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THE USE OF PROFICIENCY TESTING SCHEMES FOR AUTOMOTIVE EXHAUST EMISSIONS LABORATORY

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Abstract: In this work the Proficiency Testing Scheme (PTScheme) had been used for evaluation of performance of the laboratories of automotive emissions to measure the levels of emissions of the vehicles, supplying subsidies to the laboratories in order to identify and solve analytical problems and contributing for the harmonization of the results of the measurements in the country. The PTScheme of automotive emissions is a type of study, provided only in Brazil and it can be concluded that the results have been satisfactory and of great importance for the industry, society and environment. In this work is presented a comparison of results for the four rounds held covering the period from 2004 to 2010.

Keywords:PTScheme, automotive emissions, gas analysis.

1. INTRODUCTION

The problem of the air pollution constitutes a serious problem to the human health, diminishing its quality of life. The vehicles are potential source of this pollution in everywhere. The automotive emissions of gases load diverse toxic substances that in contact with the respiratory system can produce some negative effect on the health.

A PTScheme has the purpose to compare measurement results of different laboratories carried out under similar conditions and to have a continuous evaluation of the performance of the participating laboratories [1]. This evaluation is made through the results generated for inter-laboratories comparisons, that constitute an adjusted mechanism to evaluate and demonstrate the quality/trueness in the measurements carried out by the participants. With the final report the participant laboratories have the chance to review its procedures of analyses, as well as implanting improvements in its processes.

2. METHODOLOGY

The methodology for accomplishment of the PTSheme was established in protocol, where the predetermined characteristics of the test vehicle, the logistic of transport, schedule of execution and the definition of the parameters to be analyzed are presented. The parameters under evaluation were carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x), total hydrocarbons (THC), total non-methane hydrocarbons (NMHC), total aldehydes (ANQ) and urban autonomy. In accordance with the written standards ABNT NBR 6601, 12026, 7024, and 15598 the measurement results express the amount of pollutants emitted for a light vehicle of the Otto cycle (CO, CO_2, total NO_x, THC, NMHC, ANQ and Aldehydes), expressed in g/km and urban autonomy in km/L. The methodology of the testingdescribes situations, simulated in chassis dynamometer, of departure (in cold state), situations in urban transit and departure in hot state one. Following those, the functioning of a vehicle can be reproduced standard with description of repeatability proven in standardized situations of transit.

The statistical tools used in this work are described in ISO 5725 (E) [2].For evaluation of the laboratories results was used z-score [1] [3]. This tool represents a measure of the distance of the result presented for a specific laboratory in relation to the value of reference of the proficiency testing scheme and, therefore, it serves to verify if the result of the measurement of each participant is in compliance with the value of reference. The z-score for this was calculated using the Equation 1.

$$z_i = \frac{y_i - y_{ref}}{s} \quad (1)$$

Where y_{ref} is the value of reference (the used values of reference in the proficiency testing had been defined as being the average of the averages of the involved laboratories (consensus value)),y_i is the average result of a specific laboratory i; $s$is the standard deviation of the data set.

3. RESULTS

In this work a comparison of the results presented for the laboratories was carried through that had participated in the four carried rounds, enclosing the period from 2004 to 2010. The z-score was applied in each set of results, having generated the comparative graphs for each round in each analyzed parameter (Figures 1 to 6). The graphic of Figure 1 shows the results for COemission [5-8].Only parameters NO_x, CO_2, CO and THC had been evaluated in all the rounds, the parameters Total Aldehydes and NMHC had been evaluated from the second round, and the parameter Urban Autonomy, only in the two last ones. For the parameter CO, although the well satisfactory performance of the laboratories, could be observed that some of them still need improvement in its analyses (Figure 1). For CO_2there is a fall of the performance in the second and third rounds (Figure 3), however the perfect performance in the last round indicates that the laboratories adopted improvements in theirs methodologies and process.

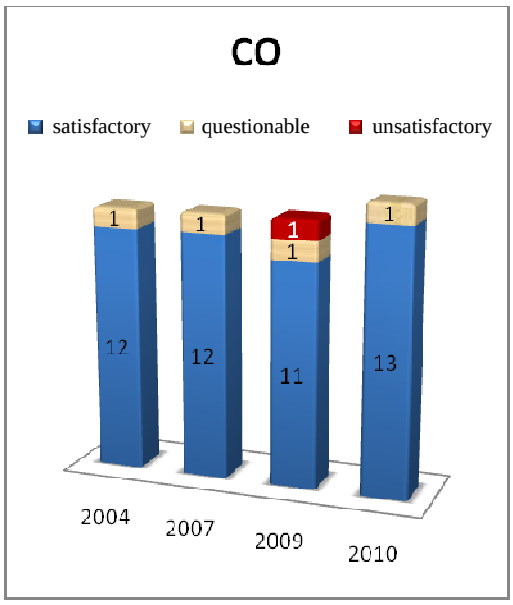

Figure 1. Laboratories performance in the measurement of CO emission

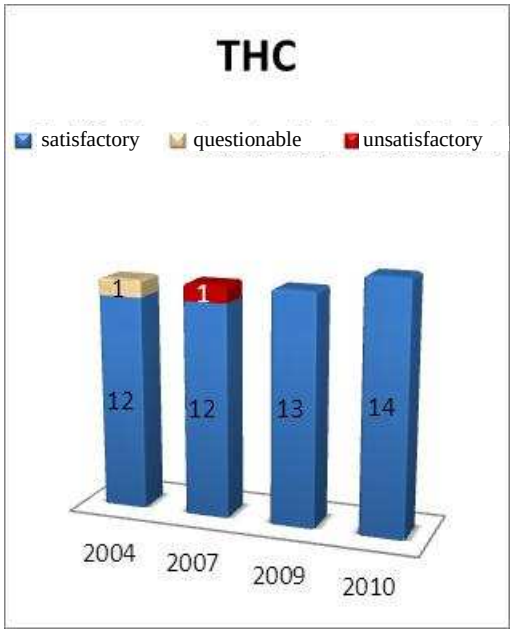

Figure 2. Laboratories performance in the measurement of THC emission

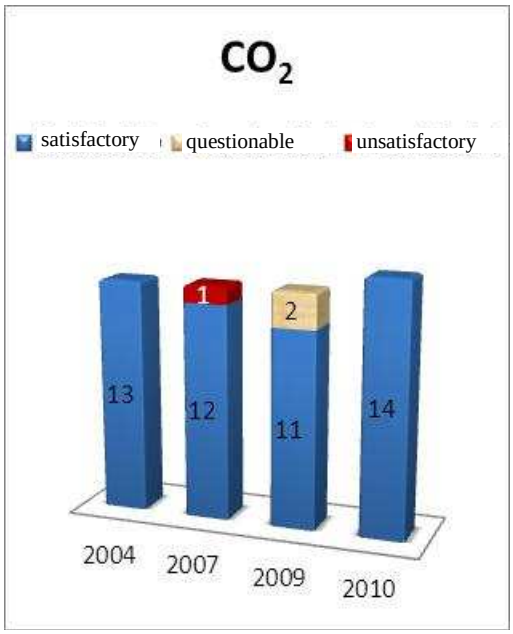

Figure 3. Laboratories performance in the measurement of CO_2 emission

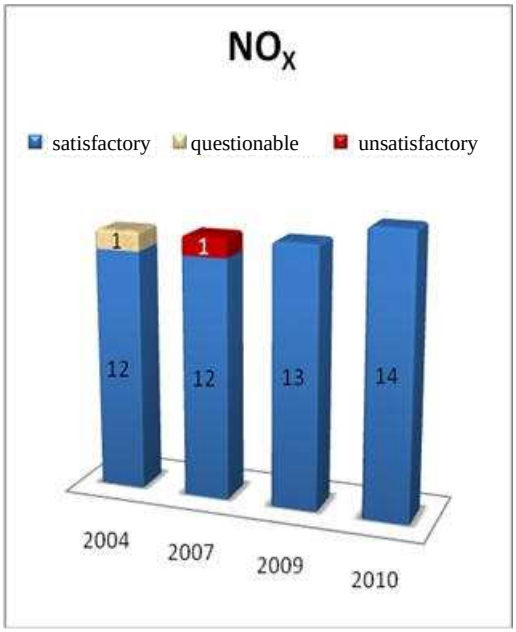

Figure 4. Laboratories performance in the measurement of NO_x emission

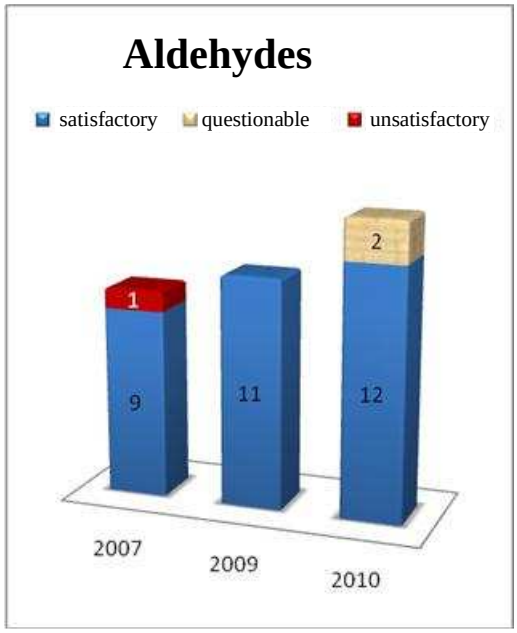

Figure 6. Laboratories performance in the measurement of Aldehydes emission

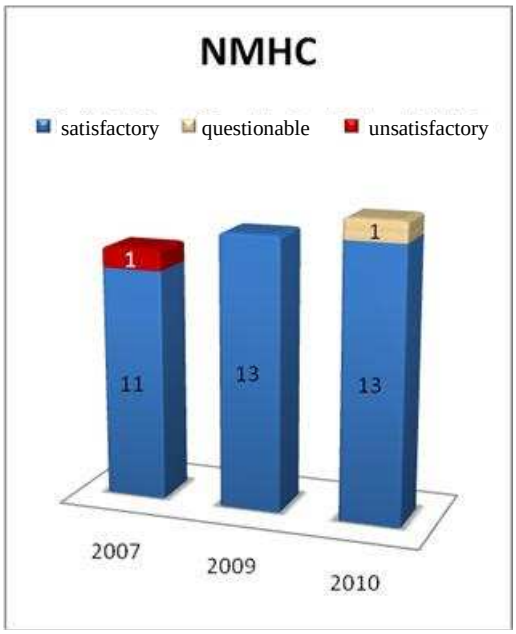

Figure 5. Laboratories performance in the measurement of NMHC emission

It can be observed that the last round presented the best performances,in all parameters, of the participating laboratories, for presenting satisfactory greater percentage of results added the absence of unsatisfactory results.

4. CONCLUSIONS

We can conclude that in the year of 2004 we got a total of 94.2% of satisfactory results and only 5.8% of questionable results. For the year of 2007 we got a total of 91.9% of satisfactory results, 1.4% of questionable results and 6.8% of unsatisfactory results. In 2009 we got a total of 94.4% of satisfactory results, 3.4% of questionable results and 2.2% of unsatisfactory results. In the year of 2010 we got a total of 95.9% of satisfactory results and 4.1% of questionable results.

It can be observed that in all the rounds the number of laboratories that had presented resulted satisfactory is considerably bigger that questionable and the unsatisfactory ones, what it comes to indicate the persistence of the laboratories with the quality of their measurement.

5. REFERENCES

[1]INTERNATIONAL ORGANIZATION FOR STANDARDIZATION – ISO/IEC 17043 - Conformity assessment – General requirement for proficiency testing.Geneva, 2010.

[2]ISO 5725 (E), “Accuracy (trueness and precision) of measurement methods and results”,1994.

[3] ISO/DIS 13528, “Statistical methods for use in proficiency testing by interlaboratory comparisons”, ISO, 2002;

[4]Vocabulário Internacional de Termos Fundamentais e Gerais de Metrologia – VIM, Portaria Inmetro 029 de 1995, 3ª edição, Rio de Janeiro, 2003.

[5]Relatório Final do Ensaio de Proficiência em Emissões Veiculares – 1a rodada. Rio de Janeiro, 2004

[6]Relatório Final do Ensaio de Proficiência em Emissões Veiculares. Rio de Janeiro, 2009

[7]Relatório Final do Ensaio de Proficiência em Emissões Veiculares – 2a rodada. Disponível em http://www.inmetro.gov.br/metcientifica/profiEmiVeicular.asp. Acesso em 20/06/2011

[8]Relatório Final do Ensaio de Proficiência em Emissões Veiculares – 3a rodada. Disponível em http://www.inmetro.gov.br/metcientifica/profiEmiVeicular.asp. Acesso em 20/06/2011