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Kapsky Denis, Doctor of Technical Sciences, Associate Professor, Dean of the Faculty of Automotive Engineering, Belarusian National Technical University, Minsk, Belarus
Bogdanovich Sergey, Candidate of Technical Sciences, Associate Professor, Head of the Department "Transport Systems and Technologies", Belarusian National Technical University, Minsk, Belarus
Kot Eugene, Candidate of Technical Sciences, Associate Professor of the Department "Transport Systems and Technologies", Belarusian National Technical University, Minsk, Belarus
Semtchenkov Sergey, Master of Technical Sciences, Senior Lecturer of the Department "Transport Systems and Technologies", Belarusian National Technical University, Minsk, Belarus

CLASSIFICATION OF ROUTE VEHICLES WITH ELECTRIC DRIVE AS THE BASIS FOR THE CHOICE OF VEHICLES TO WORK ON ROUTES

The development of the transport sector leads not only to positive changes in the life of cities and settlements, increasing convenience and comfort for residents, but also worsens the ecology and the environment of their residence. The "profitable-safe" dilemma can be solved by the approach of an environmentally oriented choice of the type of route passenger transport and decision-making in favor of electric route passenger transport. Therefore, the use of route vehicles with electric drive continues to gain popularity [1]. Currently, more than 100 electric buses of four models and about 1500 trolleybuses are in operation in the Republic of Belarus, including about 200 trolleybuses that have the ability to run independently from the overhead contact network, 300 trams.

Currently, the classification of route vehicles with electric drive is known, which provides for four main schemes:

1. Powered trolleybuses in motion (IMF) that need a contact network along the entire length of the route

2. Trolleybuses with charging in motion (IMC) and the possibility of autonomous running from the contact network

3. Electric buses with ultra-fast charging (OC), having a power reserve commensurate with the length of one flight or a turnaround flight, requiring charging infrastructure at the final station of the route (the final stations of the route), while charging is carried out for up to 10 minutes.

4. Electric buses with night charging (ONC), having a power reserve sufficient to operate for one working day. [2]

Recent years have been characterized by rapid development of electric transport, manufacturers of route vehicles with electric drive also continue to develop this direction and offer customers new solutions. The emergence of new models and modifications of vehicles has led to the fact that within the same scheme according to the existing classification there were vehicles with significant differences in parameters determining their operational properties and qualities, requirements for charging infrastructure and, as a consequence, characterizing the possibility of using vehicles on regular routes of a certain configuration and length.

Thus, the existing classification at the moment turned out to be very stingy and, in the opinion of the authors, there was a need to create an extended classification. In the extended classification proposed by the authors, in addition to the designation of the scheme, the concept of a category with a digital designation is introduced, while the higher the value of the category, the greater the margin of autonomous travel the vehicle has.

For trolleybuses built according to the IMF scheme, two categories are provided:

IMF-0 - no reserve of autonomous travel;

IMF-1 - an autonomous power reserve of up to 1 km (as a rule, this is an emergency mode).

For trolleybuses built according to the IMC scheme, three categories are provided:

IMC-1 - a reserve of autonomous travel from 5 to 15 km;

IMC-2 - autonomous range from 15 to 31 km;

IMC-3 - autonomous range from 31 to 51 km.

For electric buses built according to the OC scheme, four categories are provided:

OC-1 - a reserve of autonomous travel from 3 to 5 km;

OC-2 - autonomous range from 5 to 13 km;

OC-3 - autonomous range from 13 to 21 km;

OC-4 - autonomous range from 21 to 51 km.

For electric buses built according to the ONC scheme, two categories are provided:

ONC-1 - a reserve of autonomous travel up to 170 km (equal to the duration of one working shift);

ONC-2 - autonomous driving range from 170 to 250 km (equal to the duration of one working day with restrictions);

ONC-3 - autonomous travel range from 250 to 350 km (equal to the duration of one working day).

The proposed categories are formed based on the solutions offered by manufacturers and the established practice of using route vehicles with electric drive on regular routes. The emergence of new solutions that will require the introduction of additional categories in the classification under consideration is not excluded.

The authors' research has shown that for cities with trolleybus traffic, the IMC-2 and IMC-3 trolleybuses are of the greatest interest. From a practical point of view, IMC-2 trolleybuses have the ability to move on sections where there is no contact network in the autonomous running mode up to 15 km, and it is advisable to use them to extend trolleybus routes "in the outbound direction" for a distance of up to 7.5 km from the section with a contact network with a turnaround at the end of this section and movement in the opposite direction to the section with a contact network or to create fundamentally new routes, the sections of autonomous running of which will be located in the central part of the route. It is also possible to create combined routes. It is advisable to transfer bus routes, the route of which partially passes under the contact network, to service by IMC-2 trolleybuses. At the same time, it should be borne in mind that in order to ensure the charging of traction batteries before the sections of the route that do not have a contact network, it is necessary to provide for movement along sections with a contact network of the same length as the upcoming section that does not have a contact network. IMC-3 trolleybuses have the ability to move in areas where a contact network is not provided, in autonomous mode for a distance of up to 50 km, moreover, such trolleybuses, as a rule, have the ability to charge not only from the contact network, but also from a charging station (including a centralized system of charging stations). The use of such trolleybuses significantly expands the possibilities of organizing routes in the "departure direction" for a distance of more than 15 km, while, if necessary, additional charging of traction batteries is provided at the terminal station during the inter-trip parking by connecting the trolleybus to the industrial voltage network through a charging outlet. An example of using IMC-3 trolleybuses according to the described scheme in Minsk can be the organization of a trolleybus route in the village. Lesnoy ("Borovlyany") with the organization of additional charging at the terminal station or suburban route by the message "Minsk-Logoisk".

From the point of view of traffic management, it is important for such trolleybuses to ensure the possibility of unhindered access and placement of the vehicle on the carriageway in the area of the location of current collector catchers designed to catch the current collector head when they are automatically lifted for installation on contact wires. The use of automatic lifting significantly reduces the time required to install current collectors on the contact wires in manual mode, and also increases road safety due to the fact that the driver does not have to perform work on setting current collectors while on the roadway.

Conclusion:

1. The proposed expanded classification system for route vehicles with electric drive will allow classifying and categorizing various solutions offered by manufacturers of route vehicles with electric drive, which will facilitate the work when making decisions by both operating organizations and design bureaus, since the

designation of the scheme supplemented by the category number will make it easy to determine the scope and capabilities of this vehicle, the need for charging infrastructure.

2. The IMC-2 and IMC-3 trolleybuses are of the greatest interest for cities with trolleybus traffic, which allow expanding the route network of an environmentally friendly trolleybus and replacing a number of bus routes with trolleybuses.

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Крайник Любомир Васильович, д.т.н., професор, Національний університет «Львівська Політехніка»
Фрідріх Віктор Андрійович, студент, Національний університет «Львівська Політехніка»

ЕЛЕКТРОБУСИ КЛАСУ МІДІ: ПОРІВНЯЛЬНИЙ АНАЛІЗ ТА КОНЦЕПЦІЯ ТУР АЕ127

Зростаюче розповсюдження електробусів в країнах Європейського Союзу та очевидна екологічність цього транспорту, особлива актуальність для міст зумовлюють активність відповідних робіт і в Україні [1], на жаль, без відповідної бюджетної підтримки. Поряд із звичними міськими електробусами великого (максі) класу актуальними є також середні автобуси (міді), габаритами 8-10 метрів, для маршрутів з невеликим пасажиропотоком та вузьких звилистих вулиць історичної забудови міст.

Для України даний клас актуальний, як і для більшості міст з невеликою чисельністю населення та приватних автоперевізників, у тому числі у зв’язку з очевидно меншою вартістю електробусів класу міді, що зазвичай виконані за схемою Low-entry.

У таблиці 1 представлені базові технічні дані серійних моделей автобусів цього класу, що набули розповсюдження в країнах ЄС.