

POLLUTION OF THE CITY ATMOSPHERE BY FINE DUST OF PM_{2.5} FRACTION

The modern development of society is accompanied by a large population in cities, and hence the growth of economic and energy needs. Emissions of harmful substances from industrial enterprises into the atmosphere, car exhaust gases and the use of CFCs in the home cause the greenhouse effect on the planet, climate change and a large number of diseases in large cities. One of the air pollutants is PM 2.5 particles.

PM (ParticulateMatter) is a widespread air pollutant consisting of a mixture of solid and liquid particles suspended in the air. They range in size from about 10 nm to 2.5 μm . PM is a mixture of physical and chemical characteristics that depend on the location. Common chemical components of PM include sulfates, nitrates, ammonium, other inorganic ions such as sodium, potassium, calcium, magnesium and chloride ions, carbon, water, metals (including cadmium, copper, nickel, vanadium and zinc) and polycyclic aromatic hydrocarbons (Surfactants).

These particles are the biggest danger in the city. There is much more in the city and the chemical composition of the fine aerosol in the city is more dangerous than in nature.

According to their origin, the PM is divided into:

- Primary PM - they are released into the air ready. These are the smallest pieces of soot, asphalt and car tires, particles of mineral salts (sulfates, nitrates), heavy metal compounds (mainly oxides). Biological contaminants (some allergens and microorganisms);
- Secondary PM - are formed directly in the atmosphere. One example: nitrogen and sulfur oxides are released into the city air, they form acids when in contact with water, and solid salt particles (nitrates and sulfates) are released from them; [1]

Everyone is used to being afraid of harmful gases, because when you inhale them you will be poisoned immediately. But in fact the particles are no less dangerous. People inhale them every day. There is no immediate reaction to small doses of RM, but they accumulate in the body and over time can lead to serious problems. PM particles are so small that they pass through biological barriers in our body: the nasal cavity, upper respiratory tract, bronchi.

The researchers traced the effect of PM_{2.5} on the human body and identified six main mechanisms of harmful effects of particles:

1. Disorders of pulmonary receptors: increased respiration, cardiac arrhythmia
2. Destruction of pulmonary epithelial cells
3. Development of the inflammatory response
4. Increased blood clotting
5. Destabilization of atherosclerotic plaques
6. Thickening of vessel walls [2]

In the Shevchenkivskyi district of Kharkiv, there are eight enterprises whose activities lead to an increase in the number of RMs in the air: PJSC Pharmstandard-Biolik, SE Chemical Plant of Chemical Reagents, Institute of Single Crystals, TDV Zhytlobud-2, LLC HADO, LLC Tandem-Impex ", PJSC " Aviakontrol ", Kharkiv State Research Prosthetic Enterprise, PJSC " Tochprilad ". [3]

Due to the fact that these particles are often of anthropogenic origin and have a negative impact on the health of the population, their study is relevant. I observed the dynamics of PM 2.5 particles at three points in Kharkiv.

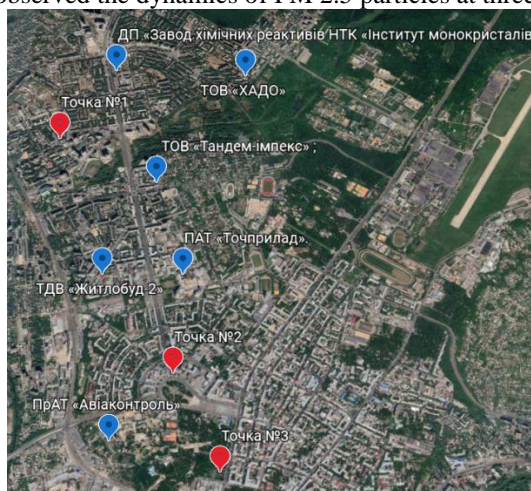


Fig. 2. Locations of the investigation

Measurements were conducted in 2019 in the period from April to July and from October to December.

The level of air pollution PM_{2.5} was determined according to the international scale of risk to public health according to the Air Quality Index (AirQualityIndex, AQI), proposed by the European Environment Agency, according to which the permissible daily average value is 25 $\mu\text{g} / \text{m}^3$ [4].



Figure 2. The average values of PM 2.5 for each observation site

The time variation of the calculated average values of mass concentrations of PM_{2.5} indicates an increase in the concentration of dust in the air from November to December. It was in December that the highest average value was 65.1 $\mu\text{g} / \text{m}^3$. The lowest averages are in the spring months, which may be due to more rainfall in those months. 40.6 $\mu\text{g} / \text{m}^3$ in April and 43.6 in May.

Therefore, fine dust poses a high threat to city dwellers, due to its ability to easily enter the human body through the respiratory tract itself due to its size. Once in the human body, it increases the risk of cardiovascular and respiratory diseases. The severity of the disease directly depends on the duration of exposure, due to the accumulation of dust in the body.

1. World Health Organization Regional Office for Europe Health effects of particulate matter. UN City, Marmorway 51, 2013. p. 2-6

2. A report by the Committee on the Medical Effects of the Air Pollutants Department of Health (DH). February 2006. p. 272-283

3. Shevchenkiivskiy district. Entrepreneurship and consumer market of Kharkiv: website. URL: <https://ppr.kharkov.ua/en/shevchenkiivskiy-district>

4. European Air Quality Index. GIS Map Application. European Environment Agency: website. Retrieved from <https://www.eea.europa.eu/themes/air/air-quality-index>