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# THE ANALYSIS OF RELATIONS OF STANDARD POLLUTING SUBSTANCES CHARACTERISTICS IN URBAN ENVIRONMENT AIR

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**Amelija Đorđević, Danilo Popović, Jasmina Radosavljević**

University of Niš, Faculty of Occupational Safety, Dept. of Environmental Protection
Čarnojevića 10 A, 18000 Niš

**Abstract**. *In this work is given the analysis of relations of standard polluting substances ($SO_2$, CO, $NO_x$, particles), as well as their damaging effect on biosystem. Although the analysis is only the starting point in this complex area, it could be a good into the atmosphere and removing the polluting substances from it.*

**Key words**: *polluting substances, aeropollution, urban environment.*

## INTRODUCTION

The program of following the urban environment air quality, includes measuring the imission of standard polluting substances: sulphur - (IV) oxide, carbon - (II) oxide, nitrogen oxides, photochemical oxidants, and particles (aerosediments and soot).

This program includes the measuring of the concentration of specific polluting substances; if while applying certain technological processes it comes to their emission in high concentrations.

After continuing measuring of polluting substances concentrations, in the period of five years at least; the evaluation of urban environment air quality is given. Measuring of polluting substances concentration is performed usually on three or more measuring places, where 24-hours air sample is gathered. Depending on the increasing trend or decreasing the polluting substances concentration, through the given period, the analyzed urban environment air quality is evaluated.

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## SULPHUR COMPOUNDS IN URBAN ENVIRONMENT AIR

Sulphur compounds in the urban environment air appear as sulphur oxides ($SO_2$, $SO_3$, sulfide ($H_2S$), sulphate ($H_2SO_4$), sulphite acid ($H_2SO_3$) and as salts of these acids. The biggest quantities of sulphur compounds in human environment atmosphere, appear while fuel burning: by coal burning about 70% and by oil burning and oil derives about 16%. From the total emitted mass of sulphur compounds, about 60% is in the from of aerosol; 20% as sulphur (IV)- oxide ($SO_2$) and 20% as sulphite acid ($H_2S$).

Sulphur - (IV) oxid greatly violates the air quality of urban environments. By chemical reactions in atmosphere, sulphur - (IV) oxide is taken into $SO_3$, $H_2SO_3$, $H_2SO_4$. By direct chemical reaction sulphur - (IV) oxide with the oxygen from the air, its oxidation is undertaken to $SO_3$:

$$SO_2 + \frac{1}{2} O_2 \rightarrow SO_3 \qquad (1)$$

The speed of this chemical reaction is small. But, in the presence of the air particles (metal salts for. ex.) the reaction is catalyzed and is performed very quickly. In the presence of sun rays, the sulphur - (IV) oxide oxidation by atmospheric oxygen is quick as well; and is performed by the following mechanism:

$$SO_2 + h\nu = SO_2^*, \qquad (2)$$

$$\begin{aligned} SO_2^* + O_2 &\rightarrow SO_4, \\ SO_4 + O_2 &\rightarrow SO_3 + O_3 \end{aligned} \qquad (3)$$

The maximal speed of atmospheric sulphur - (IV) oxide oxidation may be even bigger than 6%/h. The oxidation of sulphur - (IV) oxides in the air is performed in the gaseous phase and by heterogeneous reactions (air particles of water drops).
In touch with atmospheric water, $SO_3$ is transformed into sulphare acid:

$$SO_3 + H_2O \rightarrow H_2SO_4 \qquad (4)$$

and with water steam and water drops into sulphite and sulphare acid:

$$\begin{aligned} SO_2 + H_2O &\rightarrow H_2SO_3, \\ H_2SO_3 + \frac{1}{2} O_2 &\rightarrow H_2SO_4, \\ SO_2 + \frac{1}{2} O_2 + H_2O &\rightarrow H_2SO_4. \end{aligned} \qquad (5)$$

The sulphur - (IV) oxides oxidation ($SO_3$, $H_2SO_4$, $H_2SO_3$) products are more reactive in relation to sulphur - (IV) oxide and have more destructive effect on organic and inorganic substances. Sulphate acid destroys construction material, which has calcium carbonate. In the chemical reaction of sulphate acid and calcium carbonate; the calcium carbonate is transformed into calcium-sulphate (gypsum):

$$H_2SO_4 + CaCO_3 \rightarrow CaSO_4 + H_2O + CO_2 \qquad (6)$$

In this way the construction material is destructed because he connective characteristics are lost and their mechanical firmness is reduced, which is known as stone cancer.

Sulphur - (IV) oxide and its conversion products lead to alloy and metal corrosion (steel, iron, zinc), the colour damage, textile and synthetics tissues (nylon). These damages are specially evident when the average year′s sulphur - (IV) oxide concentration is over 300 μg/m$^3$. The sulphur - (IV) oxide in much less concentration shows phitotoxical effect; when the average year′s concentrations of sulphur - (IV) oxide are above 80 μg/m$^3$, it leads to significant vegetation damage. The damages appear on the plants leaves in the form of necrotic spots, chlorose appears, disturbance of proteins biosynthesis and disturbance of daily-night opening and closing of stomas. The increasing sulphur - (IV) oxide concentrations have negative effects on human health. When the sulphur - (IV) oxide concentration is above 0,02 mg/m$^3$ it leads to breathing organs irritation.

According to the WHO data when the concentration of sulphur - (IV) oxide is above 0,1 mg/m$^3$ it leads to respiratory diseases (bronchitis, paracheratosis) especially with children and older persons.

The time of presence of sulphur - (IV) oxide in the air is 2-3 days.

## CARBON - (II) OXIDE IN THE URBAN ENVIRONMENT AIR

Carbon - (II) oxide, which is in the atmosphere, comes mainly from natural sources. It comes in processes of incomplete carbonic oxidation and compounds. It appears in bigger concentration in the volcano smoke, in the space where the decay of organic materials appears, and in the space above the coal deposits. From the natural sources by the methane oxidation, appears about 80% of carbon - (II) oxide. By the decay of organic substances in nature is created methane, which chemically reacts with hydroxide radical according to following chemical mechanism:

$$CH_4 + {}^{\bullet}OH \rightarrow {}^{\bullet}CH_3 + H_2O \tag{7}$$

$${}^{\bullet}CH_3 \xrightarrow[\text{reactions}]{\text{several}} CO \tag{8}$$

From the total present mass carbon - (II) oxide, in atmosphere, 7% comes from anthropogenic sources. Anthropogenic sources of carbon - (II) oxide, are mainly situated in urban and industrial environments.

Because of incomplete burning of fuel in energetic plants, home headings, in different industrial processes and in the work of motor vehicles, it comes to the carbonic - (II) oxide emission. The greatest individual contribution carbonic - (II) oxide emission, from anthropogenic sources, have motor vehicles (63,8%); motor vehicles with gas motors 59,2%, industrial processed 8%, garbage burning 5% and energy plants 1,2%.

It could be distinguished three kinds of redox_processes of forming carbon - (II) oxide in the atmosphere:

1. Process of incomplete carbon burning or its compounds (gas e.g.):

$$C + \frac{1}{2}O_2 \xrightarrow{t>710^0 C} CO\,. \tag{9}$$

The first product of carbon oxidation is carbon - (II) oxide, which because of the presence of triple bonos ($C\equiv O$) is stable and further oxidation to carbon - (IV) oxide is very slow. In the case of insufficient mass of oxygen or when the mixture of fuel and air is weak, it would not come to carbon - (IV) oxide oxidation into carbonic - (IV) oxide.

2. Process of reduction of carbonic - (IV) oxide by carbon:

$$C + CO_2 \xrightarrow{high\ \ temperature} 2CO\ . \tag{10}$$

3. Process of reduction of carbon - (IV) oxide:

$$CO_2 \xrightarrow{high\ temperature} CO + O\ . \tag{11}$$

By a sudden cooling of the reactive mixture it may not come to fast reoxidation of carbon - (II) oxide and it is kept in great quantity in the air. Carbon - (II) oxide in the atmosphere often reacts with $^{\bullet}$OH radical according to the chemical reaction:

$$CO + {}^{\bullet}OH \rightarrow CO_2 + H \tag{12}$$

The greatest mass $^{\bullet}$OH in the atmosphere, comes by the reaction of oxygen with the water steam:

$$O + H_2O \rightarrow 2^{\cdot}OH\ . \tag{13}$$

In the urban environments the concentration of carbon - (II) oxide is changeable during daytime. Considering the fact that the motor vehicles are the main emitters of carbon - (II) oxide, its concentrations are directly caused by the traffic frequency. The concentrations are mainly largein the morning and afternoon hours, and in the towns with the developed traffic they could be above 114,3 mg/m$^3$.

The concentration carbon - (II) oxide control in the urban environments is undertaken because of its toxic effect. The increased concentrations may cause many physiological and pathological changes with people and animals such as: hypocsy, anoxy, creation of carboxichemoglobin, cardiovascular and central nervous system damages.

The time of presence of carbon - (II) oxide in the air is from a few months to 3 years.

## NITRIC OXIDES IN THE URBAN ENVIRONMENTAL AIR

In the atmosphere there are different forms of nitric oxides such as: $N_2O$, NO, $NO_2$, $NO_3$, $N_2O_3$, $N_2O_4$, $N_2O_5$. From the mentioned nitric oxides: nitro - (II) oxide (NO) and nitro - (IV) oxide ($NO_2$) have a big contribution in the total air pollution. The main pollutants of these nitric oxides are the natural sources. E.g.: nitro - (II) oxide, is created by the bacteria reaction, which perform the reduction of nitric compounds without oxygen presence. The created nitro - (II) oxide is further oxidized with the atmospheric oxygen to nitro - (IV) oxide:

$$2NO + O_2 \rightarrow 2NO_2 \tag{14}$$

The nitric oxides emission, which comes from anthropogenic sources, makes 10% from total emission. But big concentrations of nitric oxides that come from anthropogenic sources are kept in the urban environments. The measurings showed the concentration values which are 10 - 100 times bigger in urban and industrial environments as comparated in relation to rural areas. The basic anthropogenic sources of nitrogen - (II) oxide and nitrogen - (IV) oxide are the processes of burning. The greatest contribution, from anthropogenic sources, in the emission on nitro - (II) oxide and nitrogen - (IV) oxide have gases motor vehicles (34,9%), processes of coal natural gases is done (23,3%). Nitrogen - (II) oxide is created by uniting of nitrogen, which is the part of fuel, and oxygen on temperature above 1200 $^0$C :

$$N_2 + O_2 \rightleftarrows 2NO \tag{15}$$

By sudden cooling of nitrogen - (II) oxide, after its emitting, the recurrent of disassembling the nitrogen - (II) oxide. This is the main reason why in the emitted gases, which are created by fuel burning, are situated the biggest masses of nitrogen - (II) oxide. In the process of fuel burning by nitrogen oxidation are created even the small amounts (0,5%) of nitrogen - (IV) oxide. But, in the atmosphere by nitrogen - (IV) oxide emission; very quickly are created the biggest amounts of nitrogen - (IV) oxide. It is explained by nitrogen - (II) oxide oxidation, by atmospheric oxygen (chemical reaction 14), molecule $O_3$ (chemical reaction 16), organic radicals $^{\bullet}RO_2$ (chemical reaction 17) :

$$NO + O_3 \rightarrow NO_2 + O_2 \tag{16}$$

$$NO + \cdot RO_2 \rightarrow NO_2 + RO \tag{17}$$

From the total mass of nitrogen - (II) oxide which is created by chemical reaction (14), by fuel burning, 10% is transformed into nitrogen - (IV) oxide.

Under the influence of ultraviolet rays (< 380 nm), nitrogen - (IV) oxide in the air is disassembled to nitrogen - (II) oxide and oneatomic oxygen:

$$NO_2 \xrightarrow{h\nu} NO + O \tag{18}$$

One atomic oxygen reacts with molecular oxygen of the air and ozone is created:

$$O_2 + O + M \rightarrow O_3 + M \tag{19}$$

In the chemical reaction of forming the ozone (19) the mark M presents the participation of molecules and atom which may undertake the surplus of energy to the created molecule of ozone and to prevent its disassemblation. Molecule or atom M from this reaction stays chemically unchanged. Reactive ozone reacts with nitrogen - (II) oxide from the air giving nitrogen - (IV) oxide:

$$O_3 + NO \rightarrow NO_2 + O_2 \tag{20}$$

In this way is created the cycle of nitrogen oxide cycling which are transformed from one form into another. The scheme of photolytical nitrogen cycle which is performed in nonpolluted atmosphere is given on the fig. 1.

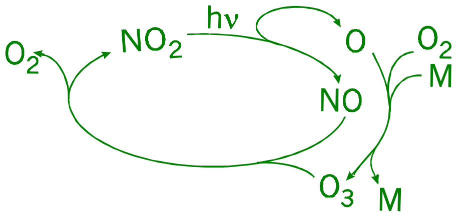

Fig. 1. Scheme of photolytical nitrogen cycle in nonpolluted atmosphere /5/

By nitrogen cycle is kept the balance in the air among nitrogen - (II) oxide and nitrogen - (IV) oxide. It comes to the interruption of this photolytical nitrogen cycle. If NO, from this cycle, oxidizes with $^{\bullet}RO_2$ according to chemical equation 17. Researches [5] have shown that the nitrogen oxide concentration during the day variates: before Sun rising, the concentrations are mainly constant, during the day the nitrogen - (II) oxide concentration increases because of the influence of anthropogenic sources in urban environment; with the increased the concentration of nitrogen - (IV) oxide; the concentration of nitrogenic oxides decreases during the night.

In winter months because of increased consumption of fossil fuels, the nitrogen oxides concentration are increased. By quantitative methods is measured the total concentration of nitrogen - (II) oxide and nitrogen - (IV) oxide and is marked as nitrogenic oxide concentration (NO). Following the concentrations of nitrogenic oxides in urban environments should be done regularly because of its destructive effect on organic and inorganic materials. Nitrogen - (IV) oxide reacts with the water drops in the air creating nitrate or nitrite acid:

$$2NO_2 + H_2O \rightarrow HNO_3 + HNO_2 \tag{21}$$

Nitrate and nitrite acid as well as nitrogen oxides destroy textile tissues, do the metal corrosion and have toxic effect on biosystem. Phitotoxic effect is expressed at the concentration 2 ppm by the disturbance the photosynthesis process, damaging and falling the leaves because of the appearance of necrotic spots and by chlorose.

The bigger nitrogen oxide concentrations take to respiratory difficulties headache, teeth damages e.t.c. with people. Because of characteristic red-orange-brown color of carbon - (IV) oxide which appears by increasing its concentration, it takes to decreased visibility in the air. Negative effect of nitrogen oxides is seen in forming special form of air pollution, known as photochemical smog. The time of presence of nitrogen - (II) oxide in the air is about 3 days, and nitrogen - (IV) oxide is 4 days.

## PHOTOCHEMICAL OXIDANTS IN THE URBAN ENVIRONMENT AIR

By photochemical reactions some primary pollutants form photochemical oxidants. Photochemical oxidants are chemically reactive compounds, molecules and atoms, which bring to the oxidation of present compounds in the atmosphere, which could not be oxidize by atmospheric oxygen molecule. From photochemical oxidants the most significant are; as secondary pollutants, tropospheric ozone ($O_3$) and pheroxiacetil-nitrate ($CH_3$-CO-$OONO_2$).

Tropospheric ozone in the greatest amount is created by photolytical nitrate cycle (Fig.1.). The concentration of ozone created in this cycle is proportional to the relation of concentration of nitrogen - (IV) oxide and nitrogen - (II) oxide. If the atmosphere are increased the concentrations of $^{\bullet}RO_2$ and nitrogen oxides, it will come to increased concentration of tropospheric ozone. The increase of tropospheric ozone is the consequence of nitrogen - (II) oxide oxidation with $^{\bullet}RO_2$ (chemical reaction 17). The speed of chemical reaction of nitrogen - (II) oxide oxidation in the air $^{\bullet}RO_2$ is bigger than the speed of chemical reaction nitrogen - (II) oxide oxidation by the molecule $O_3$. Photolytical nitrogen cycle; which is done in the air, in the presence $^{\bullet}RO_2$ , is shown schematically (Fig.2.).

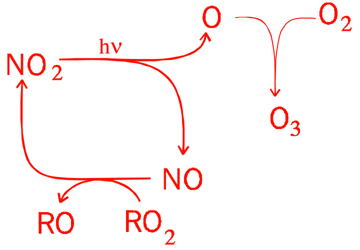

Fig. 2. Scheme of photolytical nitrogenic cycle which is done in the polluted atmosphere /5/

To the concentration of tropospheric ozone can influence sulphur - (IV) oxide presence. The oxidation of sulphur - (IV) oxide by atmospheric oxygen, in the presence of sun rays, is done by the chemical reactions.

In urban environments, the ozone concentration is less than 3,92 $mg/m^3$. The bigger concentrations of troposheric ozone lead to destruction of textile and acetate tissues, polymer, rubber, polyester, nylon and colours. Ozone in bigger concentrations shows phitotoxical effect: physiological damages and leaves changes (necrotic spots).

It is found, as well, toxically effect on man, in bigger concentrations, in the form of respiratory system, heart, liver and brain changes.

## FORMING OF PHOTOCHEMICAL SMOG IN URBAN ENVIRONMENTS

In urban environments, often, in increased concentrations CO, $NO_x$, $O_3$ and $C_xH_y$ is formed special form of pollution which is known as photochemical smog. Carbonhydrogen ($C_xH_y$) which take part in forming photochemical smog are in the air in concentrations, for which there aren′t precise data, that have negative effect on human organism, except for the aromatic and polyciclic aromatic carbonhydrogen.

By the researches [5], it is found the presence in the air of 56 different carbonhydrogens. Their origin is natural and anthropogenic. The natural sources of carbonhydrogen in the air are mainly biological processes. Big masses of carbonhydrogen in the air come from anthropogenic sources. Over 51% carbonhydrogen in the air comes from the fuel burning, which use motor vehicles; 47,5% of emitted carbonhydrogen is created by fuel burning in gas motors. In the industrial processes is emitted about 14,4% of carbonhydrogen.

By fossil fuels burning in home headings, industrial plants, and heating plants are emitted smaller quantities of carbonhydrogen about 2,2%. Measuring of carbonhydrogen concentrations in urban environments is done because of its participation in photochemical smog forming.

Process of forming photochemical smog is done through complex chemical reactions of carbonhydrogen oxidation. In oxidation of carbonhydrogen may take part besides atomic oxygen, also the molecules of ozone and oxidants such as hydroxyl radicals, excited oxygen molecules and carbon -(II) oxide. The mechanism of forming photochemical smog is shown on the scheme (fig.3.).

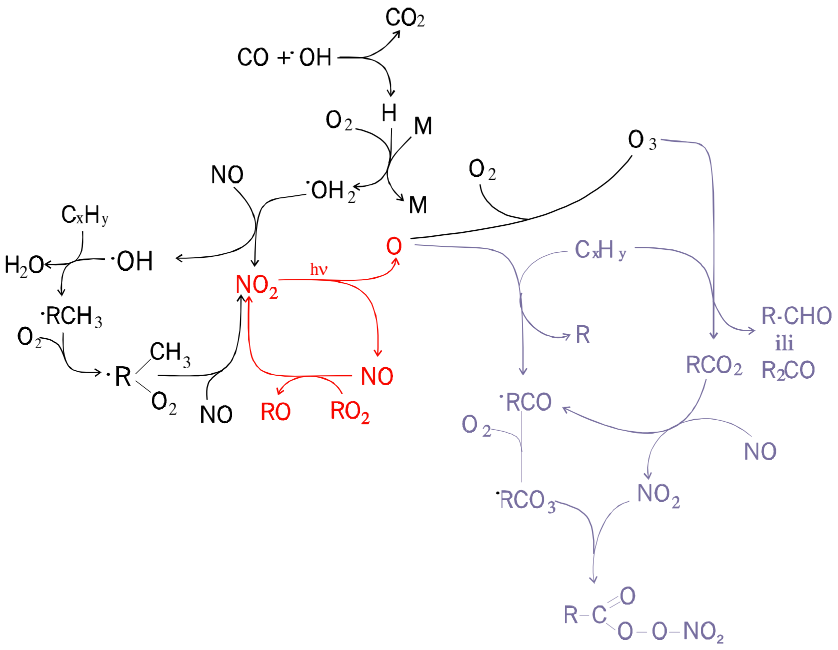

Fig. 3. Mechanism of chemical reactions of forming photochemical smog /5/

Carbon - (II) oxide in atmosphere reacts with $^{\bullet}$HO (equation 12) and provides forming hydroxiperoxide radical:

$$H + O_2 + M \rightarrow \cdot HO_2 + M \qquad (22)$$

Hydroxiperoxide radical oxides in the atmosphere nitrogen - (II) oxide to nitrogen - (IV) oxide while liberating $^{\bullet}$HO.

$$NO + \cdot HO_2 \rightarrow NO_2 + \cdot OH \qquad (23)$$

If the carbonichydrogens are present in the air, $^{\bullet}$HO may do their oxidation:

$$C_xH_y + \cdot OH \rightarrow H_2O + \cdot R - CH_3 \qquad (24)$$

Metilradicals in the atmosphere are oxidizing by atmospheric oxygen to metilperoxide radicals:

$$\cdot R - CH_3 + O_2 \rightarrow \cdot R\langle^{CH_3}_{O_2} \qquad (25)$$

Built metilperoxide radicals oxidize in the air nitrogen - (II) oxide to nitrogen - (IV) oxide:

$$\cdot R\langle^{CH_3}_{O_2} + NO \rightarrow \cdot R\langle^{CH_3}_{O} + NO_2 \tag{26}$$

The increased concentrations in the air CO, NO and $C_xH_y$ lead to the increased concentration of NO, which under the influence of ultraviolet rays is disassembled to nitro - (II) oxide and atomic oxygen (chemical reaction 18). Atomic oxygen in the air oxidizes molecule of oxygen to the ozone molecule (chemical reaction 19) or oxidizes present olephine or aromatic carbonhydrogens where the radical are created of $^\bullet$R and $^\bullet$RCO type:

$$O + C_xH_y \rightarrow {}^\bullet R + {}^\bullet RCO\,. \tag{27}$$

Ozone molecules in reactions with carbonhydrogen provides creation of free radicals of aldehydes (RCHO) or ceton ($R_2CO$) and radicals $^\bullet RCO_2$:

$$O_3 + C_xH_y \rightarrow {}^\bullet RCO_2 + \begin{matrix} RCHO \\ R_2CO \end{matrix}\,. \tag{28}$$

The created radicals $\cdot RCO_2$ react with nitrogen - (II)oxide, which is present in the atmosphere as primary pollutant, or is created by disassembling of nitrogen - (IV)oxide in photolitical nitrogen cycle:

$${}^\bullet RCO_2 + NO \rightarrow NO_2 + RCO\,. \tag{29}$$

Radical ·RCO is oxidizing by atmospheric molecule oxygen to peroxide radical ($\cdot RCO_3$).

$${}^\bullet RCO + O_2 \rightarrow {}^\bullet\, RCO_3 \tag{30}$$

Peroxide radical reacts with $NO_2$:

$${}^\bullet RCO_3 + NO_2 \rightarrow R - CO - OONO_2\,. \tag{31}$$

Oxidation of carbonhydrogen by atomic oxygen or ozone molecule is forms photochemical oxidants lacrimators ($R\text{-}CO\text{-}OONO_2$). Most often by oxidation of carbonhydrogen by atomic oxygen or ozone molecule it comes to pheroxiacetil-nitrate forming (PAN), pheroxibenzoil-nitrate ($PB_2N$), pheroxibutril-nitrate (PBN) and pheroxipropionic nitrate (PPN). The chemical reaction speed of oxidation of carbonhydrogen by atomic oxygen is $10^8$ times bigger than reaction of ozone molecule oxidation. Lacrimators bring to herbal hormones damage, to damaging membrane, structure of chloroplast, and in small concentrations they irritate eyes and respiratory organs of a man.

In photochemical smog forming, can take part even the chlorine atoms which originate from photolytical disassembling of PbBrCl., which is in structure of exhaust gases of motor vehicles.

The mixture of carbon - (II)oxide, carbonhydrogen, nitric oxides, ozone, lacrimates and different organic compounds (aldehids, ketons, nitrate) creates photochemical smog. Concentrations of some polluting substances, which are in structure photochemical smog, are given in the table 1.

Table 1. Substances which are the parts of photochemical smog

| **Polluting substance** | **Concentration (ppm)** |
|---|---|
| Carbon -(II) oxide CO | 2 – 20 |
| Total carbonhydrogen $C_xH_y$ | 0,2 – 0,5 |
| Aromatic carbonhydrogen | 0,1 – 0,3 |
| Alcens($C_x$ $H_{2x}$) | 0,02 – 0,06 |
| Aldehydes -CHO | 0,05 – 0,25 |
| Nitrogen -(II) oxide (NO) | 0,01 – 0,15 |
| Nitrogen -(IV)oxide ($N_2O$) | 0,05 – 0,2 |
| Pheroaxcetil-nitrate($CH_3$-CO-OONO$_2$) | 0,01 – 0,04 |
| Ozone ($O_3$) | 0,02 – 0,2 |

## AEROSEDIMENTS IN URBAN ENVIRONMENT AIR

Particles in the air are dispergated substances which may be in solid or liquid aggregate state. Their diameter is of size 0,001 µm to 1000 µm. On the basis of their size, the particles can be put into two categories. It can be distinguished sediment particles and particles in suspension.

The group of sediment particles (aerosediments) is characterized the diameter of size bigger than 10 µm. The particles in suspension (aerosols) have the diameter of size less than 10 µm. The separation of particles from the air of diameter across 10µm , is done by sedimenting under the influence of gravity forces. Considering the fact that the particles in suspension are following the basic air circulation, they stay dispergate in the air for longer time and are transformed to bigger distance the particles in suspension are known by the name as flying particles. Their separation from the air is only by the rainfalls.

Form, characteristics and the effect of particles as polluting substances of air is conditioned by their size. The particles of smaller size than 10 µm are usually of spherical form (liquid drops, flying particles and biological origin particles). The particles of bigger dimensions than 10 µm are mainly of irregular form: cubic, shelled, tissue, flaky or chain. The particles of diameter from 0,01 to 0,1 µm; are known by the name of Aitkens particles. These particles very often react as condensation nucleus, by satiated steams in the atmosphere.

The reflection power, refraction, diffraction, and absorption of sun rays and rays from the Earth is conditioned by the particles size. The size of particles influences optical characteristics as well as other physical characteristics such as: movement, sorption, nucleation.

The particles size which are present in the air depend from the way by which its emission is done. particles can be emitted from natural and anthropogenic sources. Natural sources of emission are: sea fog, volcano activities, chemical reactions in the atmosphere (carbonhydrogen reaction and ozone), dust that is blown by the wind etc. Anthropogenic sources of particles present in the air are: fossil oil burning and industry processes, traffic, garbage burning etc. Fossil oil burning and industry from which are particles emitted in the air; are about 30% anthrophogenic sources. The particles emitted in the process of burning are in diameter 0,1-1 µm; particles of dust; blown by the wind are by diameter of size about 0,6 µm, particles created by photochemical reactions in the atmosphere are of size about 0,4 μm and the particles blown by the wind from the water areas are of size 0,6 μm.

Considering the chemical composition, particles present in the atmosphere, contain inorganic and organic substance. From inorganic substances, metals and its ions (Cd, Co, Cr, Cu, Pb, Mn, Mo, etc.) are the most important concerning aeropollution. By fossil fuel burning in the air are emitted the particles of chemical composition: $SiO_2$, $Al_2O_3$, phosphates, iron oxides, elementary carbon, calium compounds of magnesium, calcium, natrium, sulphur and carbonates. Chemical composition of particles that come out of industrial processes is different and depends of concretely applied technological process.

In urban environments aerosol concentration is in limits from 60-220 μg/m$^3$, and sediment dust (particles of diameter bigger than 10 mμ) in the limits from 0,35 to 3,5 mg/cm$^2$. Particles concentration in the air depends from meteorological conditions, part of a day and season. Very often the concentration during the autumn and in winter is bigger. The particles concentration are monitored in urban environment because of its influence on sun rays intensity, which comes to the Earth, because of its influence on the climate, visibility, their destructive effect on organic and inorganic materials and toxic and phitotoxical effect. Negative effect of particles in the air depends on many factors: origin, chemical composition, the place of effect, size, form, biological characteristics, certain materials resistance, etc. In urban environments while monitoring aerosediments it is determined the total mass of sediment, mass of insoluble particles (the total and of ashes), mass of soluble particles (total and in the solution especially $SO_4$, Cl and Ca). That aerosediment is determined the presence of hard metals (Cd, Pb, Fe, Cr, Mn, Ni, etc.) because of their toxic effect on biosystem.

The time of keeping the particles in lower layers of troposphere is about 6-12 days, and in upper layers 2-4 weeks. Especially in urban areas the tracking of the concentration of soot particles is done.

## SOOT PARTICLES (AEROSOL) IN THE URBAN ENVIRONMENTS

Soot represents carbonic particles soaked intar, which appear in the process of incomplete burning of fuel materials which are on the carbonic base. Chemical composition of tar particles are the substances of organic and inorganic origin. The substances of organic origin such as: gaspyren, gasantracen, pyrite, fluoranten, crysen; have cancerogenic effect. Besides the organic origin particles (tar), soot particles have inorganic acids as well, from which the sulphate acid is present in the greatest measure.

The diameter of the soot particle is of the size about 0,1 μm. Because of its dimensions soot particles have small sedimenting speed. In certain conditions, small particles are connected and form the particles about 5 μm, where the sedimenting speed is bigger.

In urban environment the year′s soot particles concentration is bigger. Very often these concentrations are above 100 μg/m$^3$. The main soot source in the urban environment are bad boiler rooms where it done the complete burning of the fuel is not. The minor source of soot particles are the vehicles, which the fuel use as oil. During the year the concentration of soot particles is changeable. The greatest concentrations are registered during the heating season.

The increased concentrations of soot particles bring to: cancerogen skin diseases, scrotum and they show synergic effect with sylphur - (IV) oxide.

The soot particles take to communal problems as well, by increasing the dirtiness of external surfaces (façade, monuments, streets, etc.)

## CONCLUSION

The urban environment air protection from chemical pollution is multidisciplinary and interdisciplinary area, which can be realized by the program of air quality monitoring; which includes measuring of imission of standard polluting substances $SO_2$, $NO_x$, CO, aerosediments and soot.

Knowledge of characteristics of standard polluting substances as well as their relationship, enables the orientation in determining and predicting of its behavior in the urban environment air from different aspects: the time of keeping in the air internal effect to the biosystem and material goods; relation to meteorological, climate and topographic parameters e.t.c.

In the urban environment air, physical-chemical processes, transformations and synthesis of polluting substances, their negative effect is bigger as well the analysis of relations between physical and chemical characteristics of standard polluting substances in urban environment air gives qualitative relations between the substances relations and their internal effect.

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# ANALIZA ODNOSA KARAKTERISTIKA STANDARDNIH ZAGAĐUJUĆIH SUPSTANCI U VAZDUHU URBANIH SREDINA

**Amelija Đorđević, Danilo Popović, Jasmina Radosavljević**

*U radu je data analiza odnosa karakteristika standardnih zagađujućih supstanci ($SO_2$, CO, $NO_x$, čestice) kao i njihovo štetno dejstvo na biosistem. I ako je analiza samo polazna tačka u ovoj kompleksnoj oblasti ona može da bude dobro upustvo i pravi put za sprečavanje ulaska u atmosferu i uklanjanje iz nje zagađujućih supstanci.*

Ključne reči*: zagađujuće supstance, aero zagađenje, urbana sredina*