

ABSTRACT

The thesis of Stanislav Aryeh Fradkin "Modelling of the urban transport impact on the city atmospheric environment using apparatus of mathematical physics". The scientific supervisors: associated professor, Dr.math., Sharif Guseynov, professor, Dr.habil.sc.ing., Eugene Kopytov, and associated professor, Dr.sc.ing., Oleg Schiptsov.

This paper presents the results of study on urban ecology problems dealing with distribution and propagation of harmful substance of vehicular traffic exhaust fumes within the city scale, conducted by the author in the period from 2006 to 2012. Riga city (Latvia) is chosen as the target for the application of obtained research results. However, the obtained results are considered to be universal and could be also used for the studies in other cities. The specific features of the urban transport ecology problems are observed in the thesis; main types of harmful influences of vehicular traffic on the urban ecology are discovered and classified; the models for risk assessment are constructed taking into account the influence of pollution on a human health caused by urban vehicular traffic; the ideas concerning the application of databases and temporal databases theory in relation to the monitoring of transport ecology were elaborated.

The existing mathematical models are observed and the selection of the partial differential equations (PDE) toolset is made, which is regarded to be one of the most effective components of the apparatus of mathematical physics for solving the problems of similar type. The choice is based on classification, analysis and study of peculiarities of the turbulent flow models for the urban atmosphere and its impact on the quality of mathematical modelling. The construction of hydro-thermodynamic equations of atmospheric processes in a mesoscale was performed and numerical algorithms for its implementation were developed. The influence of the ground surface landscape roughness on the flow of air masses was mathematically studied and justified. A 3D non-stationary mathematical model for analytical determination of dynamics of the exhaust fumes` concentration in the urban atmosphere owing spatial variable was developed under a priori given information on a vertical component velocity of a turbulent air flow and at a given coefficient of a molecular diffusion. The improved 3D non-stationary mathematical model for analytical determination of dynamics of the exhaust fumes` concentration in the urban atmosphere under a priori given information on a vertical component velocity of a turbulent air flow and at a given coefficient of a molecular diffusion was developed and investigated as well. The computer implementation of the developed model was performed. The obtained model was validated.

Examples of obtained results` application to the solution of practical problems were presented. The constructed mathematical model for determination of the concentration of any harmful substance in any period of time (both for the past, and the future) and at any place of the observed part of the city allows performing both short-term, and long-term ecological projects in the city scale. The obtained results are considered to be universal and could be used in management of environmental problems of traffic control, environmental planning of urban development, planning of housing estates, road building, etc. aimed at possible reduction of the impact of harmful substance produced by vehicular traffic exhaust fumes on both human health and atmospheric environment.