Mini Review

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2023.50.007912

Environmental Protection of Healthy Living from the Aspect of Air Pollution

Krsto Mijanović[1]*, Marko Jukić[2] and Jefimija Jukić Mijanović[3]

[1]*Krsto Mijanović, Faculty of Ecology Travnik in Travnik, Bosnia and Herzgovina*

[2]*Marko Jukić, Jajce Alloy Wheels d.o.o., Bosnia and Herzegovina*

[3]*Jefimija Jukić Mijanović, NIS Gazprom Neft, d.o.o, Bosnia and Herzegovina*

***Corresponding author:** Krsto Mijanović, Faculty of Ecology Travnik in Travnik, Bosnia and Herzegovina

ARTICLE INFO

Received: April 06, 2023

Published: May 03, 2023

Citation: Krsto Mijanović, Marko Jukić and Jefimija Jukić Mijanović. Environmental Protection of Healthy Living from the Aspect of Air Pollution. Biomed J Sci & Tech Res 50(2)-2023. BJSTR. MS.ID.007912.

SUMMARY

Air pollution is the result of emissions of polluting substances from various sources. Various industrial operations and energy production from fossil fuels represent the most important stationary sources. The largest amounts of particulate matter and sulfur oxides originate from them. Mobile sources of pollution in underdeveloped countries still represent a small part of the total pollution, considering the relatively underdeveloped traffic. In developed countries, however, these sources are significant, so the quantities exceed stationary sources of pollutants. Incomplete combustion of fuel produces considerable amounts of carbon monoxide. At the same time, at the high temperature of the car engine, oxygen reacts with otherwise inert nitrogen, whereby a number of nitrogen oxides are formed, the most important of which to observe are NO and NO_2 due to their role in subsequent reactions in the atmosphere and the creation of $PM_{2.5}$ to PM_{10}. Namely, under the influence of sunlight, released NOx and hydrocarbons, together with other pollutants from gasoline, react with each other, creating a series of dangerous products and floating particles.

Exposure to highly polluted air can cause a number of consequences. The plant reacts first, as the most sensitive part of the plant-animal-human chain, while in highly polluted environments the effects are obvious for all links of the chain. This increases the risk of respiratory infections, heart attack, stroke and lung cancer. A link between short-term and long-term exposure to polluted air and heart disease has been established. People who are already sick are more susceptible, as are children, the elderly and the poor [1-5]. Harmful pollutants, which are closely related to increased mortality, are fine floating particles $PM_{2.5}$, which can penetrate deep into the lung passages. Harmful effects can occur both after short-term (hours, days) and long-term (months, years) exposure to polluted air. The various effects of exposure to particulate and other air pollution were analyzed, and a proposal was made to the management of all interested parties on how, through their activities and decisions, to reduce emissions into the air.

Keywords: Air Pollution; Particulate Matter; Gases; Atmospheric Capacity; Stationary Sources; Mobile Sources; Exposure; Permitted Concentrations; Environmental Protection

Abbreviations: O_3: Ozone; No_2 : Nitrogen Dioxide; So_2: Sulfur Dioxide; EEA: European Environment Agency; PM: Particulate Matter; O_2: Oxygen; N_2: Nitrogen; CLRTAP: Convention on Long-Range Transboundary Air Pollution; NAOH: Sodium Hydroxide or Caustic Soda; CU: Copper; AS: Arsenic; HF: Fluoride Vapors; MAK: Maximum Permissible Concentrations; MDE: Maximum Permissible Emission; ZNS: Zinc Sulphid

Introduction

With the increase in all types of activity of modern man, huge amounts of various pollutants are thrown into the air every day. The atmosphere has the capacity to absorb certain amounts of gaseous and particulate pollutants due to its dynamic nature. However, in certain meteorological conditions, this capacity narrows, so if the conditions last longer, pollutants accumulate in one specific area, which can lead to significant consequences, especially in urban areas. At this stage of development and increase in production and consumption, the concentration of polluting substances is constantly increasing, which leads to changes in the natural composition of the air, not only at the local but also at the global level. The first warning signs are beginning to appear that there is a crisis in the survival of the environment of healthy living, which warns of increased concern about the control of sources of pollution.

Serious risks to the health of the population exist from exposure to air polluted by floating particles and from exposure to ozone (O_3), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2). Concentrations of these pollutants are usually highest in urban areas of low- and middle-income countries. The presence of ozone is a significant factor in morbidity and increased mortality from asthma, while nitrogen dioxide and sulfur dioxide may also play a role in the development of asthma, bronchial symptoms, pneumonia and reduced lung function, as shown by the UNICEF study "Clear the Air for Children", from 2016. The European Environment Agency (EEA) has published a new comprehensive assessment of "Air Quality in Europe 2022", in which it presents the status of air quality in Europe, assesses the impact of air pollution on the environment of healthy living, and determines the sources of air emissions. According to EEA analysis, air pollution continues to pose a significant risk to public health in Europe, causing chronic diseases and premature deaths. According to the latest European Economic Area (EEA) estimates, at least 238,000 people died prematurely in the EU in 2020 due to exposure to $PM_{2.5}$ air pollution above the WHO guideline level of 5 [μg/m^3]. Nitrogen dioxide pollution led to 49,000 and ozone exposure to 24,000 early deaths in the EU [6-8]. In addition to premature death, air pollution disrupts the environment of healthy living and creates significant costs for the health sector. For example, in 2019, exposure to $PM_{2.5}$ particles led to 175,702 years of disabled life due to chronic obstructive pulmonary disease in 30 European countries. Sufficient research has been conducted on the adverse health effects of short-term exposure to PM_{10}. Under long-term exposure to air pollution, a higher risk factor was found for exposure to $PM_{2.5}$ (particulate matter less than 2.5 [μg/m^3]). All-cause mortality is estimated to increase from (0.2 to 0.6) % per each increase in pollution concentration of 10 [μg/m^3] PM_{10} Long-term exposure to $PM_{2.5}$ is associated with an increase in the risk of death from cardiovascular diseases by (6-13) % for every 10 [μg/m^3] increase in $PM_{2.5}$ concentration.

The paper will analyze the movement of polluting substances in a dynamic system that is maintained and supported by natural and artificial phenomena, with the assumption that movement over small distances occurs most often by diffusion and over long distances by drift. The environmental significance as a cause of disruption of the environment of healthy living in the case of the initiation and transmission of particulate matter (PM) will be observed.

Significance and Composition of Air

The physical properties, chemical composition and content of certain substances or chemicals in the air have a strong influence on the environment of healthy living, on public health, and on the productivity and distribution of plants and the general living world. Air has two basic functions: biological (primary) and production (secondary). The primary function of air is to provide aerobic organisms with oxygen and photosynthesizing organisms with carbon dioxide. Air is also a source of nitrogen, a necessary ingredient of all living organisms.

The secondary function of air is based on the presence of oxygen and other elements. The role of plants in the circulation of elements in the biosphere is very important, especially in renewing oxygen in the air. Oxygen is released in the process of photosynthesis, and thanks to this, this process has a biological significance in addition to the physiological one. Oxygen from the air is necessary in all processes of combustion, obtaining heat and electricity, and thus also in numerous other human activities.

Due to the swirling movement and flow of gases in the atmosphere up to 90 [km] high, the composition of the air is uniform. In this layer, the ratio of the content of oxygen (O_2), nitrogen (N_2) and inert gases is constant. This is why this layer of the atmosphere is called the homosphere. At an altitude above 90 [km], the components of the atmosphere mainly move by diffusion, which is slow, which is why its composition is not uniform, so this part of the atmosphere is called the heterosphere. Air is a mixture of gases of constant composition and other compounds of variable content. The composition of the air surrounding the planet consists of a mixture of gases and various particles in a solid, mixed and gaseous state. These PM impurities include dust, volcanic ash, soot, salt particles and other particles. Water vapor and various gases exist everywhere and in every place in greater or lesser quantities and concentrations. With his activity, man consciously or unconsciously pollutes the air more and more intensively. Dry air consists of 78[%] N_2 and 21[%] O_2, the remaining 1[%] is composed of CO_2, SO_2, O_3, NO_2, etc.

Brief Overview of Particle Characteristics (PM)

Dust (PM – dust particles) is represented by particles smaller than 10 micrometers, which have the ability to move freely in the atmosphere. These particles reach the atmosphere during volcanic eruptions, fires, soil erosion or from the sea. Anthropogenic sources include the formation of these particles by burning fossil fuels, in

power plants, incinerators or from various types of industry. The impact on human health primarily depends on the size of the particle. It is considered that the smaller the diameter of the particles, the more risky they are for public health. PM_{10} particles can easily penetrate to the lower layers of the respiratory organs. In the case of nano-shaped particles, we can talk about penetration even to parts of the cardiovascular system. Shorter exposure leads to irritation of the respiratory organs, more often to infections, and longer exposure can lead to the development of major respiratory problems such as chronic obstructive pulmonary disease or more serious diseases [9-11].

The shape and size of the particles is different. PM_{10} particles consist of a complex mixture of different substances, including soot (carbon), sulfate particles, metals and inorganic salts such as sea salt. PM_{10} particles can be emitted from any surface exposed to friction. A significant contribution is also the appearance of so-called secondary dust, due to the swirling of dust that already exists in mining, transport, and construction. In the natural environment, there are several sources that emit PM_{10} such as candles, hairspray or heating stoves. Dust particles are a modern problem, so the governments of the EU countries are required to plan a reduction in the amount of PM_{10} emissions within the framework of the Convention on long-range cross-border connections; "Convention on Long-Range Transboundary Air Pollution" (CLRTAP).

Natural Sources of Air Pollution with Particulate Matter (PM)

Natural sources of pollution include occurrences at sea and oceans, some meteorological phenomena, then the effect of volcanoes, natural radioactivity, forest fires, various combustions, erosion, ozone created by sparking, uncontrolled emission into the atmosphere of various gases and other substances. Natural systems also emit hazardous substances, often to an extent comparable to anthropogenic emissions. The difference between natural and anthropogenic sources is in the amount and type of polluting substances and the way in which they are emitted. The largest emission of sulfur is from the ocean, followed by biogenic processes. However, significant amounts are also emitted from volcanoes during large eruptions directly into the stratosphere. In such cases, the emission may have limited consequences for the entire planet, (Figure 1).

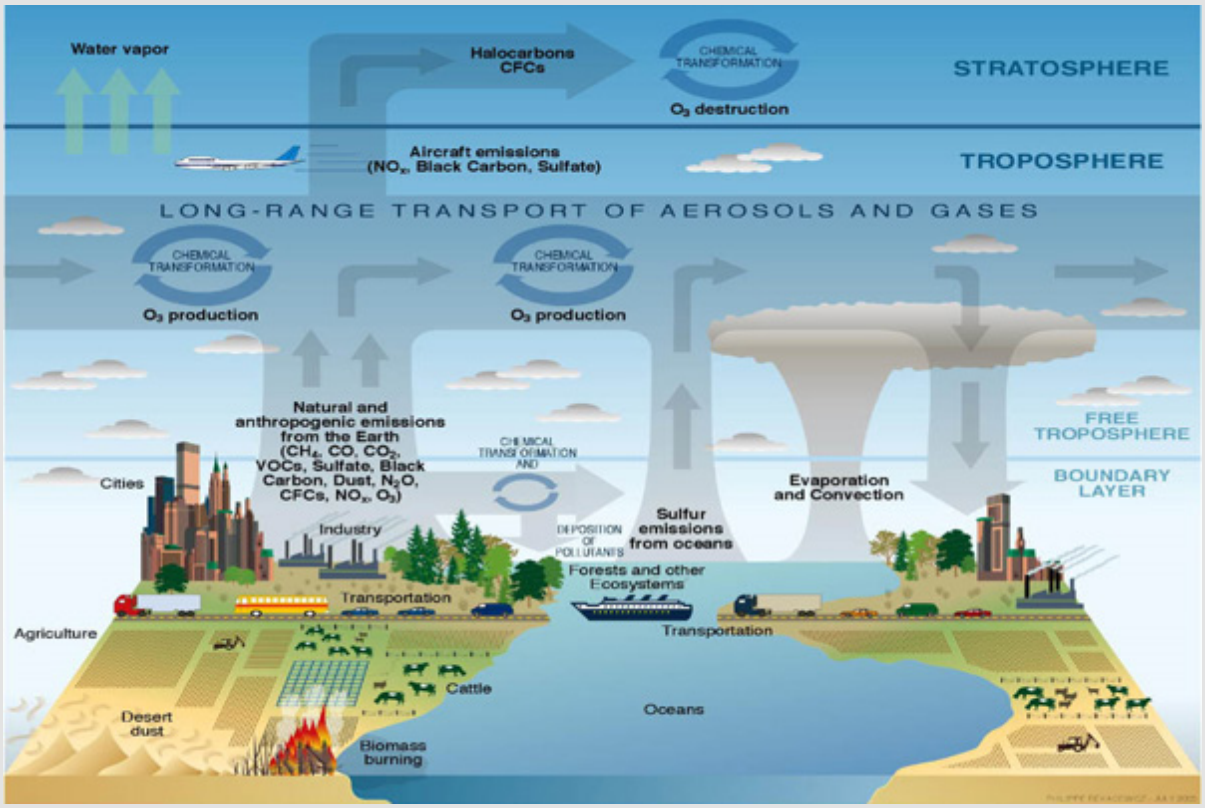

Figure 1: Sources of air pollution.

Fine dust particles and sulfate aerosols introduced by volcanic eruptions into the stratosphere remain there for a long time (deposition time up to 5 years) and can lead to a decrease in the heat energy that reaches the Earth through solar radiation. During an eruption, fine particles of dust and aerosols can be ejected to a height of (40-50) [km] and spread by air currents over long distances, which gives the pollution a global character. During the eruption of the Krakatau volcano on the island between Java and Sumatra in 1883, 2/3 of the island flew into the air, carrying about 20 [km^3] of dust ($PM_{2.5}$ - PM_{10}) to a height of 30 [km]. About 36,000 people died. The extent of pollution is shown in ancient records where the time when dusk and darkness reigned was called "the end of the world".

Air Pollution with Oxides from Metal Mining

The mining of metals and non-metals pollutes the air to a greater extent by the emission of dust and hazardous gases into the atmosphere. About 40 million [t] of various raw materials are extracted in the world, and (50 – 60) [t] of flotation tailings, which are risky for the environment of healthy living, are extracted from just 1 ton.

The most dangerous pollutants that are created during the production of aluminum are: pyralene from power plant transformers, sodium hydroxide or caustic soda (NaOH) from red mud and fluoride vapors (HF). During the pyrometallurgical processing of copper (Cu), flue gases rich in dust, metal oxides and SO_2 occur. Flue gases contain dust containing Fe, Co, Mg, Si oxide particles. The metallurgical process of obtaining lead belongs to the group of dirty technologies, because in the stages of extraction, processing and obtaining Pb, hazardous substances are released in the form of gases, PM dust containing Lead (Pb) and Arsenic (As), tailings and wastewater containing Pb. Zinc is found in the earth's crust as sulfide ZnS. Through the process, it is converted from sulphide to SO_2 of (93-97) [%] sulphide sulphur. During its processing, significant amounts of dust containing hazardous substances are emitted.

Air Pollution with Sulfur Oxides

Sulfur can be found in the atmosphere in various compounds and in various oxidation states. Above the sea, the wind creates aerosols, which contain sulfates. Hydrogen sulfide (H2S) is produced by biological decomposition in the oceans and on land. It is oxidized to sulfur dioxide, so the persistence of H2S in the atmosphere is only a few hours, Form (1).

$$H_2S + 3/2O_2 \rightarrow SO_2 + H_2O \quad \text{..... (1)}$$

The most important anthropogenic source of SO_2 is thermal power plants, from which large amounts of fly ash are released. By burning coal, elements: SO_2, NO_2, CO_2 are oxidized and appear in the form of ash.

The burning of fossil fuels emits about 62 million [t] of sulfur into the atmosphere annually. Smelting sulphide ores, which contain sulfur, releases large amounts of SO_2, Form (2).

$$Cu_2S + O_2 \rightarrow 2Cu + SO_2 \quad \text{.....(2)}$$

The biggest polluting substance in the air is sulfur dioxide and it occurs in pulp and paper factories, especially in populated areas.

Emissions, Emissions and Concentrations

Emissions and Immissions

Emission means the release of polluting substances outside buildings - pollutants (from chimneys, engines, pipelines) into the environment: air, water and land.

When studying the extent of pollution by a pollutant, it is important to determine:

a) Emission speed,

b) Total emission

The emission rate is the amount of polluting matter expressed in a unit of time: [g/sec] or in [%].

The total emission is the released amount of polluting matter expressed in grams per amount of released energy in joules [J] or in (kilograms of product [kg]). The term immission refers to the appearance of gaseous, liquid and solid substances in the air layer immediately above the ground surface. It could be bigger than the show. Their value refers to the concentration of pollutants in the air at a height of (0 to 2.0) [m] from the ground level. They can be short-term or twenty-four hours long. The value of the emissions depends on the speed, strength and type of emissions from the surrounding sources, on the distribution of polluting substances in the atmosphere, on the conditions of their separation as a function of meteorological conditions and on the type of matter (Table 1).

Table 1: Recommended values of the World Health Organization (WHO).

Value tipe	World Health Organization	
	$PM_{2.5}$	PM_{10}
Mean annual value	10 μg/m^3	20 μg/m^3
Mean daily value	25 μg/m^3	50 μg/m^3 max. 35 day/year

Maximum Allowed Concentrations

Maximum permissible concentrations (MAK) are mainly determined by how harmful they are to human health, that is, the limit of possible harm is taken, according to any indicator: toxicity, general

sanitary limit value, etc. for a longer period, does not cause pathological changes, does not violate the biological optimum for humans. The air in which the concentration does not exceed the permitted limits can be considered relatively clean air.

The maximum permissible emission (MDE) is introduced to regulate the intensity of emission of pollutants from each individual source of pollution. This value is linked to a certain product mass or the amount of energy produced in a certain technological process. That is why the World Health Organization issued recommendations with the aim of achieving the lowest possible concentrations of floating particles.

Conclusion

Environmental policy includes the measures necessary to achieve the environment of healthy living and protection of the natural system. Passing the law on air protection or reforming the existing law, and its successful implementation, will enable future generations to sustainably use the environment of healthy living. The main purpose of enacting the law is to connect the legal regulation with the market, such as the introduction of taxes and fees for air protection. Limiting polluters to reduce emissions of polluting substances into the air is done by: reengineering existing technologies, applying innovations and innovations in production, using purification technologies, using the Cleaner Production strategy, while respecting environmental standards and laws on environmental protection. Due to the extreme importance of the issue of air pollution and protection on the one hand and the great pressure on the atmosphere, the following tasks arise:

a) To the bodies of the state union;

b) Local community authorities,

c) Company management;

d) Management of educational institutions;

e) Management of health institutions

State Administration Bodies

Passing laws or reforming existing laws on environmental protection, and their successful implementation, will enable future generations to use natural resources sustainably. The main purpose of passing the law is to connect the legal regulation with the market, such as the introduction of taxes and fees for the protection of the environment. The amount of the tax varies depending on the amount of emission of polluting substances such as: CO, CO_2, SO_2, and the tax for the use of pesticides, mineral fertilizers, etc.

Local Community Authorities

By developing sensitivity to the voice of the public, searching for development solutions are strategic steps that lead to reduced emissions. Company management: The use of synthetic materials, alternative/renewable energy sources, reengineering of production systems, innovations in production, closed material flows and recycling is a space for the action of managers and technologists in the direction of sustainable development.

Management of Educational Institutions

Curriculum change in existing educational content is aimed at developing skills to overcome problems from practice in relation to harmonizing production and economy with environmental laws.

Management of Health Institutions

Monitoring of empirical data from practice and current data covered by the monitoring of large emitters of emissions to fulfill the role of on-call, advisory and intervention-corrective factor in the social community.

References

1. Agić DŽ (2005) Poboljšajmo kvalitet zraka efikasnim korištenjem energije. Centar za ekologiju i energiju, Tuzla.
2. Đukanović M, Ekološki izazov, Elit, Beograd (1991).
3. Đukanović M, Životna sredina, održivi razvoj, Elit, Beograd (1996).
4. Kastori R, Zaštita ekosistema, Feljton doo, Novi Sad (1995).
5. Mijanović K (2022) Doctrinal division of scientific fields Biomedical Research in the field of Healthy living environment. Biomedical journal of scientific and technical research 43(2): 34319-34323.
6. Mijanović K, Jukić M, Mijanović Jukić J (2020) Education for sustainable development. IRASA Second International Scientific Conference Science Education Technology and Inovation SETI.
7. Mijanović K (2021) Assessing the risk in food processing to a healthy living environment. MASO INTERNATIONAL - Journal of Food Science and Technology 11(1): 25-32.
8. https://energetika-net.com › Onečišćenje zraka glavni je ubojica u.
9. (2016) UNICEF. Clean the air for children.
10. https://www.who.int/en/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health.
11. https://www.scienceteacherprogram.org/envsci/DForbes11.html.

ISSN: 2574-1241

DOI: 10.26717/BJSTR.2023.50.007912

Krsto Mijanović. Biomed J Sci & Tech Res

Submission Link: https://biomedres.us/submit-manuscript.php