



Preventing Health Risks and Environmental Effects of Air Pollution

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A part from light, water and certain temperature ranges, “clean air” is a prerequisite for the undisturbed development of human beings, animals and plants on earth. Clean air which may still be encountered in areas which have not yet been changed by man’s activities contains by volume:

- 78.10 % of nitrogen (N₂)
- 20.90 % of oxygen (O₂)

- 0.94 % of inert gases (Ar, Kr, Ne, etc.)
- 0.03 % of carbon dioxide (CO₂)
- 0.01 % of hydrogen (H₂)

And there are traces of substances form about 0.0001% of the air volume, among them; Carbon monoxide (CO), Nitrogen oxides (NOX), Ozone (O₃), Ammonia (NH₃) and Methane (CH₄).

These traces substances stem from higher air layers (O₃) or are released during decomposition processes or resulted from meteorological effects.

Increasing industrialization and density of traffic have, all over the world, led to a considerable increase in air pollution.

Air Pollution

Air pollution (WHO definition) "... is present of an air pollutant or several air pollutants are contained in the outside air in such quantities and for such periods that they become harmful to man, animal, plant or property, contribute to damages or can unduly disturb the well-being or the possession of property."

Air-polluting waste products (emissions) from power stations, plants of the chemical and metallurgical industries, domestic fuel and motor traffic are important nuisance factors.

At present, about 300 xenobiotic substances are known to occur in the air, but so far only 20 to 30 of them have been found to be of an economic and hygienic significance.

In most cases, gaseous substances possess a high suspensibility and may be widely dispersed by the air current. They are aggressive and may influence reactions in nature more easily than other harmful substances.

1. Air Pollutants

Air pollutants; are substances changing the natural composition of the atmospheric air, they may occur in the following forms:

- Solid form (dust, soot);
- Gaseous form (sulphur dioxide, hydrogen fluoride, hydrogen sulphide, nitric oxides, chloride etc.);
- Liquid or vaporous form (sulphuric acid, tar substances etc.);
- Aerosols (mixtures of several substances with different states of aggregation).



Gaseous Substances

Substance	Origin	Peculiarities
Sulphur dioxide SO ₂	Any coal consumers, particularly power stations and chemical enterprises; fuel oil; sulphite pulp works; metallurgical plants; cocking plants	Most important pollutant in industrialized countries. Long-distance action up to 40 km. Irritant gas.
Hydrogen fluoride, Silicon tetra-fluoride, HF, SiF ₄	Phosphate plants; producers of chemicals on a flour basis; aluminum works; glass-etching workshops; brickworks; enamel works; ceramic industries	Tends to aerosol formation, effects limited to the immediate environment of the enterprises, provided the substances are not adsorbed to dusts
Sulphur dioxide SO ₂	Any coal consumers, particularly power stations and chemical enterprises; fuel oil; sulphite pulp works; metallurgical plants; cocking plants	Most important pollutant in industrialized countries. Long-distance action up to 40 km. Irritant gas.
Sulphur trioxide SO ₃	Sulphuric acid plants	Damages caused by etching; damages in the neighborhood; combined with SO ₂
Hydrogen chloride, chloride HCl, Cl ₂	Galvanizing plants; chloride electrolysis; furnaces using coal containing Na ₂ O; PVC incineration	Irritant gases, effect mostly limited to the immediate environment of the respective enterprises
Lead (Pb) compounds, Hydrocarbons Cm Hn, carbon monoxide CO, nitric oxides (nitrous gases) NO ₂ , NOx	Motor vehicles; chemical industries; pharmaceutical industries	Nuisances in conurbations and towns as well as along frequently used roads or in the immediate environment of the respective enterprises
Hydrogen sulphide mercaptans H ₂ S, CH ₃ SH etc.	Lighting gas production; sulphate pulp production; oil refineries	Cytotoxins and encymic poisons strongly smelling
Ammonia NH ₃	Intensive animal husbandry	Damages in the neighborhood

Much attention must be given to SO₂ which is formed during the burning of coal or oil and results from their sulphur content (usually between 0.5 and 4%) and is emitted from all types of furnaces. The amount of SO₂ emissions is by far greater than that of other anthropogenic air pollutants. The damages caused by it involve high economic losses. In industrialized countries, these losses account for more than 50% of the overall losses caused by air pollution.

The oxidation of SO₂ into SO₃ is particularly important, but over long distances sulphur is transported mainly in the form of SO₄⁻² aerosol. As to the most important harmful substances, mention must be made also of flour compounds which are emanating from a great number of hitherto disregarded sources and can be toxic even at low concentrations.

In towns, a large proportion of air pollution is attributable to more-vehicle exhausts. The amount of harmful substances contained in exhaust gases largely depends

on the conditions prevailing during the journey. In case of a strong solar radiation, components of exhaust gases may undergo photochemical reactions triggering off the formation of aggressive compounds. Motor-protective substances which are admixed to gasoline are the cause of a lead load which may often be rather heavy in towns and along much frequented roads.

Dust Air Pollutants

In most cases, dust air pollutants are causing visible pollution effects and are, therefore, noted more frequently. In the air layers adjacent to the ground, the dust content is varying considerably. Due to its surface activity, particles of harmful gases and suspensions of finely dispersed substances may be adsorbed and carried away by soot, which is produced during the incomplete burning of coal and is chemically indifferent. Certain amounts of phytotoxic traces elements (often fluoride) in dusts frequently cause disadvantageous changes in the soil.

Emission of air pollutant dust

Substance	Origin	Peculiarities
Fly Ash	Heavy consumers of lignite, usually power stations	Soil changes caused by basic components containing, in most cases, flour; varying quantities of other trace substances
Soot	Incomplete burning of coal; oil heating; flaring	Pollution effect; adsorption of harmful gases
Cement dust	Cement industries	Contains K and Ca
Metallurgical plant dusts	Lead melting plants; zinc melting plants; copper melting plants; steel industries	According to the type of production, they contain Pb, Zn, Cu, Fe, As, Cd, and F
Dusts from the potash, soda and detergent industry	Units for the mining and transport of potassium salt, soda works and detergent works	Polluting, phytotoxic

The emission concentration is expressed in mg of the harmful substances/m³ of air (formerly ppm; 1 ppm = 2.6 mg SO₂ /m³ of air), for dust precipitations in g of dust / m². 30 days.



Smoke, Aerosols

There are components which are smaller than 1μ ; they settle very slowly and are transported over long distances, and their behavior is similar to that of gaseous molecules.

Smog

Smog is a mixture of smoke and fog. It is a fog with great amount of smoke, and it forms haze canopies over industrial towns or densely populated areas. It prevents solar radiation and the warming up of the soil which are necessary in order to eliminate the loaded air layers.

Given the necessary air humidity, condensation nuclei will produce this worst form of air pollution. Smoke, fly ash, dust and gas particles cause a strong obstruction of visibility. In many countries limit values (MIK values) were set in order to limit air pollution.

2. Criteria of Air Pollutants

For determining the allowable concentration of substances in the ambient air, there is a level of concentration which include the most common air pollutants; carbon

monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide, which are mainly considered by WHO and EPE because they are endanger public health and the environment, and come from variety sources. The allowable concentration of these pollutants in the air determine according to the time of exposure with no effects on the human organism, and considered as follows:

MIK value; means a “maximum allowable emission concentration”, it is the concentration of air pollutants, which, according to the present state of scientific knowledge, generally has no effects on the human organism, provided it is observed or remains under the limit. The MIK values are valid for the sole occurrence of the respective air pollutant.

Short-time values; (MIK_K) limit the single or repeated short-time occurrence of air pollutants, the base of reference being the medium concentrations for 15 minutes.

24-hour values; (MIK_D) limit the protected single or repeated occurrence of air pollutants, the base of reference being the medium concentrations for 24 hours.

The following table shows the criteria of air pollutants according to the maximum allowable immission concentration values valid;

Harmful substances	Concentration in mg/m ³	
	Short-time limit value MIK _K	Protracted time limit value MIK _D
Acetaldehyde CH ₃ CHO	0.03	0.01
Acrolein H ₂ COH	0.02	0.01
Ammonia NH ₃	0.30	0.1
Arsenic As		0.003
Lead Pb		0.0007
Chloride Cl	0.10	0.03
Hydrogen chloride	0.05	0.015
Fluor compounds	0.03	0.01
Carbon monoxide CO	3.00	1.0
Phenol	0.03	0.01
Soot	0.15	0.05
Sulphure dioxide SO ₂	0.5	0.15
Hydrogen sulphide H ₂ S	0.015	0.008
Nitric oxides, NO ₂	0.1	0.04
Nontoxic dusts	Maximum annual mean value 15 g/m ² . 30 days	

The hygienically allowable limit value are related the human health. They are not generally identical with the phytotoxic concentration of these substances.