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ANALYZE OF THE AIR QUALITY IN BELGRADE CITY DURING THE PERIOD SEPTEMBER 2010 - SEPTEMBER 2011

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Abstract: In this paper are in detail analyzed values for air quality that have been extracted in monitoring sites in Belgrade since September first in 2010 until September first in 2011. Values extracted in the stations Square Slavija and Despot Stefan Boulevard was analyzed. The main task of this paper is to present the inferred air quality, while the main aim represents the checking of obtained data in respect to limit pollution values. Analyses were done for annual, seasonal, monthly and daily values.

Key words: air, quality, Belgrade

Introduction

Clean air is essential for the health of all living beings and ecosystems. According to Tomić et al. (2000), in an unpolluted atmosphere, in small quantities are numerous harmful substances, as well as persistent components. Concentrations of pollutants that reach their natural emergence, usually far less than the damage that caused industrial products, plants, animals and humans. Their subsequent insertion into the atmosphere through a process that is responsible for the man, it seems that the effect of these substances is a serious social, health, economic, and environmental problem.

The main sources of air pollution are heating apartments, industrial activities and transportation. The most common pollutants are carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxide (NO2) and soot microparticles, and specific air pollutants are lead, cadmium, manganese, arsenic, chromium, nickel, zinc and other heavy metals and organic compounds are the result of different activities. Carbon monoxide (CO) is a toxic gas with no color, smell or taste. Formed during the incomplete combustion of fossil fuels. The amount to only 1% of the gas is lethal, while a high concentration of CO indirectly contributes to global

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warming. Gas emissions come mainly from traffic. Traffic became first significant source of air pollution in big cities in Europe and North America (Colvile, Hutchinson, Mindell & Warren, 2001).

As in other areas, and the traffic in Belgrade, one of the main sources of air pollution (Fenger, 1999). A large number of vehicles, their average age and quality of the fuel are the main causes of the increase in harmful substances. The concentration of benzene as the largest air polluters in the city, at the end of November, was 24 micrograms per cubic meter, while the allowed amount of the substance five micrograms per cubic meter. Unfavorable weather conditions contribute to the pollution, especially fog. Today's vehicles emit up to 80% less pollutants than cars 60-ies, however, the presence of pollutants in the air has increased because of the increasing number of vehicles. Use of unleaded gasoline is to reduce the presence of lead is very toxic, but the increased presence of volatile hydrocarbons (benzene, benzene, pyrene, acids, formaldehyde). The highest levels of contamination have been measured in the vicinity of the city's main roads. High concentrations of pollutants measured at 10 meters from the curb at a height of 1.5 meters of soil (Source: Institute of Public Health, Belgrade).

Materials and methods

The problem of air pollution is most often refers to the increase in the concentration of pollutants in a limited geoFigureal area (urban or industrial areas) (Milanović, Lješević & Milinčić, 2012). According to Filipović (1999) to overcome this problem perform two types of activities: activities are undertaken forecasting the concentration of toxic substances and implement measures to protect the definition of standards as the acceptable level of pollution. Air quality control in Belgrade is done on the basis of Air Quality Control Program in Belgrade in 2010 to the 2011th ("Official Gazette of the City of Belgrade" No. 6/10) adopted by the Belgrade City Assembly in accordance with the law. The scope and content of the air quality control is determined by the agreement concluded with the accredited laboratories of Institute of Public Health, Belgrade and the Institute of Public Health of Serbia "Dr Milan Jovanovic Batut". Existing legislation in the Republic of Serbia on the basis of the activities that take place monitoring air quality, protection of air pollution and improve the situation in this area is:

- Law on Environmental Protection ("Official Gazette of RS", No. 135/04,36/09 and 72/09),
- Law on Air Protection ("Official Gazette of RS", No. 36/09),

- Regulation on conditions for air quality monitoring requirements ("RS Official Gazette", No. 11/10 and 75/10),
- Regulation on limit emission values of air pollutants ("RS Official Gazette", No. 71/10)
- Ordinance on the content of plans air Quality ("Official Gazette of RS" No. 21/10),
- Rulebook on methodology for the development of action plans ("RS Official Gazette", No. 72/10).

For the purposes of this study, data were taken from the Institute of Public Health in Belgrade. Then, he analyzed the data and based on the information obtained, the synthesis and classification results. For measuring station in Belgrade were obtained daily average values for the period of September 2010. by September 2011. year for the following pollutants: nitrogen dioxide, carbon monoxide and sulfur dioxide. With the help of statistical methods in Microsoft Excel to calculate minimal, maximum and average daily and monthly values and average annual value. Then they obtained results are compared with the limit values laid down in the document criteria for evaluating the concentration of pollutants by the Regulation on the conditions and requirements for monitoring air quality (Official Gazette of RS, No. 11/10 and 75/10) on the basis of which obtain information on the number of days in which there has been exceeded emission limits in this period.

Results and discussion

Polluted air is exposed to the entire city, especially disadvantaged vulnerable groups, children, the sick and the elderly. Consequences of air pollution on the health of the population, is reflected in attacks of bronchial asthma on a massive scale, mucous membranes and skin diseases and disorders in the work of the respiratory tract, whereas in the case of absorption of gases occurring metabolic disorders and allergic manifestations in 10% of population. Urban air contains a mix of urban air pollutants. Toxic fumes from factories mixed with soot, nitrogen oxides, carbon monoxide and lead from car dissolve into mist form and smog. During bright peaceful days in the presence of sunlight to run many chemical reactions, which result in smog caused many toxic compounds. Features smog differs seasons. In winter, the smog has the most soot, nitrogen oxides and sulfur dioxide (winter smog), and in the summer has the most ozone, hydrogen peroxide and nitric oxide (summer smog). Smog is increasingly present in big cities measuring station Square stalker.

Measuring station Slavija

For the reporting period the workstation Slavija in relation to the GVI 46 days was higher concentration of NO2, CO 3 days and 4 days of SO2. It should be noted that for this measurement channel data were analyzed for the period from 01.11.2010. to 01.09.2011.

The average annual value for nitrogen dioxide (Figure 1) was 63.2 mg / m³ and higher than the prescribed limits of 40 mg / m³ and tolerant values of 60 mg / m³.

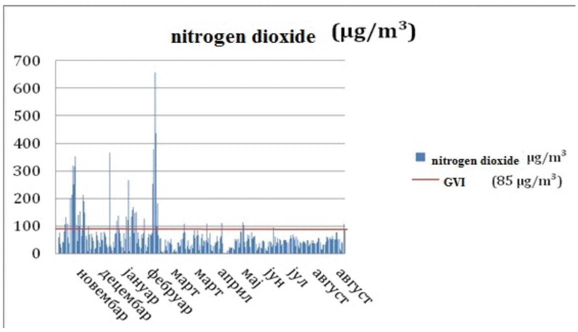

Figure 1 . Average daily values for nitrogen dioxide at the measuring station Square Slavija for the period 01.11.2010. - 01.09.2011.

The average annual value for carbon monoxide (Figure 2) was 1000 mg / m³ and is lower than the prescribed value of 3000 mg / m³.

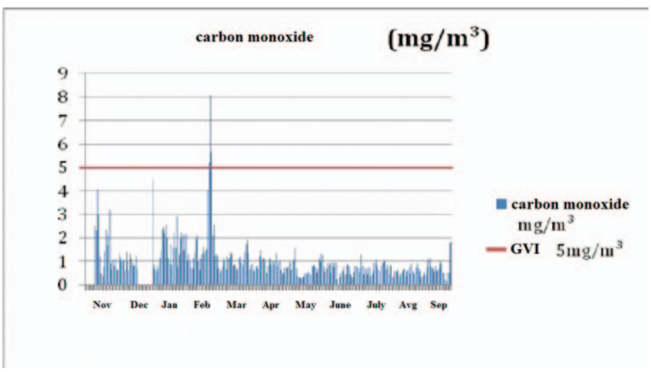

Figure 2. Average daily values for carbon dioxide workstation Slavija Square for the period 01.11.2010. - 01.09.2011.

The average annual value for sulfur dioxide (Figure 3) was 32.9 mg / m³ and is lower than the prescribed value of 50 mg / m³.

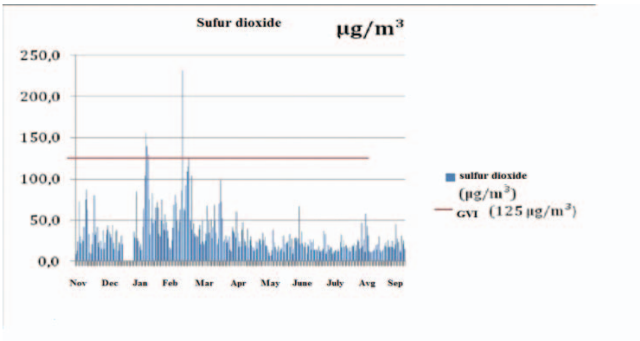

Figure 3. Average daily values for sulfur dioxide, workstation Slavija Square for the period 01.11.2010. - 01.09.2011.

When analyzing the data by season, i.e. during the period when the heating season and when it is not, the number of days with increased emission was 41 or 89% in the heating season and 5 days or 11% of the heating season. Analyzing by month with the most days over the concentration of pollutants GVI (Figure 4) was in November - 18, then in January and February - 10 in December - 6, in March, April, May, and August - 2 and June – 1.

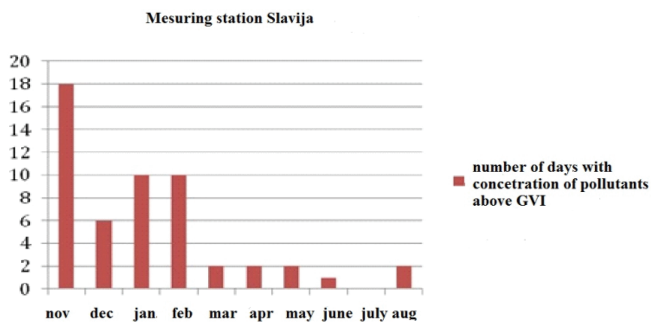

Figure 4. Number of days in the month and the concentration of pollutants through the GVI workstation Slavija Square for the period 01.11.2010. - 01.09.2011.

Lowest daily value of nitrogen dioxide was 25.04.2011. and was 0.2 mg / m³, while the highest was 657.4 mg / m³ on 07.02.2011. year, which is 5.2 times or 673% more than the MAC. As for carbon monoxide, the lowest value was 200 mg / m several times during the year, while the highest value was 8100 mg / m on 07.02.2011. year, which is 1.6 times more than the MAC. The concentration of sulfur dioxide was the lowest 25.04.2011. and was 6.6 mg / m³, while the highest was 232.4 mg / m³ on 02.02.2011. year, which is 1.9 times more than the MAC.

Measuring Station Boulevard of Despot Stefan 54 a

In the analyzed period the workstation Boulevard of Despot Stefan had 41 days worth of nitrogen dioxide over the allowed values, 2 days had significantly higher concentrations of carbon monoxide and two days was the increased concentration of the sulfur dioxide, the period of 01.09.2010. - 01.09.2011. Increased values are related pollutants in most cases for the heating season (October - April), 88.9% or 40 days, while 11.1% or 5 days during the heating season.
Nitrogen dioxide has an average annual value for the analyzed period of 59.9 mg / m³ (Figure 5), this value is higher than the average limits of 19.9 mg / m³, and is lower than the tolerance value of 0.01 mg / m³.

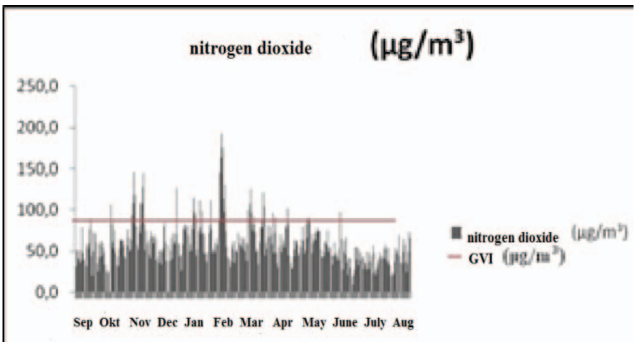

Figure 5. Average daily values for nitrogen dioxide in the workstation Despot Stefan Boulevard for the period 01.09.2010. - 01.09.2011.

The average annual value for carbon monoxide was 1000 mg / m³ and is lower than the prescribed value of 3000 mg / m³.

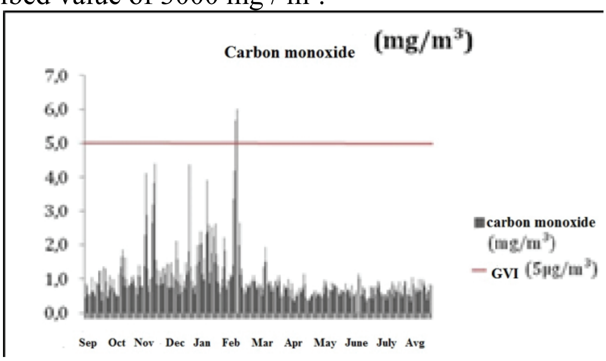

Figure 6. Average daily values for carbon monoxide at workstation Despot Stefan Boulevard for the period 01.09.2010. - 01.09.2011.

The average annual value for sulfur dioxide was 26.6 mg / m³ and is lower than the prescribed value of 50 mg / m³.

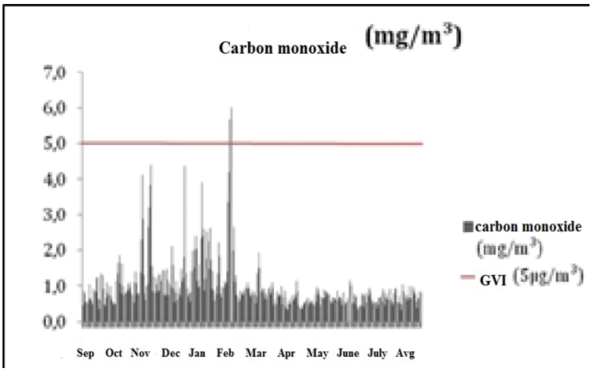

Figure 7 Average daily values for sulfur dioxide, workstation Despot Stefan Boulevard for the period 01.09.2010. - 01.09.2011.

Analyzing by month with the most days over the concentration of pollutants GVI was in February - 11, followed in November and March - 8 in January - 6, in March, December, April and May - 3 and in September, October and June-1 . Lowest daily value of nitrogen dioxide was 30.06.2011. and was 9.6 mg / m³, while the highest was 192.4 mg / m³ on 07.02.2011. year, which is 2.3 times more than the MAC. As for carbon monoxide, (Figure 6) the lowest value was 300 mg / m several times during the year, while the highest value was 6000 mg / m3 on 08.02.2011., which is 1.2 times more than the MAC.

The concentration of sulfur dioxide was the lowest 08.06.2011. and was 4.5 mg / m³,(Figure 7) while the highest was 179.2 mg / m³ on 02.02.2011. year, which is 1.4 times more than the MAC. Influence of nitrogen dioxide on human health and the environment. About half of the annual production of nitrogen dioxide comes from traffic, and 44% from other sources (power plants, industry), and the rest goes to other sources (combustion and decomposition of solid waste, agriculture) (Lješević, 2005).

Nitrogen dioxide is toxic but more severe illness left his secondary compounds, nitric acid and PAN. Peroksiacil nitrate are very toxic to plants. A nitrogen oxide from the air falls on the surface of the earth, the sea and the oceans dry and wet deposition. Dry deposition should be dropped 1/3 of the total volume of air. Wet deposition includes nitric acid, which participates in the creation of acid rain.

Of all the most toxic nitrogen oxides on human health is nitrogen dioxide. At higher concentrations, inflammation of the lungs is rapid, and the outcome can be fatal. Pulmonary edema, which causes nitrogen dioxide, develops relatively quickly, often with fatal consequences.

Concentrations of 100-150 ppm are dangerous at short exposure of 30-60 minutes. A high concentration of 200-700 ppm causes death in a short exposure. Chronic poisoning caused by irritation of the respiratory tract, cough, headache, loss of appetite, tooth corrosion.

Conclusion

Carbon monoxide, nitrogen dioxide and sulfur dioxide are the most important air pollutants (Chen T.M., Gokhale J., Shofer S., Kuschner W.G., 2007; Jablanović et al., 2003). The biggest problem of pollution and air purification is that because the pollution spread over long distances by air is the most difficult to clean up. Some of the solutions to reduce emissions from motor vehicles (as it involved about half of the total nitrogen oxides pollution) are: use of catalytic converters, the use of "cleaner" Automobile and buses off the car at the traffic lights that keep the long, green surfaces. By analyzing two of the busiest intersections in several Belgrade, we found that of 47 days over GVI concentrating on the workstation Slavjia Square 46 days has been elevated concentrations of nitric dioxide. At the measuring point Despot Stefan Boulevard 43 days with a concentration over 40 days GVI has been elevated concentrations of nitrogen dioxide gas. Also the average annual value of nitrogen dioxide is higher in the workstation Slavija Square prescribed limits and tolerance values. Mean daily maximum concentration at the measuring site Slavjia are reaching a concentration of 657.4 mg even / m^3 which is 5.2 times more than that required ILV notice to the public through electronic and print media. Based on the foregoing, it is necessary to carry out systematic measurements of air pollution in Belgrade.

It provides exercise more goals as follows:

-monitoring the level of Air pollution at relation to the limit values (MAC),

-preventative measures in the areas of importance for the protection of air pollution,

-informing the public and making recommendations for the conduct of the episodes of increased air pollution,

-monitoring the concentration trends for urban areas of the territory,

-exposure assessment for population,

-Identify sources of pollution or risk,
-Evaluation of long-term trends,
-understanding of the measures of the degree of air pollution.

To focus on health surveys, since the measurement of pollutants originating from mobile sources and exercise in order to protect public health. In this sense, monitor the health effects of lead and carbon monoxide influence peddling to the population that is most exposed to these pollutants (traffic police, working in small shops, people who live near the roads in the central city area, etc..).

References

Chen T.M., Gokhale J., Shofer S. & Kuschner W.G. (2007). Outdoor air pollution: nitrogen dioxide, sulfur dioxide, and carbon monoxide health effects. *Am J Med Sci., 333(4)*. 249-56

Colvile R.N., Hutchinson E.J., Mindell J.S. & Warren R.F. (2001). The transport sector as a source of air pollution. *Atmospheric Environment. Vol.35, issue 9*, 1537-1565

Fenger Jes (1999). Urban air quality. *Atmospheric Environment, Vol.33, issue 29*, 4877-4900

Filipovic D. (1999). *Modeling Environmental Pollution cities - monitoring and protection*. Belgrade: Andrejevic Foundation.

Jablanović M. et al. (2003). *Introduction to Ecotoxicology*. Pristina: Faculty of Science and Mathematics, University of Pristina.

Lješević M. (2005). *The theory and methodology of Environment*. Belgrade: University of Belgrade, Faculty of Geography,.

Milanovic M., M Lješević. & M Milinčić. (2012). Ecomanagment. Belgrade: University of Belgrade, Faculty of Geography.

Republic of Serbia (2009). Law on Air Protection. Official Gazette of the Republic of Serbia no. 36/09, Belgrade.

Republic of Serbia (2010). Criteria for evaluating concentrations of pollutants by the Regulation on the conditions and requirements for monitoring air quality, Official Gazette of the Republic of Serbia no. 11/10 and 75/2010, Belgrade.

The Institute of Public Health (2010). *Quality of the Environment of Belgrade in 2009*. Belgrade: Ecological Bullten,.

Tomic P., Romelic J., Kicosev S., Plavsa J., Markovic S. & Stojanovic V. (2000). *Tourism and Protection*. Novi Sad: University of Novi Sad, Faculty of Sciences and mathematics, Institute of Geography.