
THE IMPACT OF TIRANA'S GASOLINE CARS ON THE AIR POLLUTION BY CARBON MONOXIDE (CO)

NDIKIMI I MAKINAVE QË PUNOJNË ME BENZINË NË NDOTJEN E AJRIT NGA MONOKSIDI I KARBONIT (CO)

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AKTET V, 3: 385-391, 2012

PËRMBLEDHJE

Tirana është qyteti më i madh në Shqipëri që karakterizohet nga trafiku i rënduar rrugor. Një nga ndotësit e ajrit që çlirohet prej automjeteve është monoksidi i karbonit (CO), që në Shqipëri matet vetëm për automjetet me benzinë. Përqindja vëllimore e CO, që çlirohet gjatë djegies së benzinës në motor kur makina është e ndalur në vend, u mat për 121 makina të prodhuara para vitit 1986, 425 makina të prodhuara gjatë periudhës 1987–1995 dhe 499 makina të prodhuara pas vitit 1996. Rezultoi se respektivisht 9.1%, 7.06% dhe 2.0% e makinave çliruan CO në gazet e djegies më shumë nga norma e miratuar për kategorinë e tyre (në %Vol), e përcaktuar sipas vitit të prodhimit. Ekzistenca e normave tolerante për makinat e vjetra, e kombinuar me mosmirëmbajtjen e duhur dhe/ose përdorimi i benzinës jociësore është arsyeja për praninë e CO mbi normat e lejuara në gazet e djegies së makinave me benzinë.

Fjalë Kyçe: makina, benzinë, tymra djegieje, CO, ndotje ajri.

SUMMARY

Tirana is the biggest city in Albania characterized by a heavy traffic. One of the air pollutants emitted by road vehicles is carbon monoxide (CO) which is measured only for the gasoline cars in Albania. The volume percentage of CO, present in the exhaust gases released during combustion of gasoline at idle conditions was measured for 121 gasoline cars produced before 1986, 425 cars produced during 1987–1995 and 499 cars produced after 1996. From the experiments it resulted that respectively for each car category determined by their production year, 9.1%, 7.06% and 2.0% of cars emitted in exhaust fumes more CO than the approved standard for their category (in Vol %). Existence of a tolerating standard for old cars, combined with the lack of proper maintenance, or/and usage of low-quality gasoline is the reason for higher than the standard CO levels present in exhaust fumes of gasoline cars.

Key words: gasoline cars; exhaust fumes; CO; air pollution.

INTRODUCTION

The most densely populated area in Albania, Tirana, also hosts the greatest number of road vehicles. As Figure 1 shows, till 1 January 2012, in Tirana there were registered more than one third of the country's road vehicles [1]. The number of passenger cars has increased rapidly whereas the number of other types of road vehicles has known very little increase. Unlike the general

trend of increase in the last decade, Figure 2 shows that in 2011, compared to the previous year, the noticeable decrease by over 16000 vehicles in total and by about 8000 passenger cars is due to the fact that the very old cars which were not considered "in circulation" (or cars that were involved in accidents and were not repairable), were removed from the registry of

vehicles by the citizens, taking advantage of the fiscal amnesty by the Government [1].

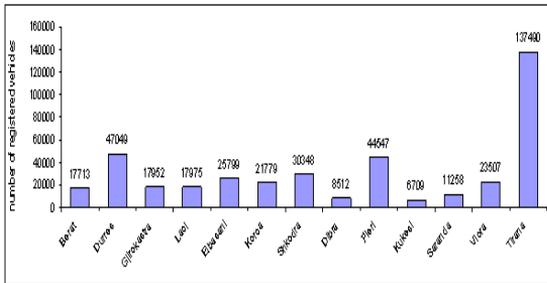


Figure 1: Number of road vehicles registered in the Albanian Regional Directories of Road Transport till 1 January 2012.

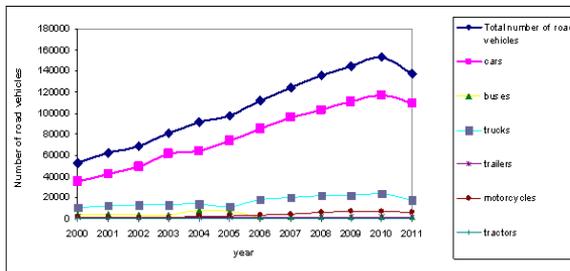


Figure 2: Progress in years of the number of vehicles for Tirana District in the period: 2000-2011.

Tirana’s vehicle fleet is composed of 79.83 % passenger cars, less than 25% of which run on gasoline [1]. The trend of purchasing gasoline vehicles is increasing in the last years [2]. This increase in the number of gasoline cars is confirmed by the increase of the gasoline quantity which has been imported in the last years. For example, in 2011 there was imported almost twice as much gasoline as in 2010, as Figure 3 shows [3].

Gasoline cars are among the most significant contributors to the release of carbon monoxide (CO, a known toxic gas) in the urban air. Factors that contribute to the CO in the air of Tirana are: vehicles’ age, the presence of the catalytic converter in cars, gasoline quality and vehicles’ maintenance. The governmental controlled vehicle inspection service in Albania requires the monitoring of the gaseous pollutants which are

released into the air with the exhaust gases during the engine operations. Concentrations of CO are quantified using gas-analyzers which measure the volume percentage of CO in the exhaust gases. The national standard of CO allowed to be present in the exhaust fumes, *in power during the time of this research*, is presented in Table 1 [4].

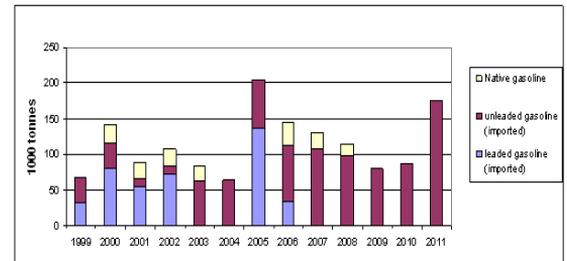


Figure 3: Progress in years of the gasoline quantity traded in Albania in the period 1999-2011

Production year	Fuel type	Engine load Rot/min	Pollutants measured
			CO (Vol %)
Before 1. 10. 1986	Gasoline	Without engine load	5.5
After 1.10. 1986 till 30. 12. 1995	Gasoline	800–1000	4.5
After 1. 01. 1996	Gasoline	Without engine load	2.0
		On engine load 2000-2500	1.5

Table 1: The allowed norms in power till January 2010 for the CO emitted from gasoline cars according to their categories.

On the State of Environment reports issued annually by the Ministry of Environment, Forests and Water Administration for the years 2008 and 2009 it is reported that the average annual concentrations of CO in a monitoring station near a section with a high traffic density have increased from 0.017 mg/m³ measured in 2008 [5]

to 0.394 $\mu\text{g}/\text{m}^3$ measured in 2009 [6]. Both values, despite the increase from one year to another, are a lot under the Albanian standard of 2 g/m^3 CO [7].

To better understand the main factor of CO generation in Tirana's air, the objective of this study was to evaluate the CO levels emitted by gasoline cars in Tirana. The CO is present also in the exhaust fumes of Diesel cars but that is not possible to be measured due to the lack of equipments for such measurement in Albania.

This study is important because carbon monoxide is the most toxic one compared to other air pollutants. CO is a potentially lethal gas which cannot be detected by the senses. It seems to affect the risk of heart disease [8] and also it plays an important role on the photochemical reaction leading to the production of oxides of

nitrogen and tropospheric ozone [9]. It is already confirmed that the NO_2 and O_3 concentrations resulted the highest on the monitoring stations near the roads with a high traffic density in Tirana [5, 6].

It is worth mentioning that this was the first time that such a research has been undertaken in Albania. Because there are not many published data, information on the gasoline quantity, and vehicle numbers was obtained from various Governmental Institutions, such as Ministry of Public Works, Transport & Telecommunication, Ministry of Finance etc, as presented in the Bibliography.

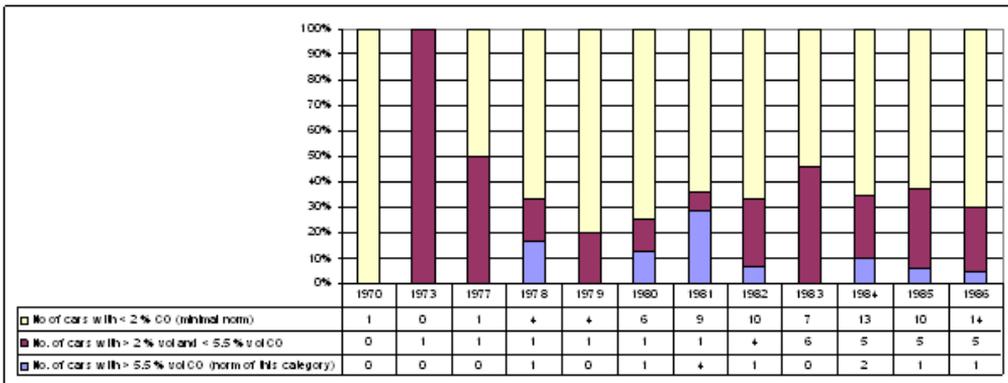


Figure 4: The percentage (and number) of gasoline cars produced before the year 1986, which had concentrations of CO above the norm of their category and above the minimal existing norm.

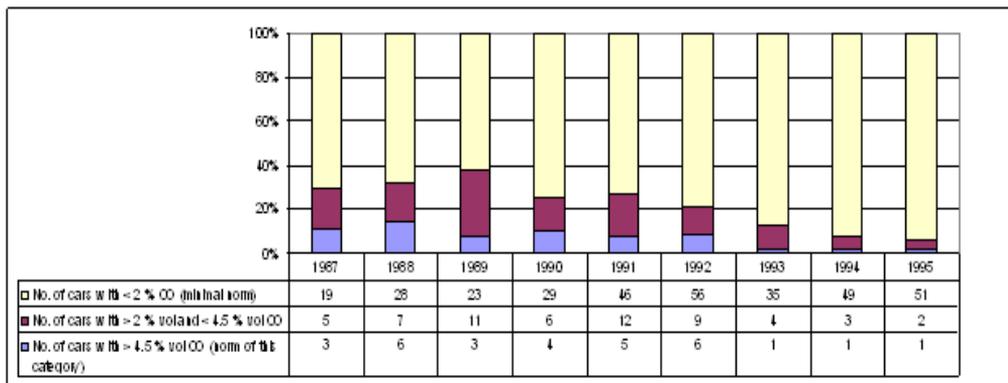


Figure 5: The percentage (and number) of gasoline cars produced in the period 1987 - 1995, which had concentrations of CO above the norm of their category and above the minimal existing norm.

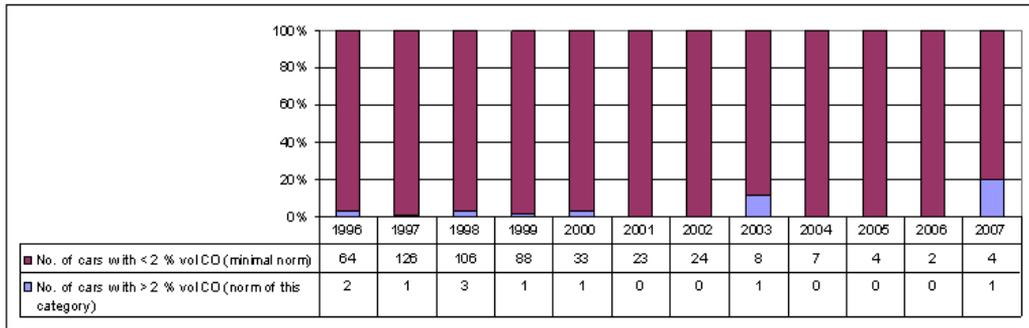


Figure 6: The percentage (and the number) of gasoline cars produced after the year 1996, which had concentrations of CO above the norm of their category, (the minimal existing norm).

MATERIAL AND METHODS

The exhaust emissions of a sample of 1045 gasoline cars operating in Tirana were measured. The choice of cars was made randomly as they presented themselves to the Center for the Technical Inspection of Vehicles for their annual check up. The sample size comprises almost 4 % of the gasoline cars of Tirana District. The average age at the moment of testing of these gasoline cars was 14.21 years old, ranging from 25.3 to 9.52 years old. The sample was divided in three groups, respectively: 121 gasoline cars produced before 1986, 425 cars produced during 1987–1995 and 499 cars produced after 1996 to match the division foreseen by the national standard for CO emissions in the exhaust fumes.

The experiments were performed at the Center for Technical Inspection of Vehicles in Tirana by using the gas analyzer STARGAS 898 Global Diagnostic System [10, 11]. Car testing was done in idle conditions with the engine running at 800–1000 revolutions per minute (rpm) following the Guideline No. 6527 dt. 24.12.2004 issued by the Ministry of Environment, Forests & Water Administration and the Ministry of Transports, Public Works & Telecommunication [4]. Because in the documentation of the vehicles issued by the General Directory of Services to the Road Transport there is no information regarding the presence of the catalytic converter or of the Lambda probe, during this research it was taken into

consideration only testing without engine load for all cars tested.

RESULTS AND DISCUSSIONS

The number (and percentage) of cars which emitted more CO than the national standard for their category, as well as the number (and percentage) of cars which emitted more CO than the minimal existing standard at the moment of testing are presented in Figures 4, 5, 6 respectively for each vehicle category.

As it is shown on the Figures 4, 5, 6, only 10 cars produced after 1996 had exhaust gas with concentration of CO above 2 % in volume, whereas 31 cars produced before 1986 and 59 cars produced during 1987–1995 exceeded this level. These “polluting cars” have been allowed to circulate freely on the roads, although their CO concentration was much greater than 2 % in volume, because they emitted less CO in their exhaust gases than the allowed standards for their categories, respectively 5.5 % and 4.5 % in volume. The presence of CO in the exhaust fumes is an indicator of a dysfunctional catalyst which is not able to convert the CO (resulting from the incomplete combustion of gasoline in the engine) into CO₂.

Moreover, the majority of the drivers whose cars were tested were not aware of the gasoline quality they were using and whether it could affect the catalyst or not. The terminology they used for the gasoline quality was not according to EURO standards but according to the price, being divided into two

major groups: “cheap” or “expensive” gasoline. This is an indicator of the little information (or little interest) they have on the fuel pollutants that affect the catalyst’s functioning.

To compare results of this study, a sample of 7 gasoline cars from emigrants who live in Greece was taken for the measurement of the CO in their exhaust fumes right after their arrival in Albania. These cars’ production years ranged from 1996–2005, all of them were reported as “running on EURO 5 gasoline”, and actually after testing, it resulted that all of them emitted 0 % CO in volume in their exhaust fumes. This comparison shows the combined effect of

having efficient catalysts on cars *and* using good quality gasoline on the reduction (or elimination) of CO concentrations in exhaust fumes [12].

The results of the impact of production year of cars on the average concentrations of CO for the entire group of tested cars are shown in Figure 7. The average values of CO in % volume are compared with *the standards which were in power during the study time*. It is noticeable that the standards were set too high for each car category and this explains why almost all cars passed the “pollutants’ testing”.

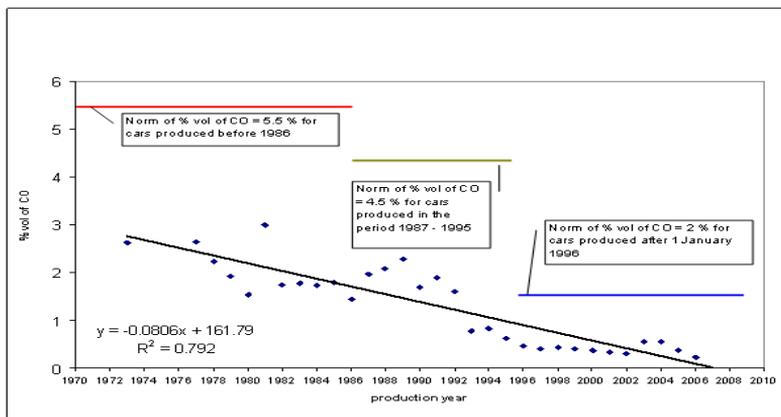


Figure 7: The dependence of average concentrations of CO (in % vol) from the year of production for the entire target group of gasoline cars, compared with the norms in power during the study time.

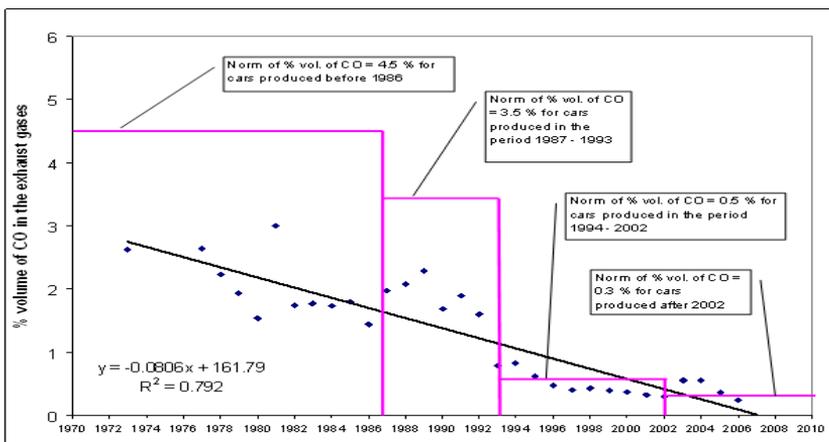


Figure 8: The average values of % vol CO according to production years of gasoline cars in Tirana, in comparison with the new norms for CO, in power since February 2010

The new standards for CO content in the exhaust fumes, approved recently by the Government, are set higher for old cars, thus favoring them in the testing procedure. On Figure 8, the values of average concentrations of CO of this study are compared with the new standards, in power from February 2010 [13]. In comparison with the new standards, 257 cars (*respectively: 15 cars produced before 1986, 51 cars produced in the period 1987–1993, 177 cars produced in the period 1994 – 2002 and 14 cars produced after 2002*) exceed the limit values of CO in % volume set for each category. On the other hand 606 cars (*respectively: 89 cars produced before 1986, 214 cars produced in the period 1987–1993, 289 cars produced in the period 1994–2002, and 14 cars produced after 2002*) exceed the minimal existing standard of 0.3 % CO in volume in the exhaust gases, thus resulting in 349 cars being permitted to circulate on the road because they meet the standard of their own vehicle category.

It is obvious that the average concentrations of CO emitted by newer cars are much smaller compared to the ones emitted by older ones (Figure 7). The presence of the catalytic converters on new cars could be one of the main reasons for it, because besides the conversion of CO to CO₂, it also conditions the drivers to purchase good quality gasoline for their new cars, thus resulting in lower CO emissions. Old cars also lack a proper maintenance compared to the new ones, for which drivers take a better care.

In fact, in other countries the CO emissions generated from road transport have been reduced significantly in the last decades. For example, in Hungary the CO emissions from the transportation sector have been reduced from 546 ktone in 1980 to 422.6 ktone in 2007 [14]; in the United Kingdom the average CO emissions originated from road transport have gradually decreased from 4768 ktone in 1998 to 1537 ktone in 2008, out of which 1362 ktone CO in 2008 are calculated to have come from passenger cars [15]. It is still early for Albania to define a clear trend for the CO emissions (in tones)

originated from passenger cars or from road transport.

In the European Union (EU) countries the air pollutants are measured in *grams per kilometre* for Diesel and gasoline cars alike. Moreover the standard for Diesel cars is set at 0.5 g CO/km driven, whereas for gasoline cars it is set at 1.0 g CO/km driven [16]. It is worth mentioning that in Albania the Diesel cars comprise more than 75 % of the vehicle fleet, nevertheless their CO emissions still remain unknown.

In conclusion, based on the findings of this research, in order to improve the urban air quality it is recommended for the Government to:

- invest on the establishment of CO air monitoring stations in Tirana and other cities;
- promote the purchase of brand new gasoline cars equipped with catalytic converters;
- provide the Albanian drivers with good gasoline quality complying with the EURO 5 standard;
- improve the Technical Inspection of vehicles by renewing the testing procedures in order to comply with the EU procedures, also by including the Diesel cars in the CO measurement procedures.

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