INFLUENCE OF TRAFFIC MANAGEMENT MEASURES ON ENVIRONMENTAL LOAD IN CITIES

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The main problem of the modern city in any economically developed country in the world is the increase in transport and environmental load associated with the growth of motorization. Being developed cities in Ukraine are plagued by congestion of the city road network (RN) with traffic flows (TF), which causes an increase in the number of road accidents and formation of multi-kilometre traffic jams; excessive pollution of the environment with exhaust gases and other harmful substances. Kharkiv is not an exception. In recent years, according to the Main Department of Statistics emissions from stationary sources are decreasing and emissions from mobile sources are increasing, mainly due to motor transport [1]. The quality of atmospheric air in the city is 80% affected by TFs, which also produce from 60 to 80% of noise in the city, which negatively affects the living environment of residents. At the same time, on average, about 1 kg of pollutants is emitted from one car into the air per day, and at idle the emission is increased by 2.5 times.

Exhaust emissions from motor vehicles contain such harmful substances as carbon monoxide, nitrogen dioxide, soot, BaP. The degree of air pollution on the streets of Kharkiv with heavy traffic is moderately dangerous, and on major highways of the city is dangerous.

The main factors of intensive air pollution by vehicles are the ever-increasing number of vehicles; usage of obsolete car fleet; low quality of fuels and lubricants; insufficient capacity of the road transport network, which was formed under conditions of the current building, especially in the downtown of the city (DC); unsatisfactory condition of the road surface of the roadway, etc.

The problem can be eliminated by having a comprehensive influence on the level of air pollution in three directions: first, by reducing the toxicity of emissions from every individual vehicle (IV) by improving individual units and using safer fuels; secondly, by reducing the concentration of harmful substances in the air due to rational planning and building areas near highways, as well as gas protection structures and landscaping; third, by reducing TF emissions on highways by improving the transport planning characteristics of the RN and improving traffic management (TM).

The last direction includes introducing traffic light regulation, limiting the overall intensity of TF, adjusting their composition, allocating non-traffic zones, forming pedestrian zones, building parking lots, including underground, and others. This is especially true for DC, where landscaping or using engineering structures are not possible or impractical in most cases due to lack of space or aesthetic concepts. That is, the best way to call it is the development of comprehensive schemes of TM.

The Department of Traffic Management and Road Safety of KhNAHU has been developing comprehensive TM schemes for a long time and assessing the level of air pollution on city roads in Kharkiv, for example, Sumska Street, Heroyiv Stalingradu Avenue, Olexandrivsky Avenue. The sections of selected streets and avenues were divided into zones depending on the type of traffic management. The concentration of carbon monoxide (CO) in mg/m^3 is determined according to the method [2] for each zone where TM schemes were changed. The result is the size of emissions depending on the TM type (before and after measures).

Taking into account that all objects of research are streets of the city with existing buildings and planning structures, application of engineering protective constructions (walls-screens, excavations, embankments) and landscaping in these areas are impossible and inexpedient because of lack of necessary area. In this case, along with changing RN transport planning characteristics and TM improving by introducing traffic light regulation, limiting TF intensity, changing TF composition, creating pedestrian zones and areas with limited access to transport. However, the results of calculations proved that introducing traffic light regulation does not exclude an environmental threat.

In difficult conditions of RN reconstruction of any zone in the city with formed valuable buildings such compulsory measures for restricting the movement of some types of vehicles can be applied. When designing a transport network, there are different options for creating such zones: pedestrian, residential, areas with limited access to transport [3].

Thus, it is advisable to implement coordinated management at the research sites, as the introduction of the “green wave” requires at least two lanes in each direction. But this is impractical for several reasons (distance between traffic lights, etc.). Having ignored the conditions for introducing coordinated management, instead of local traffic light control, it would be possible to introduce coordinated traffic management. That is, to change the TM type in areas with traffic lights to with control (ACS), but the results of calculations show that introducing traffic ACS also does not exclude an environmental threat.

The option of introducing one-way traffic necessitates the construction of a bypass road and the high costs associated with the relocation of the trolleybus contact network. You can find a territory for this, but it requires a lot of capital investment and this does not exclude the emergence of an environmental threat. The option of TF redistribution on adjacent streets also does not exclude significant costs and environmental load on them.

There are centres of transport attraction at the objects of the study, which leads to an increase in the movement of vehicles and the formation of sidewalks when they are prohibited. On most highways of the city, there are parking lots on both sides of traffic (for example, Oleksandrivsky Ave., Plekhanivska Street), which reduces the capacity of the carriageways, because one lane in each direction is occupied for parking vehicles. We conclude that one of the best solutions for TM changing at the object of the study is to prohibit vehicle parking on the roadway along the sidewalk. For example, this will greatly affect the speed limit on the highway, and the ban on parking vehicles will reduce the queue for passing, i.e. change the idle time of the engine, which will affect the level of pollution.

In large cities, pedestrian traffic is organized by building pedestrian crossings or pedestrian traffic is organized at intersections by introducing pedestrian traffic lights. An equally favourable measure to decrease environmental pollution would be constructing an above-ground or underground pedestrian crossing. There is a necessary area for constructing above-ground and underground pedestrian crossings (especially because we have artificially reduced their number) in the study areas, but too dense underground communication network does not allow us to build underground crossings and above-ground ones require large capital investments.

It is necessary to develop traffic light control software at busier intersections, but this approach requires installing additional equipment, in particular a time synchronization module for GPS signals.

The analysis of the research results showed that the level of air pollution in all areas corresponds to the level of "environmentally hazardous". The proposed options for reducing pollution by means of introducing traffic light control software or coordinated management contribute to reducing pollution from 22% to 60%.

The provided practical recommendations for improving the environmental load confirm the need to choose the most rational measures of TM. But the problem can be solved with an integrated approach: reducing the toxicity of emissions from each vehicle, rational planning of gas protection structures and landscaping and changing RN transport and planning characteristics along with TM improvement.

References

1. Informacija ob jekologicheskoj situacii v g. Har'kove i merah po ee uluchsheniju [Information on the environmental situation in Kharkov and measures to improve it]. Available at: https://pandia.ru/text/77/196/43656.php (Accessed 07.07.2020)

2. Shapovalov A. L. Prognozirovanie zagrjaznenija atmosfernogo vozduha v pridorozhnom prostranstve [Prediction of air pollution in the roadside space]. *Vestnik Har'kovskogo nacional'nogo avtomobil'no-dorozhnogo universiteta - Bulletin of Kharkov National Automobile and Highway University*, Kharkov, 2002, no.19, pp.82-84.

3. Vukan R. Vuchic. Transportation for Livable Cities. *CUPR/Transac*tion, 1999, 376 p. (Rus. ed.: Vukan R. Vuchik Transport v gorodah, udobnyh dlja zhizni. Moscow, 2011, 576 p.).

THE PROBLEM OF AIR POLLUTION IN SERBIA

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The atmosphere is a mixture of gases, some with fairly constant concentrations, others that are variable in space and time. In addition, there are suspended particles (e.g. aerosol, smoke, ash, etc.) and hydrometeors (e.g. cloud droplets, raindrops, snow, ice crystals, etc.).