

CONCENTRATION DISTRIBUTION OF NO_x IN THE AIR OF SKOPJE CITY, REPUBLIC OF MACEDONIA

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Abstract. A total of 100 monitoring points were selected using a 1 km mesh as a reference mesh to evaluate the concentration distribution of NO_x (NO and NO₂) in the whole of Skopje City. The monitoring points were selected based on the topographic condition, density of dwelling houses and existing data and information as a reference. Simplified samplers were installed at these monitoring points. Mounted filter paper moistened with an absorption solution inside the simplified samplers. The filter paper was replaced every 24 hours for the investigation period of 10 days. NO and NO₂ concentrations were determined by spectrophotometric method.

Key words: air pollution, nitrogen oxides, monitoring

1. Introduction

During the consumption of different fuels, high level of NO and NO₂ (NO_x) are emitted in the air. Usually, concentration of the NO_x in the air is determined as one of the most important parameters for air pollution. The NO_x influence on the health of the people in different ways, contribute to formation of acidic rains, influence on ecosystems, etc. This is very important for main urban and industrial centers as the city of Skopje [1-3].

In this paper the results of nitrogen oxides determination on 100 monitoring points which were selected using 500 m mesh as a reference mesh to evaluate the NO₂ concentration in the whole city of Skopje. For this measurements one hundred sampling points were established and one hundred simplified samplers have been installed. The samplers were placed after studying the topographic conditions, density of residential houses, and existing data and information.

In the same period of November 10 to November 20, 1997 (when atmospheric concentration distribution of NO₂, were measured by the Simplified Method) a meteorological survey was performed by measuring of wind speed and wind direction. Measurement were performed by a portable wind vane anemometer on 10 points in Skopje, 4 times per day (every 6 hours).

2. Experimental

2.1. NO₂ Measurements

Sampling period:	November 10 to 20, 1997 24-hours sampling (replacement between 7:00 and 8:00 a.m.)
Sampling cycles:	10 times
Monitoring items:	NO ₂
Sampling method:	Mounted filter paper with absorption solution inside the simplified samplers. The simplified samplers use the principle of gas molecule diffusion and almost immune to impacts by winds as its feature.
Analytical method:	Filters were extracted using water and were used for spectrophotometric determination of NO ₂ by Saltzman method.

2.2. Meteorological Measurements

Meteorological survey was performed by the measuring of wind speed and wind direction. Measurement were performed by a portable wind vane anemometer at 10 points in Skopje, 4 times per day (every 6 hours).

Start of measurements: November 10, 1997 at 7.00 a.m.

End of measurements: November 20, 1997 at 7.00 a.m.

3. Results and Discussion

Fig. 1 shows the wide area concentration distribution of NO₂ in the entire area of Skopje. The concentration distribution diagrams were prepared for average value of the entire cases of NO₂. The three cases selected for NO₂ (RUN-2, RUN-3 and RUN-9) showed relatively high concentrations during the period.

According to the results of the monitoring survey, the concentration was lower than anticipated in all cases and the three cases (second, third and ninth day), which showed relatively high concentration among all the cases, were selected.

3.1. NO_x Distribution

Generally, the following observation can be made from wide-area concentration distribution diagrams of NO₂:

1. As far as the overall concentration levels are concerned, cases of windy days and days affected by rainfall registered low concentrations compared to the other cases.
2. According to the data of individual cases, especially high concentrations were not recorded with NO₂, except for RUN-1 and 10 with concentration exceeding 100 µg/m³. The reference value of 85 µg/m³ was exceeded only in some areas.

3. In the NO₂ concentration distribution, the central part of the city showed high concentration, while high concentrations were also recorded locally in some suburban areas.
4. Summarizing the above, the impact of mobile emission sources (vehicles) and area emission sources (heating of individual homes and small factories) are large with NO₂.

3.2. Meteorological survey

On the basis of the results of this survey, the following observation can be made:

1. The wind velocity level during the survey period was generally gentle breeze or calm. The monitoring altitude was 1.5 m above ground. The impact of the structures and the topography unique to Skopje seemed to have greatly affected this.
2. Cases and monitoring points showing great wind direction variation in 24 hours could be found;
3. In RUN-3 (November 13 to 15) some monitoring points had relatively strong winds;
4. Depending on the monitoring positions, the topography greatly impacted and window systems W to NW and ESE to SSE more frequently.

References

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Апстракт. Вкупно 100 мерни места во мрежа од 1 km беа избрани како референтни места за следење на дистрибуцијата на азотните оксиди (NO и NO₂) на територијата на градот Скопје. Мерните места беа избрани врз основа на топографските услови, густината на објектите и постојните податоци и информации. На секое мерно место беа инсталирани едноставни земачи на проба. На 16 мерни места земачите на пробите беа поставени близу до постојните класични земачи на проби поради споредба на резултатите. Во земачите на проби се поставуваат филтри кои претходно се потопуваат во апсорционн раствори. Филтрите се заменуваат на секои 24 часа во период од 10 дена. Концентрациите на NO и NO₂ беа определувани спектрофотометриски.



Fig. 1. The concentration distributions of NO₂