgmt/USDA_DOE_biofuels_letter_61208.pdf. Retrieved 2012-04-02.
[12] National Renewable Energy Laboratory (2007-03-02). "Research Advantages: Cellulosic Ethanol". National Renewable Energy Laboratory. http://www.nrel.gov/biomass/pdfs/40742.pdf. Retrieved 2012-04-02.
[13] Sheehan, John; et al. (July 1998). "A Look Back at the U. S. Department of Energy's Aquatic Species Program: Biofuels from Algae". National Renewable Energy Laboratory. http://www.nrel.gov/docs/legosti/fy98/24190.pdf. Retrieved 16 June 2012.
[14] Briggs, Michael (August 2004). "Widescale Biodiesel Production from Algae". Archived from the original on 24 March 2006. http://web.archive.org/web/20060324084858/http://www.unh.edu/p2/biodiesel/article_alge.html. Retrieved 2007-01-02 publisher = UNH Biodiesel Group (University of New Hampshire).
[15] "Valcent Products Inc. Develops "Clean Green" Vertical Bio-Reactor". Valcent Products. http://www.valcent.net/t/news_detailf62c.html?id=36. Retrieved 2008-07-09.
[16] "Technology: High Yield Carbon Recycling". GreenFuel Technologies Corporation. http://www.greenfuelonline.com/technology.htm. Retrieved 2008-07-09.
[17] ^ R. E. Teixeira (2012). "Energy-efficient extraction of fuel and chemical feedstocks from algae". *Green Chemistry* **14** (2): 419–427. doi:10.1039/C2GC16225C.
[18] B.N. Divakara, H.D. Upadhyaya, S.P. Wani, C.L. Laxmipathi Gowda (2010). "Biology and genetic improvement of Jatropha curcas L.: A review". *Applied Energy* **87** (3): 732–742. doi:10.1016/j.apenergy.2009.07.013.
[19] Biofuels Digest (2011-05-16). "Jatropha blooms again: SG Biofuels secures 250K acres for hybrids". Biofuels Digest. http://www.biofuelsdigest.com/bdigest/2011/05/16/jatropha-blooms-again-sg-biofuels-secures-250k-acres-for-hybrids. Retrieved 2012-03-08.
[20] SG Biofuels (2012-03-08). "Jmax Hybrid Seeds". SG Biofuels. http://www.sgfuel.com/pages/hybrid-seeds-and-services/jMax-hybrid-seeds.php. Retrieved 2012-03-08.
[21] Plant Research International (2012-03-08). "JATROPT (Jatropha curcas): Applied and technical research into plant properties". Plant Research International. http://www.pri.wur.nl/UK/research/plant-based_raw_materials/jatropha/JATROPT. Retrieved 2012-03-08.
[22] Biofuels Magazine (2011-04-11). "Energy Farming Methods Mature, Improve". Biofuels Magazine.

http://www.biofuelsmagazine.com/articles/7743/energy-farming-methods-mature-improve. Retrieved 2012-03-08.

[23] Sergeeva, Y. E.; Galanina, L. A.; Andrianova, D. A.; Feofilova, E. P. (2008). "Lipids of filamentous fungi as a material for producing biodiesel fuel". *Applied Biochemistry and Microbiology* **44** (5): 523. doi:10.1134/S0003683808050128.edit

[24] Strobel, G.; Knighton, B.; Kluck, K.; Ren, Y.; Livinghouse, T.; Griffin, M.; Spakowicz, D.; Sears, J. (2008). "The production of myco-diesel hydrocarbons and their derivatives by the endophytic fungus Gliocladium roseum (NRRL 50072)". *Microbiology (Reading, England)* **154** (Pt 11): 3319–3328. doi:10.1099/mic.0.2008/022186-0. PMID 18957585.edit

