SIMULATION OF EMISSION DISPERSION AS THE METHOD OF AIR QUALITY MANAGEMENT

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Abstract. The article overlooks the mathematical simulation of air pollutants dispersion in the ambient atmosphere. A short analysis of the necessity for atmospheric dispersion modeling is presented and the influence of major factors on emission transfer in the atmosphere is examined. Based on the given factors a mathematical model of air pollution dispersion is developed. The operation of this model is examined on x-pollutant of an industrial enterprise from Moldova and the graphic visualization of the dispersion progress is presented.

Keywords: Dispersion models, emission transfer, atmospheric turbulence, mathematical modeling, difference schemes, numerical methods, graphic visualization

1. Necessity for Air Pollution Dispersion Models

Atmospheric dispersion modeling is the mathematical simulation of how air pollutants disperse in the ambient atmosphere. It is performed with computer programs that solve the mathematical equations and algorithms which simulate the pollutant dispersion.

The dispersion models are used to estimate or to predict the downwind concentration of air pollutants emitted from sources such as industrial plants and vehicular traffic. Such models are important to governmental agencies tasked with protecting and managing the ambient air quality. The models are typically employed to determine whether existing or proposed new industrial facilities are or will be in compliance with the National Ambient Air Quality Standards (NAAQS) in the United States and other nations [1]. The models also serve to assist in the design of effective control strategies to reduce emissions of harmful air pollutants.

The results of dispersion modeling are a base for the Law of Clean Air, which aims at "achievement and maintenance of an air quality level, necessary for the health and welfare of the population" [1]. The law determines as well the maximum admissible emissions for every type of production that restricts all permanent air
pollutant emissions. There is one other conception — prevention of the essential air quality infringements (PEI), where atmospheric dispersion modeling is wildly applied. The implementation of PEI consists in preliminary evaluation of new industrial facilities with the view of emission explosion and harmful air pollutants neutralization. No one source of emission can be planned in a region until the owner proves that the estimated emissions, with the view of production volume development, will be in line with the admissible increments in the region. In such a way atmospheric dispersion modeling is a preliminary analyzing method, which is convenient for air pollution assessment.

2. Movement in the Atmosphere

The emission transfer in the atmosphere is mainly caused by two components: field of the wind (speed, direction, etc) that transfers pollution from one point to other and atmospheric turbulence that disperses pollution with respect to the center of emission. The major part of these processes takes place in the planetary interface layer which is a part of the atmosphere between the earth’s surface and the free atmosphere. The movements in this layer basically are not influenced by surface friction and cooling and heating of the ground surface. The areas of atmospheric movements in the planetary interface layer are presented in the figure 1. The preliminary grade of heights is given as well.

![Diagram of atmospheric movements](image)

**Figure 1.** Areas of atmospheric movements.

2.1. ATMOSPHERIC TURBULENCE

The amount of turbulence in the ambient atmosphere has a major effect on the dispersion of air pollution plumes because turbulence increases the entrainment and mixing of unpolluted air into the plume and thereby acts to reduce the concentration