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THE STATE OF THE QUESTION OF ASSESSING OF CAR EFFICIENCY IN URBAN ENVIRONMENTS

Ziyayev Kamoliddin Zukhritdinovich,
PhD., Docent of Tashkent State Transport University

Abdujalilova M. B.
Student at Tashkent State Transport University

Yangiyeva I. I.
Student at Tashkent State Transport University

Abstract
Design development and growth in the number of vehicles and the increase in varieties of fuel requires a modern approach to estimating fuel-economic characteristics of cars. The article discusses the foundations and objectives method of evaluation of car efficiency in urban environments. In the paper given the results of experimental studies to determine the condition of the driving modes of Tashkent city and justification of the relevance and objectives of the study evaluating of cars efficiency in urban environments.

Keywords: efficiency; automobile; driving cycle; urban cycle; fuel consumption, fuel efficiency; energy; driving mode, GPS (Global positions systems).

Introduction

The economy of Uzbekistan is growing steadily and dynamically, annually accounting for more than 8% of the GDP. The volume of freight turnover by road transport is ahead of the economic indicator within 1.25 times. Foreign experience, in particular the European Union, shows an increase in freight turnover for 2001-2010 by 38%, with an average economic growth of 1.34%. The number of cars in Uzbekistan by the beginning of 2014 reached more than 2400.0 thousand cars, of which 1960.0 thousand belong to private owners. This is 70% more than in 2000. A significant share of the number of cars falls on large cities, so in Tashkent there are 570.0 thousand cars. A car is one of the largest consumers of oil products and causes significant harm to the environment. In addition, other types of energy and natural resources are consumed in the process of its maintenance. The organization of traffic becomes difficult. In urban conditions, traffic jams are observed, causing uneven movement of the car with excessive fuel consumption and increased toxic exhaust gases. Despite these factors, the need for cars in the economy and social sphere is growing.

The fuel efficiency of cars and the issues of standardizing fuel consumption during operation in urban conditions were studied by leading research (NIIAT, NAMI, NIIPiN) and educational organizations (MADI, SibADI, IrSTU, TyumGNGU). The basis of such studies were the works of Chudakov E.S., Velikanov D.P., Govorushchenko N.Ya.,

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Zimelev G.V., Lurye M.I., Narbut A.N., Rubets D.A., Tokarev A.A., Platonov E.M., Sheinin A.M., Falkevich B.S., Farobin Ya.E. and others. Researchers have noted the significant influence of variable driving modes of vehicles and the operation of their power plants during operation in urban conditions on operational fuel consumption [1]. There are a number of methods for determining fuel consumption rates intended for resource planning, maintaining statistical and operational reporting, determining the cost of transportation and other types of transport work, implementing economy and energy saving modes of fuel consumed, making settlements with drivers, etc. Combining them into a single methodology is very difficult due to the differences in approaches to determining the standard in different countries, car manufacturers, depending on operating conditions and the level of requirements. This problem also applies to the assessment of exhaust gas toxicity.

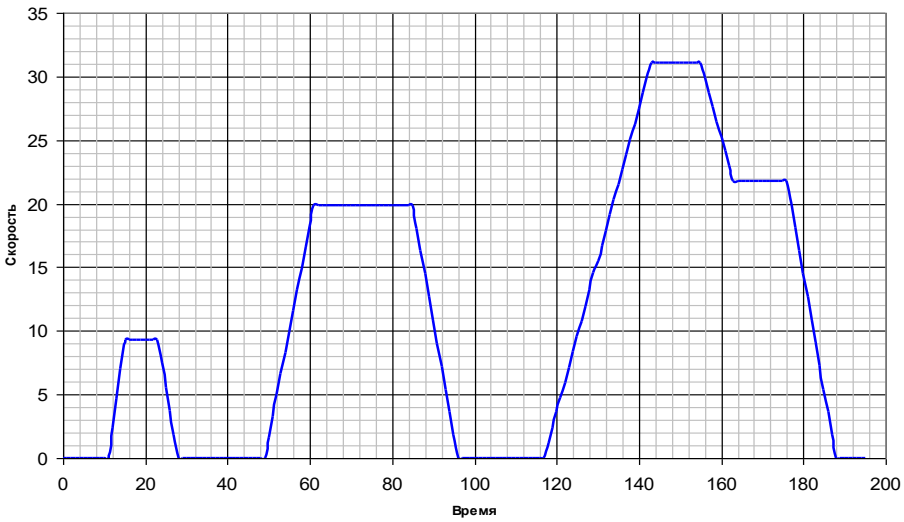

Figure 1. ECE driving cycle

A widely used method is to standardize fuel consumption and determine toxicity over standard vehicle driving cycles. Different countries have their own standardized driving cycles (Fig. 1). Driving cycles characterize the vehicle's driving mode and are determined for specific operating conditions. An analysis of more than 55 standardized driving cycles showed that, in urban vehicle driving conditions, the unsteady mode in time reaches 70%. The length of the sections of the acceleration and deceleration phases is 70-80% of the total distance traveled by the car. With the development of vehicle traffic intensity, road network and traffic organization, the characteristic traffic regime in a given area also changes. Each city and area where cars are used differ in their driving style. This feature affects fuel consumption. The development of the use of information technologies with on-board, remote and central equipment would make it possible to improve the correctness of solving the analyzed issue.

Vehicle fuel consumption is regulated according to the methodology established in O'z RH 88.20-01:2003 "Fuel and lubricant consumption standards for automotive rolling

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stock and road construction machines," which requires scientific research to update standards taking into account modern vehicle designs.In Uzbekistan, it is customary to evaluate the fuel efficiency of a car according to GOST 20306-90, integrated with the international document UNECE Regulation No. 83, based on the European driving cycle, introduced in 1985. In the republic, due to limited testing equipment, it is not used in practice. The driving cycles given in it were obtained experimentally for operating conditions at that time. Since driving cycles directly depend on the number and purpose of vehicles in use, the equipment and type of roads, timely updating of driving cycles is necessary. And also, many of the mathematical models of fuel consumption depending on various factors for cars with gasoline engines, developed in the last century, have lost their relevance with the transition of the automotive industry to engines with electronically controlled fuel injection. In developed countries, there is constant updating and replacement of outdated cycles. This is due to the fact that traffic conditions in and outside cities change quite quickly over time, and for the main cities of our republic there are no corresponding standardized driving cycles.

The theory of constructing test driving cycles is based on the representation of a fairly long (in the static sense) process of changing the speed of movement over time as a random stationary process, typical for given operating conditions, and its schematization according to characteristic modes to highlight the most important features in a compressed form.If we take the process of changing speed recorded during a run along a given typical route as the implementation of a random process, then within certain tolerances for deviations from the linearity of the relationship between speed and time, this record can always be marked in such a way as to highlight successively changing modes or phases. Each phase is expressed by a pair of random values of change in speed and duration.

If we now build a sequence of the most probable modes (with possible repetition to increase reliability), then a continuous process is formed, reflecting in probability the main features of the random process represented by its processed implementation. Such a time-limited and controlled process of movement is accepted as a preliminary one for those conditions in which the initial continuous process of changing speed is recorded over a sufficiently long time.

Much more detail can be included in a basic driving cycle (for example, gear shift modes, deceleration with the clutch engaged, etc.). Accordingly, the layout of the original process and the construction of an equivalent test cycle will also be more detailed and complete.

To compile an urban driving regime, it is necessary to determine the actual speed, acceleration, maximum speed, maximum acceleration, maximum deceleration, average speed, average acceleration, distance traveled, number of stops, time and number of gear changes. For this purpose, it is advisable to use modern information technologies, in particular GPS monitoring.

The GPS system, together with satellite communication systems GSM/GPRS and INMARSAT, as well as electronic computing technology, allows you to obtain

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information about the movement of vehicles based on traffic monitoring on an electronic map.

Preliminary experimental studies to determine the current driving mode (Fig. 2) showed a significant difference in the driving modes of a passenger car in the city of Tashkent in comparison with the standard driving cycle (Table 1). The experiment was carried out on 4 routes (Fig. 3) with different traffic loads (Samarkand Darvoza-Chukursoy, Chukursoy-Ibn Sino, TADI-Samarkand Darvoza, TAYI-Feruza massif) using a GPS monitoring system.

Table 1 Average result of preliminary experimental studies

Driving mode	According to the experiment (%)	According to GOST 20306–90 (%)	Difference
Idling	16.247	11,273	+32,3 %
Acceleration	36.568	28,732	+27,2 %
Slowing down	29.705	27,344	+ 8,6 %
Moving at a constant speed	17.480	32,651	-46,5 %

The results show a significant difference between real urban driving conditions and normative ones.

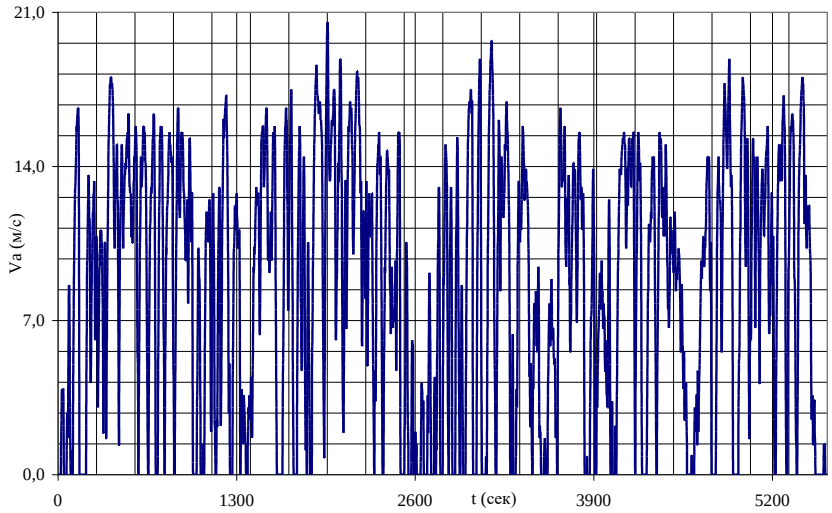

Figure. 2. Results of experimental studies

Currently, there is no methodology for comparative evaluation of standardized driving cycles. All standardized driving cycles have different parameters, and modern cars use power plants with different types of fuel. Since the driving cycle is one of the main determining factors in the energy consumption of a vehicle, it is advisable to consider the problem of energy assessment of a vehicle.

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Based on the above, it can be argued that the problem of energy assessment of a car, regardless of the type of fuel consumed, and the development of new methods for regulating fuel consumption for modern operating conditions is relevant.

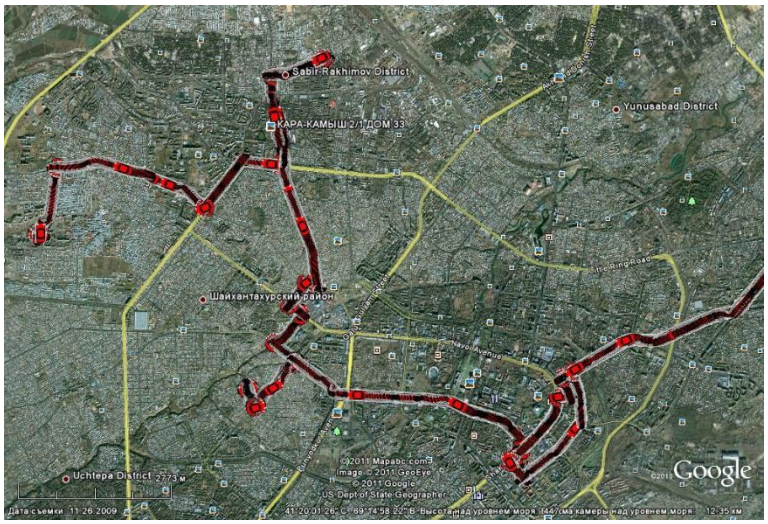

Fig.3. Route map

The development of a methodology for assessing the energy efficiency of vehicles operated in urban conditions and the development of recommendations for creating a guideline document for standardizing fuel consumption will help solve the above problem.

A systematic approach to solving the problem based on the analysis of existing studies shows the formulation of the following tasks:

- Analysis of known methods for assessing and determining fuel consumption standards for vehicles operated in urban conditions;
- Comparative analysis and assessment of the energy intensity of typical driving cycles to determine the causes of variety and commonality;
- Development of a method for determining the standardized driving cycle for specific operating conditions, for cities with different traffic intensity and modes;
- Development of a method for applying information technology achievements to the process of determining the energy efficiency of vehicles;
- Development of an experimental and calculation program for assessing the energy efficiency of a vehicle using information technology;
- Development of recommendations and a regulatory document for assessing the energy efficiency of a vehicle on a route.

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Сведения об авторах

Мухитдинов Акмал Анварович, Заведующий кафедрой «Автомобили и СПС» Ташкентского автомобильно-дорожного института.
100057, г.Ташкент, Юнусабадский р-н, 1-я линия Сандиккурган, 10-дом.
E-mail: akmalmukhitdinov@gmail.com
Телефон: (+99871) 2343823
(+998 90) 977-38-23
(+99871) 232-14-59

Зияев Камолиддин Зухритдинович, Ассистент кафедры «А и СПС» Ташкентского автомобильно-дорожного института.
100068. г. Ташкент, Шайхантахурский р-н, массив Ибн-Сино II, 14-15.
E-mail: komoliddin28@mail.ru
Телефон: (+99871) 218-04-61
(+99890) 189-14-58
(+99871) 232-14-59