

Teteriatnyk Oleksandr, assistant, Kyiv National University of Construction and Architecture, teteriatnyk.oa@knuba.edu.ua

Komotska Svitlana, assistant, Kyiv National University of Construction and Architecture, komotska.siu@knuba.edu.ua

Khoroshun Anastasiia, student, Kyiv National University of Construction and Architecture, khoroshun_av@knuba.edu.ua

ENERGY INDEPENDENCE WAYS OF CONSTRUCTION EQUIPMENT IN THE MODERN GEOPOLITICAL CONDITIONS

The increase in small-scale earthworks, especially within large cities and suburbs, causes an increase in the number of companies that have such a class of equipment as mini-excavators in their model range. This compact and maneuverable technique is already quite widely used by various structures and services to perform auxiliary work on the excavation of small volumes of soil. In addition, low-power construction equipment (mini-excavators, mini-loaders), as well as small mechanization tools, are used for earthworks in private construction.

If you look closely at the modern park of construction equipment, you can see that almost all major manufacturers of such equipment have begun to introduce almost completely electric machines into their model range, which are similar to serial machines with internal combustion engines. Moreover, these models, which are equipped with an electric or hybrid power plant, in most cases have a power unit power that does not exceed 10 kW [1].

The Bobcat company presented the world's first electric mini-excavator Bobcat E10e at the Bauma 2019 international exhibition (Fig. 1, *a*). Thanks to the electric drive, low noise level and small dimensions (excavator width is 72 cm), this model can work on objects with limited space and in closed rooms. The German company Wacker Neuson introduced the 803 model mini-excavator with the dual power function. In addition to the built-in diesel engine, the HPU8 electro-hydraulic device can be connected to the excavator, which will allow the excavator to work with zero emissions (Fig. 1, *b*).



a



b

Figure 1 – Mini excavator with electric engine: *a*) Bobcat E10e, *b*) Wacker Neuson 803 dual power with electrohydraulic device HPU8.

There are more powerful models equipped with electric motors. In 2020, CASE Construction Equipment introduced the industry's first backhoe loader 580 EV with an electric power plant (Fig. 2, *a*). The loader is powered by a 480-volt, 90-kW lithium-ion battery that can be charged in eight hours from any 220-volt three-phase connection. CASE emphasizes that one battery charge can last an eight-hour working day. In addition, many manufacturers of specialized equipment, in particular manufacturers of airfield tractors (Fig. 2, *b*), use electric models in their fleet of equipment. And such machines already have sufficiently large capacities and traction characteristics.



Figure 2 – *a*) Electric backhoe loader CASE 580 EV, *b*) electric airfield tractor Trepel Challenger 280e for aircraft with a steering mass of 250 tons.

Taking into account the global trend aimed at reducing CO₂ emissions, it is safe to say that the number of construction equipment with an electric power plant will constantly increase. And if we take into account the achievements of many developed countries in the automotive industry (which specifically concern electric cars), then the speed of this process will only increase.

This trend will lead to the fact that most construction companies will have an additional "problem" related to the need to charge batteries when operating equipment with an electric power plant. The capacity of the batteries is calculated in such a way that the machine can work a full shift with an average load. In most cases, such a "problem" does not require any additional equipment and is solved quite simply, but all this leads to an increase in the load on the local power grid. Taking into account the latest events in the world and the global challenges caused by these events, there is a need to introduce and implement technologies that can reduce energy dependence and create a more flexible and energy-efficient network.

For example, it is possible to propose the idea of location on the basis of an enterprise that has construction machines with an electric drive, stations for charging batteries that will be able to receive energy from renewable sources. Such a station can be located on the territory of the enterprise and have the necessary power to ensure maintenance of the accumulator batteries of all construction equipment with electric power plants available at the enterprise. As energy sources, it is most appropriate to use vertical axis wind turbine (VAWT), based on the fact that several devices of this type can be placed on a sufficiently small area (for example, on the

roof of an administrative building). Moreover, with an increase in the number of generating objects, it is possible to reduce their dimensions and weight with a constant required power. Such a step will make it possible to design an energy supply system in a sufficiently wide range of geometric dimensions, technical solutions and price policy.

If analyze the given model of energy supply, it is possible to see quite a lot of aspects and possibilities of using alternative energy sources. Having mentioned another type of renewable energy sources, namely solar panels, and realizing the possibility of their integration into the general system together with wind generators, the number of possible technical solutions for the implementation of similar projects can increase by an order of magnitude.

Moreover, if we take into account the trend of building machines (including construction) and aggregates according to the modular principle [2, 3], it is possible to present technical solutions at an even more universal level. It can be a separate module that will have an optimized power value and the ability to combine with most modern models of construction equipment. Such a module may be aggregated with a wind generator and a sufficient number of solar panels. At the initial stage, it can be a sufficiently large structure of the trailer or semi-trailer type. With appropriate calculations, such a module can be used to power several units of construction equipment on one construction site. It is considered possible to create a sufficient reserve of power of this type of equipment to ensure the possibility of charging batteries directly at the site of construction works while simultaneously ensuring the operation of equipment directly from the unit. This technology is very similar to the modern use of diesel generating stations when ensuring the operation of small mechanized equipment in the field.

1. REFERENCES

2.

1. Lahovskyi V.V., Paianok T.M. (2018). Modeliuvannia dynamiky rozvytku budivelnoi haluzi Ukrainy / elektronne nauk. fakhove vydannia «Hlobalni ta natsionalni problemy ekonomiky», № 23, s.710-716 (ISSN: 2413-3965) (in Ukrainian).

2. Khmara L.A, Kravets S.V., Nichke V.V. [Nazarov L.V] ta in. Pid zahalnoiu redaktsiieiu prof. Khmary L.A. ta prof. Kravtsia S.V. Mashyny dlia zemlianykh robit: Navchalnyi posibnyk / Rivne - Dnipropetrovsk - Kharkiv. - 2010. (in Ukrainian).

3. Fomin A.V., Kosteniuk O.O., Teteriatnyk O.A. (2018) Analiz konstruktsii ta kontseptsii rozvytku kompaktnoho ekskavatsiinoho obladdnannia // Vseukr. zbirnyk nauk. prats «Hirnychi, budivelni, dorozhni ta melioratyvni mashyny» – Vyp. 92. – K.: KNUBA, S. 56–62. (in Ukrainian).