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ANALYSIS OF THE CURRENT STATE OF AIR POLLUTION FROM MOTOR TRANSPORT AND MEASURES TO REDUCE EMISSIONS

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Abstract : Air pollution is one of the most pressing environmental issues of our time. In large cities, motor vehicles are among the main sources of air pollution. Engine exhaust gases contain a complex mixture of over two hundred components, including many carcinogens. Harmful substances enter the air practically within the human breathing zone. Therefore, motor vehicles are among the most dangerous sources of air pollution.

This paper examines the problems of air pollution from vehicle emissions and the meteorological aspects of addressing them. It analyzes the state of air pollution from vehicle emissions in various cities and considers two approaches to reducing air pollution: short-term reductions in vehicle emissions during periods of unfavorable meteorological conditions based on short-term air pollution forecasts, and the implementation of long-term programs of technical and organizational measures to reduce vehicle emissions.

Key words: Air pollution, greenhouse gases, carbon dioxide, methane, nitrogen oxides, sulfur dioxide, particulate matter, smog, fossil fuels, industrial emissions, vehicle exhaust, deforestation, climate change.

In some cases, it is impossible and economically irrational to predict such low emissions of harmful substances into the atmosphere that ground-level concentrations of air pollutants would never exceed maximum permissible levels. Therefore, achieving hygienic standards is achieved under relatively frequent adverse meteorological conditions, and in the rare instances of abnormally hazardous situations, air quality is ensured through emission forecasting and regulation. This explains the significant economic impact of air pollution forecasting.

In this paper, a short-term forecast refers to a forecast of air pollution levels up to 24 hours in advance, which includes measures to prevent increases in air pollution. A long-term air pollution forecast refers to a forecast of estimated pollutant concentrations for 10-15 years, taking into account measures to reduce vehicle emissions.

The purpose and objectives of the study . The aim of this work is to study the influence of meteorological factors on the level of air pollution from vehicle emissions; to develop a short-term forecast of air pollution for the city as a whole and near individual highways; and to assess possible changes in air pollution levels, taking into account measures to reduce vehicle emissions.

To achieve this goal, the following tasks must be solved: to clarify, on the basis of theoretical and experimental research, the meteorological conditions that contribute to increased air pollution from motor vehicles; to substantiate the possibility and develop schemes for statistical forecasting of air pollution from motor vehicles; develop a method for predicting air pollution generated by individual highways and groups of highways; Conduct an analysis of fields of calculated concentrations of impurities in cities with varying traffic intensities; conduct an analysis of the effectiveness of measures to reduce vehicle emissions in order to achieve air quality standards .

Research results: An approach to short-term forecasting of air pollution from vehicle emissions has been formulated. It is based on the physical laws governing the propagation of emissions from low- and cold-air sources, such as vehicles, and the influence of meteorological conditions on the concentration of harmful substances in urban air. The adopted approach involves developing and compiling two types of forecasts: for the city as a whole and for the vicinity of specific highways. The feasibility of using statistical forecasting schemes for nitrogen dioxide and carbon monoxide air pollution in the city to prevent hazardous levels caused by vehicle emissions is substantiated. Statistical models for forecasting nitrogen dioxide air

pollution were developed using multiple linear regression with preliminary exclusion of nonlinear relationships and a sequential graphical regression method. The accuracy of high-level forecasts was 89% and 86%, respectively. The accuracy of high-level nitrogen dioxide air pollution forecasts, generated using the multiple linear regression method with preliminary exclusion of nonlinear relationships, was 75%. A method for predicting air pollution for various types of highways has been developed. The method is based on the results of mathematical modeling of air pollution and involves dividing highways into groups with identical complexes of adverse medical conditions, taking into account the intensity of traffic flow, the width of highways, and the estimated concentrations of impurities. The method involves establishing these complexes and generating warnings separately for each of the identified groups. To ensure clean air in the city, it is of greatest importance to generate warnings of 3 hazard levels for the busiest highways (group 1). The main indicators for assessing the environmental state of motor vehicles are considered. For the first time, an assessment of emissions from individual vehicles, which are currently not included in statistical reporting, was conducted. The obtained results indicate that accounting for emissions from individual vehicles significantly clarifies the general information on the state of emissions in cities and regions. At the same time, vehicle emissions of carbon monoxide, nitrogen dioxide, and hydrocarbons increase by 1.5 - 2 times. Methodological approaches to forecasting air pollution from motor vehicles for the future, taking into account planned measures to reduce the transport load on the atmosphere, have been developed.

A methodology was developed for surveying the composition and intensity of vehicle traffic and calculating emissions (with a more detailed breakdown into six vehicle categories). Calculations were made of vehicle emissions for five substances: nitrogen dioxide, carbon monoxide, hydrocarbons, soot, and lead on major highways.

Using the obtained data on vehicle emissions on city highways, calculations were made of the territorial distribution of the concentration of harmful substances in cities with different traffic intensities.

Conclusions. Based on the analysis of the calculated air pollution from motor vehicles, it was established that in all the cities studied, air pollution from nitrogen dioxide and carbon monoxide is very significant. There is a zone with exceeded maximum permissible concentrations of nitrogen dioxide, in the central part of the city there is a zone with exceedances of 5 MAC, and on the highways themselves, nitrogen dioxide concentrations reach 19-24 MAC.

Similar data are presented for carbon monoxide and lead compounds. Emissions of hydrocarbons and soot do not create citywide zones with excess of maximum permissible concentrations (MPC); maximum concentrations of these substances are observed in the immediate vicinity of highways. The results of forecasting maximum concentrations of impurities for the future are presented, taking into account the phased implementation of measures to reduce emissions, using the city of Pskov as an example. In order to reduce air pollution from motor vehicles in the city of Pskov, an action plan was developed with the participation of the dissertation candidate, providing for a phased reduction of motor vehicle emissions by 2005. With the implementation of this plan, one can expect a reduction in motor vehicle emissions: for carbon monoxide by 47.7%, for nitrogen dioxide - by 41.3%; for hydrocarbons - by 46.1%, for soot - by 35.4% and for lead compounds by 66.7%.

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