

## STUDY ON NEGATIVE EFFECTS ON THE ENVIRONMENT DUE TO AIR POLLUTION WITH SO<sub>2</sub>.

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**ABSTRACT.** The development of human society lead to a negative technogenic and anthropogenic impact on air quality. Both at European and national environmental policy major objective is to prevent, limit, damage and improve air quality in order to avoid adverse effects on human health and the environment as a whole. Knowing the negative effects on the environment presents actual effects of human intervention in nature and projected its reckless serious consequences on ecosystems and the population. Considering the above, for health insurance, it requires knowledge of the concentrations of sulfur dioxide monitoring using standardized measurement methods and suitable equipment. This paper will review the analysis of sources that generate air pollutants, the effects of air pollution on environment issues and concepts regarding ecotoxicology, dispersion phenomena due to the existence of SO<sub>2</sub> pollutant in the environment.

**Key words:** pollution, environment, ecotoxicology, negative effects, sulfur dioxide

### ИЗСЛЕДВАНЕ НА НЕГАТИВНИТЕ ЕФЕКТИ ВЪРХУ ОКОЛНАТА СРЕДА ПРИ ЗАМЪРСЯВАНЕ НА ВЪЗДУХА СЪС СЕРЕН ДИОКСИД

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**РЕЗЮМЕ.** Развитието на човечеството е довело до негативни техногенни и антропогенни влияния върху качеството на въздуха. Както на европейско, така и на национално ниво, основната цел на политиката за опазване на околната среда е да предотвратява и ограничава вредата и да подобрява качеството на въздуха, за да се избегне неблагоприятните въздействия върху човешкото здраве и околната среда като цяло. Познаването на негативните ефекти върху околната среда показва реалното въздействие на човешката намеса върху природата и дава представа за сериозните последствия върху екосистемата и населението. Имайки предвид горното, за осигуряване на здравето, е необходим мониторинг на концентрациите на серен диоксид като се използват стандартни методи за измерване и подходящо оборудване. Този доклад разглежда източниците на замърсители във въздуха, ефекта от замърсяването на въздуха върху околната среда и проблеми, свързани с екотоксикологията и феномена на разпространяване, дължащ се на съществуването на SO<sub>2</sub> в околната среда.

**Ключови думи:** замърсяване, околна среда, екотоксикология, негативни ефекти, серен диоксид

### Sources that are generating atmospheric pollutants

Sources of the pollutants are extremely varied, with numerous classifications otherwise in this respect, reflecting mainly the role of anthropogenic factor. Figure 1 summarizes the main classifications of sources of atmospheric pollution.



Fig. 1. Classification of air pollution sources

There are two types of pollutants:

- Primary air pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds and particulate matter);
- Secondary air pollutants (resulting from chemical reactions that occur between primary pollutants in the atmosphere and natural environment sometimes involves components such as water and oxygen).

Between the two types of pollutants are continuously inter-correlation. The most important pollutants are ozone, sulfur dioxide, nitrogen oxides and particulate matter.

Of the many air pollutants particular attention is given to: ozone (O<sub>3</sub>), particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>), carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>) and lead due to the risk they can pose to human health and influence on the environment.

## Negative effects on the environment due to air pollution with SO<sub>2</sub>

Sulphur dioxide (SO<sub>2</sub>) is a colorless gas with a pungent characteristic odor, heavier than air. Very soluble in water, the solutions are slowly oxidized to form sulfuric acid. SO<sub>2</sub> is soluble in alcohol. A liter of liquid SO<sub>2</sub> goes off about 500 liters of gas.

It has reduction character: reducing iodic acid, hydrochloric acid, mercuric chloride and permanganate fade. It is fixed by lead oxide (PbO<sub>2</sub>), manganese oxide (MnO<sub>2</sub>).

- Molecular weight: 64;
- Melting point: - 75.5° C;
- Boiling point: - 10° C;
- The critical temperature: 158° C;
- Relative density, gas: 2.3 (air = 1);
- Relative density, liquid 1.5 (water = 1);
- Vapor pressure at 20° C: 3.3 bar;
- Solubility mg / l water: hydrolysed;
- Appearance / Color: Colorless gas;
- Smell: Pungent;
- Auto-ignition temperature: Not applicable.

**Effects on health:** exposure to high concentrations over a short period of time can cause severe breathing difficulties (especially in people with asthma, children, the elderly and persons with chronic diseases of the airways); exposure to a low concentration in the long term may result in respiratory tract infections, may increase the dangerous effects of ozone.

**Effects on plants:** affects many plants visible negative effect on the structure and tissues is noticeable to the naked eye.

Effects on the environment: the atmosphere, contributing to the acidification of rainfall, with toxic effects on vegetation and soil; increasing the concentration accelerates the corrosion of metals due to the formation of acids; can erode stone, masonry, fiber, paper, leather and electrical components.

Acid rain is defined as atmospheric precipitation at pH <5.6. The term "acid rain", namely "acid rain" currently means of acidic deposition in rain, snow, fog or dry particles.

Acid rain occurs when SO<sub>2</sub> and NO<sub>x</sub> emitted into the atmosphere are absorbed by water droplets, after passing through a series of chemical transformations. The compound drops back to earth as rain, snow, mist, dry powder, sleet, hail, increasing the acidity of the soil and affecting surface water hydrochemistry. The term "acid rain" is sometimes used more broadly, including all forms of acid deposition - both wet deposition, acid gases and particulates that are entrained from the atmosphere by rain and other precipitation and dry deposition, which entrained gases and particles in the atmosphere without precipitation (Fig. 2).

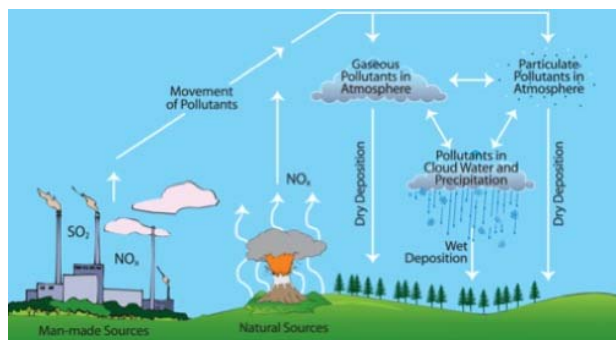


Fig. 2. The formation of acid rain

Determination of SO<sub>2</sub>, is performed using the reference method, namely by ultraviolet fluorescence.

Figure 3 shows equipment for determining the immission of sulfur dioxide.



Fig. 3. Analysis of sulfur dioxide continuous kind Ecotech Serinus 50

Fluorescence is a phenomenon of photoluminescence which involves the generation of a first absorption phenomenon. Luminescent molecules excited by certain quantum states (in this case in the ultraviolet irradiation) remain in this state at least 10<sup>-9</sup> seconds after returning to the ground state by emission glow. This secondary emission is proportional to molecules of sulfur dioxide (SO<sub>2</sub>) in the sample and captured, converted and transmitted as electrical signals by photomultiplier tube (PMT) of the device.

## Dispersion of gaseous pollutants

The harmfulness of industrial gaseous effluents that may be considered potential aggressors environment (people, animals, vegetation, materials), depends primarily on the concentration of these substances in the air in the vicinity of the ground. It is therefore important to specify the conditions for dispersion of pollutants in the atmosphere and effectiveness of means available to control this release.

The emission of the pollutant in the atmosphere may be accompanied by a significant rise of the pollutant plume, as if hot gases emitted from industrial chimneys. The element rises more, the greater the dilution vertical scattering that occurs before the pollutant to be observed on the ground.

Pollutants discharged down the chimney have a certain kinetic energy and forms a jet in the vertical direction. This effect is reinforced by buoyancy forces that arise due to gases, which have a much higher temperature than the surrounding atmosphere. By mixing with ambient air, it creates a temperature balance that by sharing environment cancels jet pulses.

Pollutant dispersion simulation by mathematical equations is inevitable in areas such as analysis and completion of remediation strategies for compliance with imissions, evaluation of critical episodes, broadcasters optimal spatial location, location alarm systems exceeding maximum permitted levels of pollution and correlating and analyzing simultaneity operation of pollution sources.

## Ecotoxicology of surrounding environment

Toxicology is a discipline of interest include the basic sciences (pharmacology, biochemistry, epidemiology, etc.) and dealing with adverse effects from exposure to the action of chemicals living organisms.

Ecotoxicology is a sub-discipline of ecology that studies the effects of toxic chemicals on people and ecosystems.

Ecotoxicological effects materialize through changes in state and dynamics of a body or a different level of biological organization (cell, tissue, individuals, populations, ecosystems) resulting from exposure to chemical substance.

### Concentration - response dependence

In toxicology, one of the basic principles is the dose - response. This dependence is underlying the assessment of environmental impacts due to toxic chemicals.

The overall ecological response to dose (concentration of a pollutant) comprises three areas:

- The effects are measurable;
- The effects are measurable effects in the population;
- The adverse effects are measurable in the community and / or ecosystem, while increasing the concentration of toxic chemicals.

This model is observed that organisms in an ecosystem has a different sensitivity to chemical exposure, and the answer is more or less severe depending on the level of exposure.

### Exposure time - effect dependence

The time between exposure to various pollutants and when it is observed impact is different from the population at the community and ecosystem.

The time between exposure to various pollutants and the appearance of the effect (response) differ so pollutant nature and the nature of the organisms exposed to the pollutants concerned.

Accommodative response time to effect refers to the time of propagation of individual populations and the time required for feedback disrupted due to environmental interactions of chemicals.

## Conclusions

The atmosphere is the broadest driver of pollutants whose effects are felt at the local level to the global level of all biotic and abiotic elements.

The major objective of environmental policy at both European and national levels, the prevention, restriction, damage and improve air quality in order to avoid adverse effects on human health and the environment as a whole.

Knowledge of the mechanisms of atmospheric pollution, involves studying the phenomena of four categories, namely:

- Emissions of air pollutants related to natural and anthropogenic sources;
- The transfer of pollutants from the source to the receiver (transmission);
- Immission, in other words, spatial distribution temporalo and concentrations of pollutants in the atmosphere;
- The effects of pollution on human health, the environment, construction and materials.

Ecotoxicological effects of air pollution is reflected by changes in state and dynamics of a body or a different level of biological organization resulting from exposure to chemical substance.

Description of air pollution dispersion phenomena, is according to the three components of the speed are using the continuity equation, the Navier - Stokes and Euler equation.

Among the gaseous pollutants of air, high potential harm includes: sulfur dioxide, nitrogen oxides, hydrocarbons and heavy metals.

Air pollution with sulfur dioxide generates acid rain that attacks mainly the leaves of plants (by blocking the respiratory system and disrupt the photosynthesis phenomena), and tree roots (neutralization of soil nutrients). Also, increasing the concentration of sulfur dioxide into the atmosphere accelerates corrosion of metals and can erode the stone, masonry, fiber, paper, leather and electrical components.

## References

- Ciolea Daniela, Air depollution, Publisher Universitas, Petroșani 2012.
- Cristina Costache, Ecology and risk assessment, AGIR Publishing, București, 2006.
- Dănilă Gheorghe, Toxicological Data Guide, Medical Publishing House, București, 1984.
- Ioana Ionel, Anthropogenic sources of air pollution, Polytechnic University of Timisoara.
- Mihăiescu Radu, Integrated monitoring of the environment, Cluj Napoca 2014.
- Neagu Corneliu, General Industrial Toxicology, Ministry of Health, București 2013.
- Popa Ion, Toxicology, Medical Publishing, București, 1978;
- \* \* \* Law no. 104 / 15.06.2011 on ambient air quality.
- \* \* \* Directive 2008/50 / EC on ambient air quality and a cleaner air for Europe.

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