CITY AIR POLLUTION BY VEHICLE ENERGY REQUIREMENTS

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INTRODUCTION

This work is originated from an investigation project, which is in charge of G.E.S.E. Group belonging to the National Technological University in Rosario city and it is about the air pollutants monitoring in certain cities of Santa Fe, Argentina. The studies of some air pollutants have being developed since 1994 and consisted in the measurement of them in four active monitoring points (1). The measured pollutants were: Nitrogen Oxides, Carbon Monoxide, Sulphur Dioxide and Particulate Material.

Afterwards with the object to enlarge the measurement area it was begun to use the monitoring passive techniques, but only to measure nitrogen dioxide because, according to our evaluations, it is the one which shows best the atmospherical pollution degree in the mentioned (1). The present measurements are done simultaneously in Rosario and Santa Fé cities.

By means of passive techniques (Palmes tubes) the monitoring points were increased at a lower cost. The costs represented a restrictive factor in the investigations, because of the short financial recourse of the investigation group.

METHOD

The passive samplers (sample equipment) are simple mechanisms which can be used for the measurement of gaseous pollutants in the environment. They consist of a small tube with a closed extreme and the other open. They are based in the “molecular diffusion” principle of a gas from the environmental air, through the tube, to an absorbent situated in the closed extreme of it.

The tubes that are used, have 70 mm of length and an inner diameter of 12 mm. The absorbent reagent is TEA (TriEthanolAmine), which is placed between two meshes of stainless steel. The calculations based in the diffusion speed of the nitrogen dioxide in the air, shows that a passive equipment of these characteristics has a volumetric flow of 72 cm3/h (2).

In the areas of study the samplers were placed in appropriate supports at a height between 1,5 m and 3 m. Among the 29 selected places for measurement, it was found that in 10 of them the sample (as a process) was discontinuous because of the loss (or waste) of the samplers.

The samplers are collected and replaced monthly since August of 1998. The rebound of the samples and the losses of the measurers (6,7 %) are attributed basically to breakage, insect invasion and vandalism.

During the exposure to the environment, the NO2 is accumulated as nitrite ion upon the TEA situated between the meshes of the samplers. The analysis involve diazotisation of sulphanilamide by the nitrite, and the formation of a purple azo dye through coupling of the diazonium salt with N-1 naphthylethilenediamine dihydrochloride. Samples and standards are measured spectrophotometrically at 540 nm using low volume 10 mm cells.-

TOPOGRAPHY OF THE STUDY AREAS

Rosario and Santa Fe cities are built up on the right bank of the Parana River. The regions present some relationship, with wet climates and average temperatures of 20 ºC. Predominant winds come from the Northeast quadrant, followed by the ones from the Southeast quadrant.

In the particular case of Rosario city, the urban conglomeration presents an extended form in the North - South direction, occupying a surface of nearly 170 Km2. The population is about 1.000.000 inhabitants. The vehicle system has approximately 400.000 vehicles and the edification in the centre of the city is almost completely of an important height.

Santa Fe city, situated at 160 km to the North of Rosario, is surrounded by masses of water, which originate a high degree of humidity in the environment.

DISCUSSION AND RESULTS

Table 1 shows the results registered in the period between August 1998 and October 1999, from 19 sites of Rosario city and 10 sites of Santa Fe city.

Concentration Averages of Nitrogen Dioxide

The Figure 1 shows the concentration averages (during all the monitoring period) in the places of measurement of both cities).

Places of Large Concentrations

As it can be seen the monitorig site Nº 7 of Rosario city is the one which presents the larger average concentration of NO2 (63,8 g/m^3) during the measurement period. In Santa Fe city the point of greater average was the Nº 3 (33,3 g/m^3).
The difference between the two larger concentration places of both cities is of 30,5 g/m^3, a significant value, which indicates that the big urban areas are exposed to a greater contamination, with all the risks that this involves. The investigations made by the Health World Organisation, indicate that an increment in NO2 concentrations of 30 g/m^3 will make possible an increase of 20 % in the probability of respiratory diseases in small children.

The national and international regulations do not fix limit values of NO2, but they fix concentrations of total nitrogen oxides (NOx), that is the sum of NO and NO2, both expressed as NO2.

Nevertheless, the air protection rule of United Kingdom, fixes a maximum limit of air quality for the NO2 of 50 g/m^3 as annual average. If we take this concentration into account, we may say that two monitoring points of Rosario city exceed this limit (points 3 and 7), while in Santa Fe city in none of the measurement sites this parameter is exceeded; the largest average of this last city (corresponding to point Nº 3) is 16,6 g/m^3 below the limit fixed by the english legislation.

Observing the two points of each city with greatest average concentrations we may say that in all of them there is an important vehicle traffic, which is characterised by the passage of several transport lines and a great quantity of particular vehicles.

As regards of the gaseous diffusion, we may mention that the measurement points in Santa Fe present buildings of low height in opposition to the sites of Rosario city, which are characterised by point Nº 3 with a higher edification and narrow streets. This explains the great difference between the two registered averages of both cities, as in Rosario city there had been a minor removal of the pollutants which increases the concentrations of inmission.

It must take into consideration that the point Nº 7 of Rosario city is close to a square with big trees and without any kind of edification. Probably the vegetation influences in a negative sense the removal. What is mentioned before can also be seen in relation to point Nº 11 of Rosario city, which is in a zone situated in front of the Independence Park, where the constructions and buildings are low, the vehicles are too numerous and there are big trees; the average value of 46,3 g/m^3 holds the idea that the groves (woods, plantation of trees) hinder in a way the removal of the pollutants.

Table 1. Nitrogen Dioxide Concentrations (g/m^3)

	aug 98	sep 98	oct 98	nov 98	dec 98	jan 99	feb 99	Mar 99	apr 99	May 99	jun 99	jul 99	aug 99	sep 99	oct 99
Ros.1	83	32	36	34	18	60	50	46	30	55	44	34	66	15	33
Ros.2	18	8	16	11	5	9	8	15	14	40					
Ros.3	52	46	73	97	67	37	80	65	32	48	39	23	83	10	36
Ros.4	20	8	8	7	3							8	35	17	14
Ros.5	46	30						42	35	41	33	25	31		50
Ros.6	62	29	27	56	50	49	30	40	57	36	32	26	63	28	39
Ros 7	98	37	82	79	60	79	74	54	47	64	35	49	75	45	79
Ros.8	37	23	16	9	2			14	3	33	25	19	12	13	16
Ros.9	23	9	16	48	11	8	6	15		15	17	22	19		
Ros. 10	11	4	9	7	10	6	7	7	16	18	9	5	5	4	7
Ros. 11	66	37	53	75	48	53	60	10	43	59	51	33	37	27	42
Ros. 12	65	22	64	59	56	61	47	23	30	48	40	48	33	44	46
Ros. 13	13	3	6	7	5	4	4	4	29	17	14	16	11	3	5
Ros. 14	31	11	25	16	16	17	27	9	12	26	15	28	28	19	20
Ros. 15	53	32	41	29	26	46	57	32	38	43	28	37	46		
Ros. 16	4	4	7	7	14	16	10	5	5	9	6	3	5	3	3
Ros. 17	3	4	4	10	11	5	11	2	6	6	4	2	2	3	4
Ros. 18	4	1	6	9	9	16	5	3	9	14	10	6		3	6
Ros. 19	31	12	21	11	9	12	13	24	22	42	34	26	28	23	19
S. Fe 1	30	10	42	33	21	19	28	20	14	31	26	25	18	13	31
S. Fe 2	17	19		15	9	11	15	14	18	37	26	46	27	26	35
S. Fe 3	23	26	56	34	23	31	28	30	36	48	30	43	34	15	43
S. Fe 4	44	15	33	27	17	16	16	21	17	37	33	48	31	19	30
S. Fe 5	10	8	9	12	7	7	22	6	9	13	20	11	7	2	7
S. Fe 6	23	13	15	7	9	9	12	20	12	26	21	21	13	6	11
S. Fe 7	49	12		11	11	14	17	11	1	22		4	15	8	18
S. Fe 8	10	2	7	9	11	9	10	5	3	11	13	11	7	3	11
S. Fe 9	12	20	5	11	13	7	10	2	1	7		9	6	11	4
S. Fe 10	19	22	16	14	13	17	18	12	15	26	35	20	19	10	31

Places of Lower Concentrations

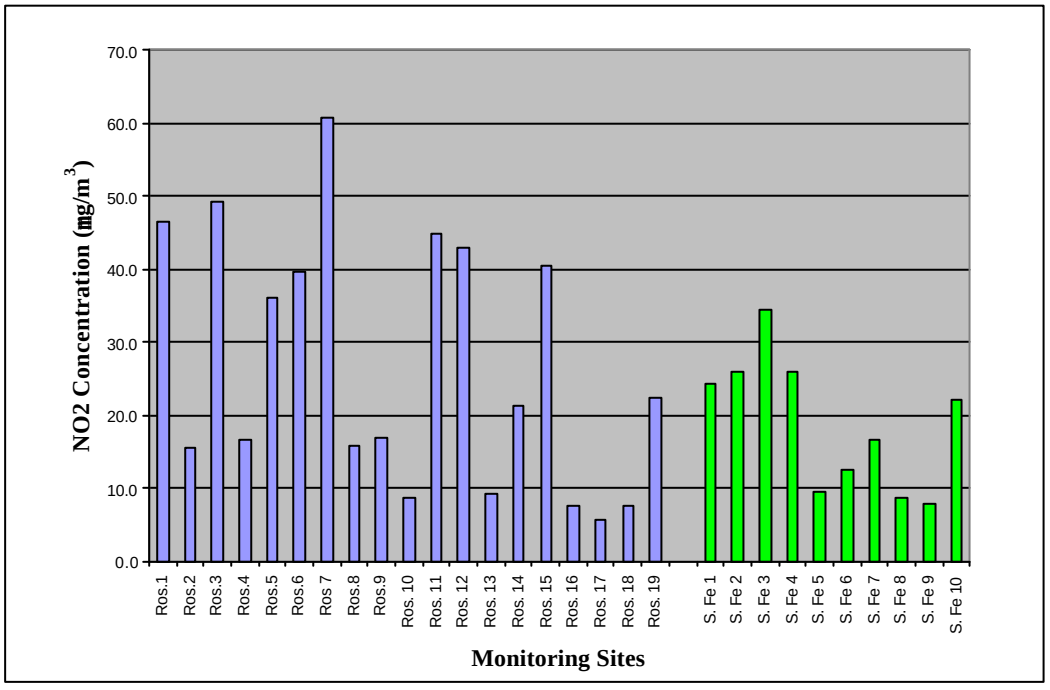
Considering the graphic about the averages of concentrations, it is seen that five points in Rosario city (points 10, 13, 16, 17, and 18) and two points in Santa Fe city do not exceed of 10 g/m^3.

The points numbered as 16, 17, and 18 in Rosario city are situated in the northern area of the city; they were placed there, with the object to establish the influence produced by an important Electrical Power Station (Sorrento), which is built up in the neighbourhood of the positions where the samplers are. Analysing the registered concentrations in points numbered as 16, 17 and 18, it is deduced that the emission from the Sorrento Thermoelectrical Station do not produce any significant influence on the inmission concentrations of NO2, existing a large diffusion due to its instalments, which are placed near the Parana River, and its chimney which is of great height (approximately 80 meters).

The point Nº 13 in Rosario city, is placed in a park, in an area which is relatively separated from the vehicle NO2 emission. In this point, it is expected the presence of low concentrations of pollutant.

The point Nº 10, which also presents low average concentrations of NO2, is situated on the intersection of an avenue and a street, both with an intensive traffic; we may express that in the mentioned zone exists a great emission of the pollutant. The low inmission concentrations may be due to the existence of a large removal because of the low building and the width of the avenue where the monitoring point is placed. This zone is also characterised by the total lack of plants; therefore, it is held the idea that the trees or plants in general, make difficult the removal of the pollutants.

Fig. 1 Average Concentration of Nitrogen Dioxide



In Santa Fe city, the two points of lower concentrations are situated in zones with a considerable traffic and an edification of low height. In consequence, we suppose that in those areas the gaseous diffusion is of much importance that it overcomes the contribution made by the vehicle emission, resulting in low inmission concentrations of the pollutant. However, in Pellegrini Boulevard, where it is the sampler

Nº 8 (it presents a central way with plants and trees) the low registered concentrations would be in opposition to the hypotheses mentioned before where it is indicated that in areas with leafy trees it is made difficult the gaseous diffusion increasing the inmission concentrations.

CONCLUSION

Although the studies continue, it is concluded the following:

- The pollutant concentrations are influenced by the intensity of the vehicle flow, the characteristics of the edification, the width of the streets and the presence of any vegetation.

- In both cities, the higher concentrations appear in areas with an important traffic, due to the greater emission of the pollutant. As regards of the removal of it, in general, the degree of difficulty increases with the presence of narrow streets, very high edification and any kind of plants and trees.-

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