STUDIES ON THE REDUCTION OF ROAD VEHICLE POLLUTION

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Abstract. *PSA vehicles (Citroën, Peugeot, some Ford, Volvo models) have installed a special additive dosing system (DPF). The device has its own tank and with the help of an injection pump it automatically doses the amount of additive required for the periodic regeneration of the particle filter into the fuel tank. This mode of active regeneration is based on fuel additive in order to lower the combustion temperature of soot particles. The engine control system monitors with the help of sensors the load level of the particle filter, triggering the regeneration procedure by changing the setting of the fuel flow and the timing of the engine operation. The additive is stored in a separate tank and is automatically mixed with the fuel at the time of fueling. The system requires periodic refilling (at approx. 120,000 km) with JLM PAT Fluid additive of the DPF tank and usually also involves resetting the engine computer, for the operation the presence of a specialist is required. The active regeneration system of the particulate filter is triggered by the sensors that determine the pressure of the exhaust gases or the level of soot loading of the filter. The cleaning occurs by adjusting the fuel injection in order to increase the temperature of the exhaust gases to a value that allows the burning of the deposited soot. Depending on the vehicle model, this type of regeneration can also be initiated by the engine computer every 400-600 km or depending on the mode of operation of the car (urban traffic), the duration of the cleaning cycle being approx. Ten minutes. For systems using this mode of particulate filter regeneration, JLM DPF Cleaner can be used.*

Keywords*: PSA vehicles, additive, regeneration system*

INTRODUCTION

The interest in environmental pollution has grown in recent years, from a small number of people, who dealt sporadically and casually with pollution to the entire population of the globe and the most diverse institutions and organizations [Merker, G.P.; Schwarz, C.; Rüdiger, T., 2012]. Of course, pollution deserves interest, primarily for its current aspects, because it creates inconveniences and damages that affect health, sometimes involving large masses of people [ABĂITĂNECEI, D., și colab., 1978, GRUNWALD, B., 1980, WARNATZ, J.; MAAS, U.; DIBBLE, R.W., 2006]. This forces its knowledge to be as thorough, urgent and extensive as possible. Emissions from internal combustion engines, due to the nature of combustion, consist of a number of pollutants, the most dangerous of which are nitrogen oxides and suspended dust [BĂRBULESCU, F.M., 1960, Mariașiu, F., 2005]. The Euro VI emissions regulation, which applies to all road vehicles, introduces significant reductions in permitted tailpipe levels [APOSTOLESCU, N.; BĂȚAGĂ, N., 1967, APOSTOLESCU, N.; CHIRIAC, R., 1998]. Thus, emissions of nitrogen oxides must be at least 80% lower, and those of particles reduced by 66% compared to the Euro V standard. Euro VI also introduces a limit on ammonia emissions for the first time [BĂȚAGĂ, N. și colab. 1995, BĂȚAGA N., ș.a, 1979].

Nowadays, in the diesel engine, the injection systems and the injection pressure are improved to achieve high pressures when spraying the fuel. This also improves the efficiency of the diesel engine. [BOBESCU, GH. ș.a., 1996, Mihuț, C.; Niță L., 2018]. The combustion process is very complex both from a thermodynamic point of view and in terms of heat transfer. In recent years, internal combustion engines have had and continue to have a spectacular evolution

[DRAGOȘ, T., și colab., 1981, Mihăţoiu, I., ș.a. , 1984]. In addition to mechanical components, electronic control systems have appeared that can implement complex laws to ensure optimal engine operation, achieving a compromise between performance, lowest possible emissions and reliability [BOCA COSMINA, ADRIAN MURA, RADU ILEA, ANISOARA DUMA COPCEA, 2019]. Along with the evolution of technology, the pollution norms have also evolved, becoming more and more restrictive. Reducing the emissions produced by the internal combustion engines of motor vehicles is the most important goal of the manufacturers at the moment [DUMA COPCEA, A.; MIHUȚ, C.; POPA, D., 2018, ILEA R., 2003]. The increase in the number of road vehicles has led to the need to improve the ecological performance of the engines that equip them, in order not to increase air pollution substantially [Reif, K., 2014]. In order to meet the requirements of the European Union, the major car manufacturers came to the market with revolutionary technologies to reduce the pollution of internal combustion engines, the noise and vibrations of road vehicles [Negurescu, N.; Pană, C.; Popa, M.G., 2013, VASILESCU, A.C., 1975, VASILESCU, A.C.; BOBESCU, GH., 1964].

MATERIAL AND METHODS

The studies for this paper were carried out at an I.T.P. station. The ITP station is equipped with the following:- a space set up for examining the braking assembly of class 1 vehicles (vehicles with a maximum weight of less than 3.5 tons);- a space set up for examining the braking assembly of class 2 vehicles (vehicles weighing more than 3.5 tons);- exhaust gas analyzer for engines with spark ignition and LPG;- opacimeter for diesel engines;- sliding platforms for checking the direction of vehicles;- hydraulic axle loading devices;- device for adjusting headlights; - manometers for pressure measurement; - calipers for checking the depth in the tire profile. During the periodic technical inspection of a motor vehicle, the following checks are carried out;- the correspondence between the vehicle series and the car documents;- the level of polluting emissions and their inclusion in the Euro norms;- steering system;- the braking system;- the lighting installation;- external appearance (rust, dents, windshield, rear window, etc.). If during one of these checks it is found that the values exceed the normal parameters, the vehicle is rejected and given a period to remedy the detected defects.

RESULTS AND DISCUSSIONS

The brakes were checked on the roller stands provided at the ITP station.For vehicles weighing less than 3.5 tons, the S.F.R. roller stand was used. 1, respectively for those with a mass greater than 3.5 tons, equipped with a trailer, the S.F.R. roller stand. 2.The technical characteristics of the S.F.R.1 roller stand are as follows:- braking force: 0 – 600 daN;- axle weight: 0 – 3000 daN; - brake pedal effort: 0 – 80 daN. Stand for testing brakes S.R.F. 1 is equipped with: device for measuring pedal effort, device for weighing mass, analog device for indicating braking forces and with a central control, acquisition and data processing unit. Two cars with a mass of less than 3.5 tons were checked. The results are centralized in tables 1 and 2.

Table 1

Car brake test results no. 1

Brand			Type			No. matriculation
Remarks						
Remarks	Remarks Braking force (daN)		Imbalance			Braking coefficient(%)
	Left	Right	Calculated	Admitted	Result	
Service brake						
axis 1	1961	1428	27	30	Admitted	50
axis 2	521	373	28	30	Admitted	24
Parking brake						

axis 2	2534	1488	41	100	Admitted	
Total efficiency						
	Braking force total (daN)		Braking coefficient (%)			
			Calculating		Minimum allowed	Result
Service brake	4283		40		50	Rejected
Parking brake	4022		38		16	Accepted

Table 2

Car brake test results no. 2

Brand			Type			No. matriculation
Remark						
Remarks	Remarks Braking force (daN)		Imbalance			Braking coefficient (%)
	Left	Right	Calculated	Admitted	Result	
Service brake						
axis 1	327	377	13	30	Admitted	89
axis 2	151	154	2	30	Admitted	66
Parking brake						
axis 2	192	177	8	100	Admitted	
Total efficiency						
	Braking force total (daN)		Braking coefficient (%)			
			Calculating		Minimum allowed	Result
Service brake	1009		80		50	Rejected
Parking brake	369		29		16	Accepted

The technical characteristics of the S.F.R.2 roller stand are as follows: - braking force: 0 – 3000 daN; - axle weight: 0 – 13000 daN; - brake pedal effort: 0 – 80 daN; - axle pressure: 0 – 20 bar; - axle load: 0-4000 daN. Stand for testing brakes S.R.F. 2 is equipped with: device for measuring pedal effort, device for weighing mass, analog device for indicating braking force and with a central control, acquisition and data processing unit. A vehicle with a trailer weighing more than 3.5 tonnes was checked. The results are centralized in table 3.

Table 3.

Brake test results vehicle with trailer no. 3

Brand			Type			No. matriculation
Remarks						
Remarks	Braking force (daN)		Imbalance			Braking coefficient (%)
	Left	Right	Calculated	Admitted	Result	
Service brake						
axis 1	422	499	15	30	Accepted	44
axis 2	495	775	36	30	Rejected	84
axis 3	803	681	15	30	Accepted	90
Parking brake						
axis 1	603	651	7	100	Accepted	
axis 2	460	844	45	100	Accepted	
axis 3	742	734	1	100	Accepted	
Total efficiency						
	Braking forcetotal (daN)		Braking coefficient(%)			
			Calculating		Minimum allowed	Result
Service brake	3675		70		43	Accepted
Parking brake	4034		77		16	Accepted

Checking the noxes emitted by internal combustion engines with gasoline and LPG was done with the gas analyzer AG – 001 from the ITP station. The gas analyzer AG – 001 measures the noxes emitted by gasoline engines. The measured parameters are: HC, CO, CO_2, O_2, Lambda and Nox. Display of the measured parameters is done on a laptop connected to the gas analyzer. The results of the measurements are centralized in table 4.

Table 4.

Gasoline engine exhaust gas analysis

Fuel type	Benzine
The rev(rpm)	915
CO_{cor} (% vol)	0,77
HC (ppm vol)	265
Lambda	0,978
O_2 (% vol)	0,19
CO_2 (% vol)	15,72
CO (% vol)	0,75
Oil temperature(^{0}C)	72,0
Result	Admitted

The analysis of exhaust gases in diesel engines was done with the opacimeter OP – 001 from the ITP station equipment

The results of the measurements are centralized in table 5.

Table 5

Diesel engine exhaust gas analysis

Sample no.	K (m^{-1})	Minimum speed (rpm)	Maximum speed (rpm)	Time The base (dry)
1	0,25	909	4053	1,830
K_{med} (m^{-1})				-
Oil temperature (^{0}C)				81,0
Result				Admitted

CONCLUSIONS

The studies carried out on road vehicles regarding the pollution produced by them in traffic led to the establishment of the following conclusions and recommendations.

•The pollution of road vehicles manifests itself through: air pollution with exhaust fumes, noise pollution and pollution produced by vibrations.

•The main source of atmospheric pollution with toxic emissions is the internal combustion engines that equip road vehicles. The inadequate technical condition of the engine and other systems and installations lead to a significant increase in the pollution produced by road vehicles.

•The pollutant emissions of internal combustion engines are caused by the way the fuel is burned and by the imperfect sealing of the engine cylinders and fuel system. Strong exhaust gas emissions occur when the fuel is incompletely burned, the engine is improperly adjusted, when the engine is started or stopped, when traveling at low speed, etc.

•During the periodic technical inspection of motor vehicles, the tightness of the combustion gas evacuation is checked and the concentration of noxes is determined with the help of the gas analyzer. The running, steering and braking systems are also checked.

•In Europe, the legislation limits the noxes produced by the internal combustion engines of motor vehicles by imposing rules for the progressive reduction of pollutant emissions. Starting with the Euro 1 to Euro 6 pollution standards, particle emissions have been reduced 28 times.

•In order to reduce noise pollution, it is required that the vehicles correspond in terms of direction, suspension and running system and their cabins are insulated against noise and vibrations

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