Journal of Environmental Protection and Ecology 6, No 3, 513–520 (2005)

RESULTS OF AIR QUALITY MONITORING IN BOSNIA AND HERZEGOVINA

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Abstract. In development and survival of living organisms, the quality of gas mixture that surrounds those beings extremely affects the natural process of the observed system. Disturbance of the optimum air content can originate from the local region, but can also come with shifting of airstreams from the surrounding areas. The paper gives the results of the air quality control in Bosnia and Herzegovina in the last 20 years.

Keywords: air quality, monitoing, SO_2, smoke, pollutants.

AIMS AMD BACKGROUND

Man is a sole species able to think and change nature with its action, mainly endangering natural balance. By jeopardising natural environment with these actions man directly endangers himself as well. By his selfishness and narrow-mindedness an individual does not endanger only himself and his environment but also through the fluid flows, which have no limits, he endangers the others outside his surroundings.

The gases coming from industrial and power plants chimneys as well as car exhaust gases are released directly into atmosphere. Depending on air temperature changes with the altitude, they will either start falling upon reaching certain altitude or they will be distributed horizontally.

If gases are not cooled quickly they will rise high, which may have positive effects from pollution aspect on the local level. In that case, the pollutants are being dispersed high and far from the pollution source. Accordingly, the emitted gases can not have harmful effects in the vicinity of the pollution source.

It is understood that the issue of air pollution is not resolved with this, since the transport of pollutants far from the pollution source may cause unwanted effects in the areas where the pollution source is not existing, i.e. 'virgin regions'.

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If temperature of gases that carry pollutants drops abruptly with altitude and becomes lower than the temperature of environment, gases return to close vicinity of the source of pollutants, which results in sudden increase of concentration of pollutants. It often happens that air temperature goes up with altitude instead of dropping, thus creating conditions known as temperature inversion[1]. That is the most difficult situation from the aspect of pollution of air of the close environment. Under such conditions, distribution of pollutants in bigger spaces is not possible.

Man can choose the quality of food and water, whereas he is forced to take the surrounding air. One can live without food for 40 days, without water for 5 days, and without air for 5 min. For 24 h man needs 1 kg of food, 2.5 kg of water and 12 kg of air.

Disturbance of ratio of the permanent air components: nitrogen, oxygen, hydrogen and precious gases, as well as water vapours and carbon dioxide is deemed air pollution.

INFLUENCE OF AIR POLLUTION ON QUALITY OF LIFE

Air pollution negatively affects all the organs[2]. Respiratory system is the most affected one. It is affected by air pollution both acutely and chronically. The acute phase appears on the fourth day of the pollution duration. Firstly, children and elderly get sick.

Many scientific studies have already pointed out to correlation between origin of lungs cancer and air pollution. Decrease of solar radiation penetration due to air pollution indirectly reflects on outbreak of rachitis and similar diseases. The unbalanced concentration of oxygen violates metabolism and other processes in organism either directly or indirectly.

In 1952, due to too high concentration of soot and sulphur dioxide SO_2, 4000 of adults and children died in London in four days. The similar event happened in New York ten years later, and in Tokyo, in 1970, only in one month 9000 persons got sick for the same reason. The flora, on the other hand, is less adjustable to change of natural ratio of the gas mixture, which is surrounding it. Sensitivity of the flora to disturbances of ratio of components of the gas mixture is more than 10 times higher than the human. Diversity of air pollution affects the flora in different ways.

Figure 1 shows the condition of the tree that has been exposed to exhaust gases of the car that is waiting to enter the main road. Reaction of chlorophyll and pollutions jeopardises the expected photosynthesis. Leaves appear light green and turn to yellowish: the tree becomes undeveloped and dies (Fig. 1,b).

Also, increased concentration indirectly affects the photosynthesis development in other ways. Reduction of photons number that reaches the leaf under

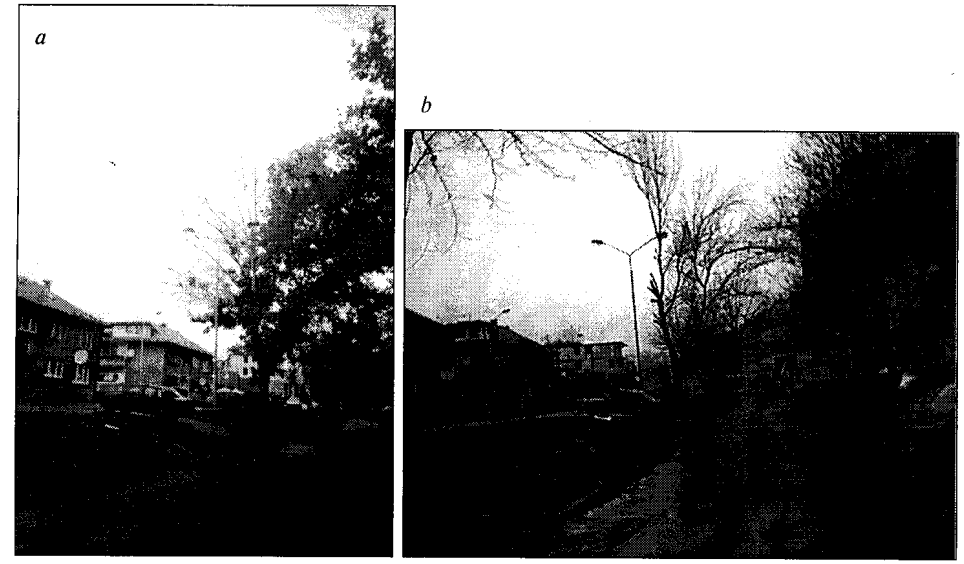

Fig. 1. Tree at the crossroad-uphill is more intensely exposed to higher concentration of car exhaust gases: P. Kosorica street, Tuzla–Slatina (*a*), part of the tree has died (*b*)

conditions of air pollution slows down the photosynthesis and normal development of flora. Due to reduced visibility caused by air pollution in vicinity of the factory as well as in vicinity of power plants without environmental treatment, one of the local popular proverbs says: 'dusk begins even at noon'.

As the gas mixture the air is easily movable, and does not know any limits. This is what makes monitoring and analysis of gases on each locality interesting.

QUALITY OF AIR MONITORED THROUGH CONCENTRATION OF SO_2 AND SMOKE

Quality of air and precipitation has been monitored periodically in all bigger cities in Bosnia and Herzegovina since 1967 through basic network of meteorological stations. Concentration of sulphur dioxide is one of the major and also unpleasant indicators of air pollutions[3]. There are data available for areas of Sarajevo and Tuzla. Figure 2 indicates the data on average annual concentration of sulphur dioxide and smoke for longer period (1975-2003) on locality of Bjelave-Sarajevo.

Life and work inside the city determines the concentration of pollutants. The diagram in Fig. 2 indicates the occurrences in Bosnia and Herzegovina and 'purification of atmosphere after their war'. Stagnation of industry has reduced concentration of the pollutants. Analysis of these data indicates that concentration of sulphur dioxide in atmosphere of Sarajevo in period 1995-2002 gradually

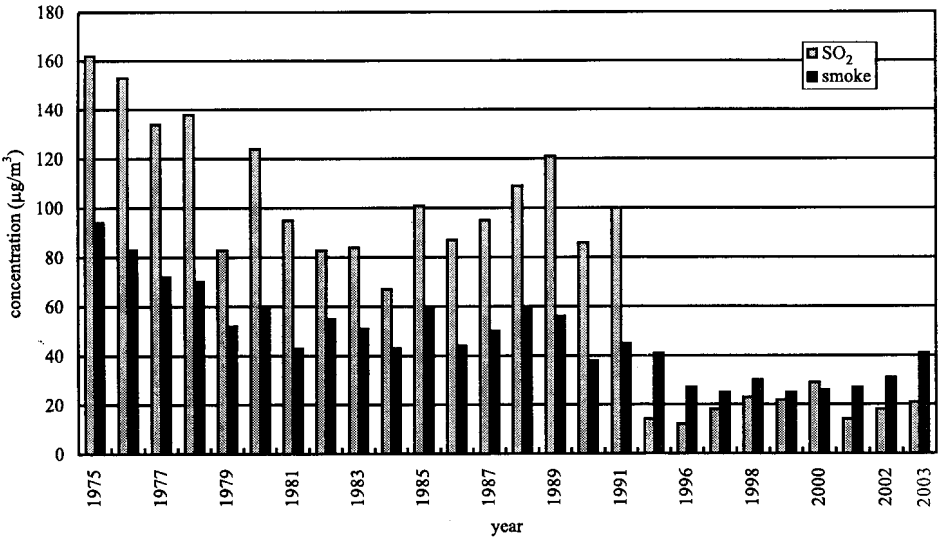

Fig. 2. Average annual concentration of sulphur dioxide and smoke on locality of meteorological station Bjelave–Sarajevo (1975-2003)

increased after the war. In the year 2001, there was a drop in concentration of the discussed pollutants. This can be interpreted by favourable meteorological conditions. During the winter period of the year 2001 there was no long periods with temperature inversions, and the temperatures were higher on average, so that less energy has been spent for heating, and the pollution of atmosphere was lesser. Statistical indicators show that after the war air was 'clean' against the standards of pollution and against the pre-war state, when Sarajevo was among the most polluted towns in Europe.

Monitoring the concentration of sulphur dioxide and smoke in air at Mostar indicates relatively low values of these two parameters, so that it can be concluded that quality of air in the analysed period from 1999-2001 was not endangered. Monitoring of annual concentration of sulphur dioxide and smoke in Tuzla Meteorological station shows stagnation of concentration of SO_2 for period from 1990-2003 (Fig. 3).

By measuring and analysing the concentration and other pollutants, the picture of condition of air quality in some environment: SO_2, NO, NO_2, NO_x, CO gets more completed.

Air in Bosnia and Herzegovina is not jeopardised, except locally and occasionally. On representative spots it is possible to have automatic recording of concentration of pollutants, which jeopardise the environment. Figure 4 indicates the data about automatic measurement of large number of pollutants on locality Bjelave–Sarajevo. The average annual values are calculated for the year

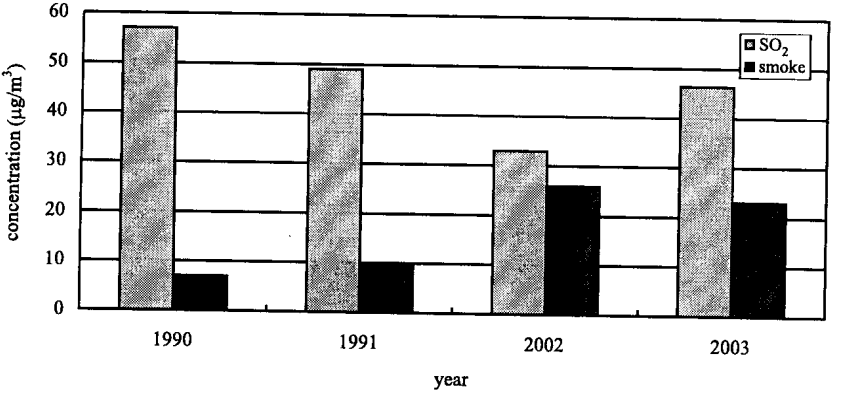

Fig. 3. Average annual concentrations of sulphur dioxide and smoke on locality Tuzla–Meteorological station (1990-2003)

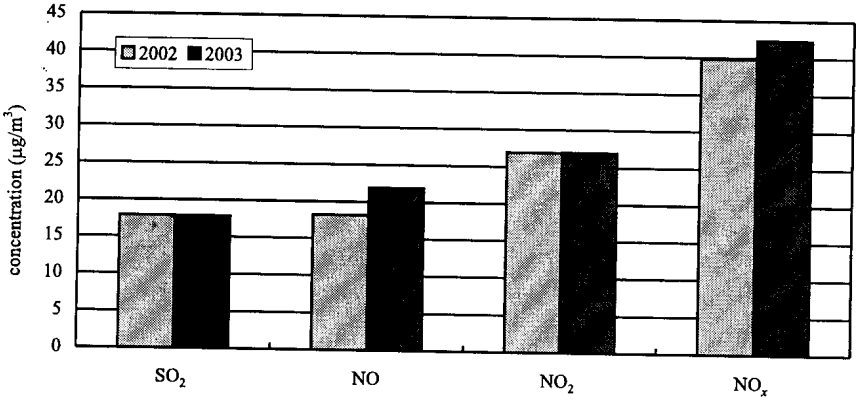

Fig. 4. Average annual concentrations of pollutants Bjelave–Sarajevo (2002 – 2003)

2002. Figure 4 indicates average annual concentration during the year 2002 for the locality Bjelave–Sarajevo.

Chemical processes of pollutants and water vapour result in acid precipitation. These processes can start at the place of pollution source and act both directly and aggressively on the materials at the spots where pollutants were formed. However, pollutants are more often transferred by the air fronts, flows, to the 'virgin' localities. By the air fronts pollutants are being brought and removed, expressing their presence through the acid precipitations.

The samples were taken and the acidity of the precipitations at locality Bjelave–Sarajevo was checked up. Figure 5 represents a diagram of the number of acid precipitations for period from 1996-2002.

From Fig. 5 a gradual increase in acidity of precipitation can be seen. Gradual increase in acidity of precipitation is symptomatic. Correlation is incomplete with average concentration of SO_2 in the discussed period.

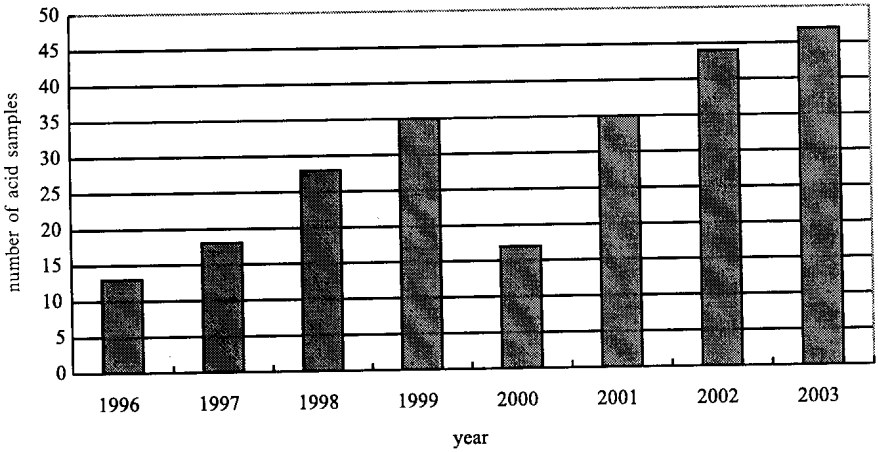

Fig. 5. Number of acid precipitation on locality of Bjelave–Sarajevo (1996-2002)

Pollutants obviously arrived by shifting of airstreams of the fronts, which brought pollutants from another locality. Analysis of percentage of acid precipitation for period from 1996-2000 indicates the expected results per months (Fig. 6).

Percentage of acid precipitation in spring and summer months is half lesser (3% and 4%) than in autumn and winter months (11% and 13%). This can be interpreted by airstreams and meteorological conditions, by arrival of air fronts in autumn and winter period.

The biggest number of acid precipitation can be explained by the already known fact of distant transports. By analysing directions of wind, over 80% of acid precipitation comes by air masses from north-west to Sarajevo. This proves the fact that local pollution in Bosnia and Herzegovina area does not affect the

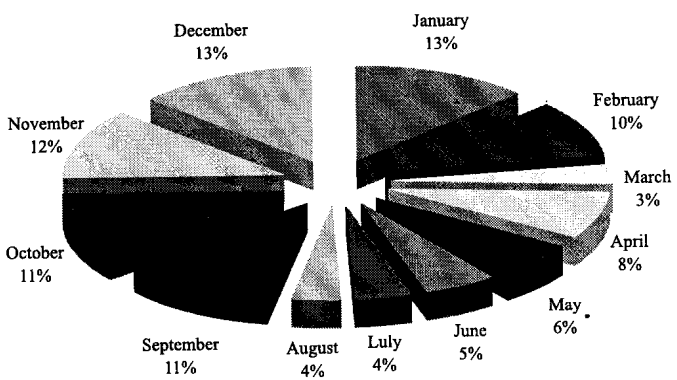

Fig. 6. Percentage of acid precipitation on locality Bjelave–Sarajevo (1996-2002)

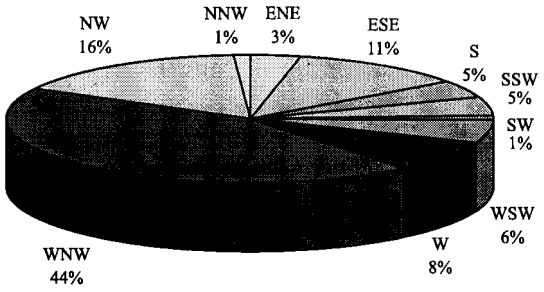

Fig. 7. Functional dependence of wind direction and acid precipitation on locality Sarajevo (2002-2003)

frequency of acid precipitation. Namely, it is a consequence of frontal masses, which got polluted moving over Europe.

It would be interesting to determine the sources of emission from cars and energy plants, separately. Statistical recording should be done for representative localities and representative periods.

IONISING RADIATION OF AIR POLLUTION MEASURES

Bringing the energy in through ionising radiation can greatly disturb normal functioning of living systems. Presence of ionising radiation in the air also gives a more complete picture of disturbed composition of air.

According to the data of continuous measurements over years (1998-2004) on locality Sarajevo, there is no alarming disturbance of natural system due to ionising radiation. Figure 8 indicates annual absorbed doses of the ionising radiation on locality Bjelave–Sarajevo.

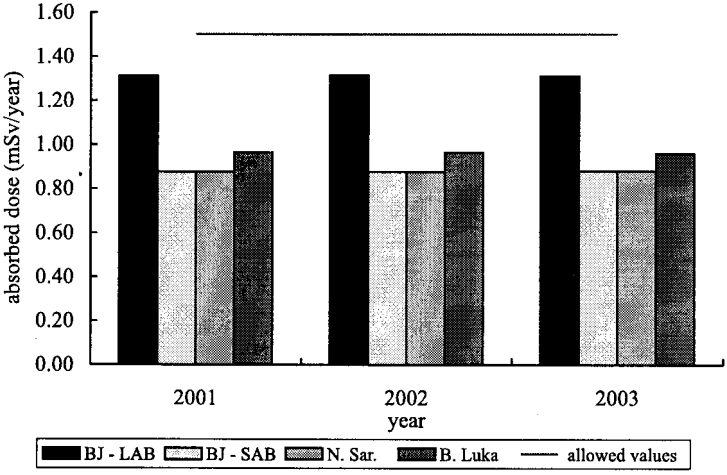

Fig. 8. Annual absorbed doses of ionising radiation on locality Bjelave–Sarajevo (1998-2002)

The data do not include existence of areas on which there are remnants of radioactive materials or natural radioactive materials (poor uranium and alike). By comparing the measured data in Bosnia and Herzegovina with the known ones, there is no reason for any concern about possible danger[4]. Having in mind that a big number of nuclear plants operate in Europe, which increases possibility of extraordinary situations, there is a logical need for establishment of network for monitoring radioactivity. Experience from the 'Chernobyl' incident indicates that the nuclear cloud can cross several countries and primarily jeopardise human lives and other living world. The air fronts do not have any limits. By timely warning through the network for monitoring of the pollutants, the main harmful effects to the health of people can be essentially prevented and reduced.

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Received 5 July 2004
Revised 3 October 2004