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COMPANHIA DE TECNOLOGIA DE SANEAMENTO AMBIENTAL

THE BRAZILIAN TRENDS ON NON-CONVENTIONAL VEHICLE EMISSION REGULATIONS

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DOCUMENTO

TIPO	DATA	ORIGEM	Nº PÁGINA/V.	Nº MAPAS
Trabalho exposto em seminário	30.5.89	DEC/DEV	05	–

TÍTULO DO DOCUMENTO

THE BRAZILIAN TRENDS ON NON-CONVENTIONAL VEHICLE EMISSION REGULATIONS

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ASSINATURA / CARIMBO / DATA

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DOCUMENTO AUTORIZADO POR

ASSINATURA / CARIMBO / DATA

DOCUMENTO REVISADO

ASSINATURA / CARIMBO / DATA

CLASSIFICAÇÃO DE SEGURANÇA

[X] EXTERNA [ ] INTERNA [ ] RESERVADA

PALAVRAS CHAVES

EMISSÕES NÃO CONVENCIONAIS – POLUIÇÃO POR VEÍCULOS – CHUMBO – ALDEÍDOS – GÁS SULFÍDRICO – NÍQUEL

CÓDIGO E TÍTULO DO PROJETO

DISTRIBUIÇÃO INTERNA

ÁREAS/Nº DE CÓPIAS

D(1) DE(1) DEC(5) DEV(2) TEDB(2)

USO DA BIBLIOTECA

CLASSIFICAÇÃO DE ASSUNTO	Nº DOCUMENTO	VISTO / CARIMBO / DATA

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SUMMARY

This paper presents the governmental point of view on non-regulated vehicle emissions.

The discussion covers present emission problems such as oxygenated and non-oxygenated organic compounds as well as new pollutants which eventually migth have to be controlled, like nickel emissions, from certain types of catalytic converters.

Finally, the use of unleaded gasoline which will be officially specified by CNP, as of january 1990, is taken as a successful example of a control action directed towards the public health protection.

INTRODUCTION

The continuous growth of the air pollution in metropolitan areas led the Brazilian Federal Government to establish a comprehensive Air Pollution Control Program for Automotive Vehicles (PROCONVE) enacted on May 6, 1986 by the National Environment Council - CONAMA.

This Program has been designed to achieve significant vehicle emission reductions for carbon monoxide - CO, hydrocarbons - HC,

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Presented at the International Symposium on Specific Emissions of Ethanol/Gasohol Fueled Vehicles held in São Paulo, Brazil, on May 30th, 1989.

nitrogen oxides - NO_x and Diesel smoke, which are presently the main atmospheric pollutants from mobile sources.

The brazilian vehicle fleet has an approximate proportion of forty to sixty, for alcohol and gasohol fueled cars. Almost all heavy duty vehicles are diesel fueled. Concerning this peculiarity, PROCONVE has: a) considered ethanol as hydrocarbon emission; b) established some modifications for the SHED evaporative emission measurement procedure; c) required test procedure improvements; d) foreseen the need for ethanol and aldehyde emission limits.

Since PROCONVE induces vehicle manufacturers to develop and implement the best available technology, reasonable periods of time to adopt and take these necessary actions are required and, therefore, were granted.

ENFORCEMENT OF NON-REGULATED EMISSION LIMITS

As pointed out above, PROCONVE is following similar experiences adopted in the developed countries, in order to provide and assure a better air quality in the brazilian cities.

Under this main objective and depending on the brazilian technology evolution, some other pollutants have to be probably considered in a near future for control actions.

Just to highligth the concepts involved, we will present some examples.

1st example: Gaseous organic compounds:

As mentioned before, until now all organic compounds have been measured as hydrocarbon. It becomes obvious that improvements are necessary for emission characterization . Therefore, specific measurement procedures such as the MBTH spectrofotometry and DNPH chromatography methods, for aldehydes, are being developed and standardized. In addition, a corrected procedure for ethanol evaporative emission was developed and will be required for the 1992 model year certification.

Furthermore, other technical procedures are being developed for future enforcement, such as the correction for evaporative emission of gasoline-ethanol blends and "hydrocarbon" or specifically ethanol exhaust emission of alcohol vehicles.

The proposal of specific emission limits for aldehydes, presented by CETESB in December 1988, is supported by two main reasons:

1. Some catalist formulations can, actually, increase aldehyde emissions.

2. Aldehydes contribute to smog, play an important role in the formation of acid rain and fog and are also considered a risk to public health, as consequence of the hazardous effects to the environmment and human health ascribed to acetaldehyde, formaldehyde and acrilaldehyde[2,3,4].
Its was found in in vitro tests using very low concentrations of acetaldehyde (0.020-0.88 mg/ml) induction of chromosomal aberrations, sister chromatid exchanges in human lymphocytes and DNA cross-link in human leucocytes and several other kinds of DNA damage induced in other cell types. Moreover, in vivo animal studies have shown that acetaldehyde is a clastogenic compound inducing sister chromatid exchanges or chromosomal aberrations in animal cells. In relation to the formaldehyde negative results were more frequent when using in vivo systems, while genotoxicity is evident among the in vitro systems, including the Ames test, mouse lymphoma or cell transformation assays.

Nasal tumours together with acute tissue degeneration death and inflammation was observated when rats and mice were exposed by inhalation to formaldehyde (15 ppm/6h day/5 days wk) through 11-12 months for rats, 23-24 months form mice[3,4]. According to the Occupational Safety and Health Administration (OSHA) a 8-hour permissible exposure level to 0.5 ppm as an 8-hour-time-weighted average. A limit of 2 ppm for 15 minutes - Short Term Exposure Limit-STEL - was cited recently[6].
According the EPA's Carcinogen Assessment Group, acetaldehyde is classified in the B2 class, that includes compounds with sufficient animal data, but with inadequate or no data available on the human population. No classification exists in relation to formaldehyde or acrilaldehyde[4].

In the same way ethanol emission may need to be controlled, however, more details have to be known before a specific emission limit is established.

2nd example: Lead

As well known lead, which in urban areas is primarily emitted by vehicles, has harmfull effects on public health.

Biological effects from lead are referred only in relation to the lead acetate, a water soluble compound, and lead phosphate a white powder insoluble in water. Both are carcinogenic in experimental animals, inducing kidney cancer and neural neoplasias when rats were fed by diets containing these compounds. In humans, the available data are not conclusive yet[1,2,4]. Acceptable intake for lead and coumpounds, according to EPA/USA, are $1.4 \cdot 10^{-3}$ mg/kg b.w./day in the oral chronic exposure and $4.3 \cdot 10^{-4}$ mg/kg b.w./day by inhalation, while the TLV is 0.15 mg/m^3.[5]

The use of lead additives in gasoline as octane improvers has been greatly substituted by ethanol addition. This practice has led to a significant reduction of lead levels in the atmosphere and soil. PETROBRÁS assumed, in 1988, a public compromise, which is backed by the National Petroleum Council - CNP, for the supply of only lead-free gasoline, as of January 1st, 1990.

The prospect of availability of lead-free fuels meets both needs, the feasibility of lead sensitive emission control technologies and the reduction of lead emissions.

3rd example: Presently non-significant pollutants

Although PROCONVE does not regulate pollutants, which are presently emitted in trace concentrations, certain compounds may have their emission increased due to the use of new control technologies or new fuels.

Therefore, if their emission becomes an environmental threat, they will certainly have to be considered for regulation.

Included in this case is the hydrogen sulfide - H_2S and sulfuric acid - H_2SO_4 emissions, which are produced in the catalitc converters when operating under certain conditions. While these problems are solved by the manufacturer, before a critical situation is reached, the Environmental Agency may not enforce any mandatory control. However, if a warning situation is reached, the Agency will be forced to define new control guidelines.

Furthermore, it is known that the use of additives such as nickel in the catalist formulation can reduce H_2S formation. However, since nickel can vaporize in the converter and produce oxides and other toxic Ni-derivatives, this technology should be evaluated before, if it becomes a solution for the H_2S emission. There are in the literature, several evidences that nickel exposure by ingestion, inhalation and skin absorption can induce cancer in humans[8]. Cancer of the nasal cavity, lung and larynx is more frequent among those workers in nickel refineries, when compared with the general human rate. However, it is not possible until now to specify those nickels compounds having carcinogenic activity in humans. Lung cancer in rats was induced by nickel sulfide inhalation while local sarcomas in mice, rats and hamster were induced by intramuscular injections of nickel compounds (subsulfide, oxide carbonate). According to the National Institute of Occupational Safety and Health, exposure to nickel should be limited to 15 micrograms/m^3/10-hour time-weighted average, based on its carcinogenic potential. Recent review by EPA/IARC also indicates a high genotoxic activity, since nickel compounds can induce DNA damage as evidenced by several in vitro and in vivo genetic assays[1].

This sort of evaluation is of prime importance, since an unproven technology may have to be prohibited immediately after its adoption, resulting in loss of manufacturer's time, development work and money.

FINAL CONCLUSION

The main conclusion of this emission regulation concept is that any technology to be used in the vehicle production line in Brazil, must be previously evaluated, considering those informations already available in the developed countries, related to the environmental and health impact.

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17.07.89

Data Aquis.:	15/8/89
Indic.:	doação DEC
Procedência:	
Preço:	C$
Data Tomba:	15/8/89