TESTING THE EFFICIENCY OF THE INSTALLATION OF BASALT WIND TURBINES WITH ONIPKO ROTOR

OLEYNIKOVA Iryna, LAGODA Oksana, ISAIEV Denys
Kyiv National University of Technologies and Design, Kyiv, Ukraine
*Corresponding author: LAGODA Oksana: e-mail lagoda.oa@knutd.com.ua

Abstract: *The problem of autonomy and distribution of the source of renewable energy is considered. The use of wind power stations in combination with solar panels is proposed. Taking into account the declared high energy efficiency of the Onipko rotor at low wind speeds it is proposed to use it as a component of wind turbines. From the analysis of the available potential capacities of wind turbines in Ukraine the places for which the placement of standard blade contracture of wind turbines is not expedient were identified. For the validity of the decision to install Onipko rotors it is proposed to create an interactive map using small mobile prototypes. Basing on such properties of basalt as high strength, resistance to aggressive environments and environmental friendliness, its use as a component of the composite for the production of structural elements of the prototype is substantiated.*

Key words: *wind turbine**,** rotor Onipko, basalt composite, industrial sample, mobile prototype, interactive map.*

1. INTRODUCTION

The terrible war that is still going on in Ukraine has caused a lot of disaster. First of all, it took the lives of thousands of Ukrainians, destroyed hundreds of thousands of people's homes, entire cities and villages, destroyed or damaged infrastructure. The extreme conditions faced by the Ukrainians brought many problems, in particular energy problems. In the absence of electricity, people's lives centered around generators that hummed and burned gasoline. Practice has proven that the availability of electricity, its availability, and cost are vital for people. Even the mobile Internet was unavailable during the blackout associated with the Russian attacks on the energy infrastructure of Ukraine. The issue of alternative energy sources has become more urgent than ever. It became obvious that if there was a developed network of solar and wind mini-power plants, Ukraine would not be plunged into darkness without water, heating and the Internet. One of the possible solutions to this problem may be, firstly, the widest possible use of the Onipko rotor [1] for converting wind energy into electrical energy, and secondly, its combination with solar panels. If for the latter, effective installation angles and directions are already researched, then for the Onipko wind generator, the answers are not so obvious. The inventor emphasizes that even on a relatively small area, you need to experiment to find the best place to install the rotor. To *create an interactive map using small mobile prototypes for validity of the decision to install Onipko rotors* is the main goal of the study.

2. ONIPKO ROTORS

Figure 1: Onipko rotor

Advantages of Onipko rotor (Figure 1):

1. Starts working at low wind speed (0.1 m/s). While the usual bladed windmills begin to spin at speeds of 4-6 m / s. (in most regions of Ukraine, the average wind speed ranges from 2-6 m/sec). It works in a wide range of wind speeds of 0.3-20 m/s. For the Onipko rotor a special energy generator which converts the smallest revolutions of the moving part of the structure into electric current has been developed.
2. Does not create noise and can be installed near the location or residence of a person. Not harmful to birds.
3. Does not require a high altitude to work effectivelly. There have been cases when, in calm weather, the rotor installed above the ground produced more energy than the one raised to a height of 15 meters. This happens because in calm weather, air masses move above the ground due to the difference in pressure and temperature.
4. The device is adapted to a sharp change in the speed and direction of the wind flow. The peculiarity of the Onipko rotor is that it produces energy more efficiently at wind speed drops. That is, if, for example, for a certain time its speed was 1 m/sec., and then 7 m/sec., then this is 400 times more efficient than when the wind constantly blows at the same speed at the same speed — 4 m/sec.
5. High coefficient of wind energy conversion. Unlike conventional wind turbines, which use the effect of wing lift, wind pressure energy is additionally used.
6. Aesthetic appearance of the turbine. When designing, a "golden section" was used - a kind of standard of beauty in nature.
7. Various materials (metal, composites) are suitable for production.

Besides this, a small rotor — the size of a household fan — can stand on the balcony, producing up to 200 watts of energy. This is enough to power a modern computer with a TV. The three-meter rotor is capable of producing power up to 3 kilowatts in strong winds. On average, it produces about 300 kilowatt-hours of electricity per month. For most private houses, such a wind turbine is enough to fully provide all household electrical appliances, except for heating. Two or three such rotors will also provide heating of the house in the winter. For autonomous power

supply of an ordinary private house, in addition to the rotor itself, an inverter and a battery are also needed. Ukraine is developing batteries that are most adapted for energy storage from the Onipka rotor. They are made on dry mixes, can be installed in the house.

3. INTERACTIVE MAPS

Analysis of the identified advantages and disadvantages of wind power plants with a Onipko rotor demonstrates the ambiguity of their rational use. For the consumer, the installation of such a generator may cause certain doubts. First of all, this is due to the high cost of the structure itself. The question which arises is what can help the consumer choose this type of unconventional energy source? The efficiency of the wind power plant (WPP), as noted earlier, is primarily due to the natural conditions and territorial characteristics of the terrain of its location. Although the technical characteristics of the device indicate that it can produce energy even at a wind speed of 0.3 m/s, for the real consumer such information will not be taken on faith. To date, a study has been conducted on the potential of using wind farms in different regions of Ukraine [2]. From Figure 2 it can be seen that in some areas of western Ukraine and Kyiv region the standard design of the wind farm will not be sufficiently effective and the use of structures with a Onipko rotor is especially relevant.

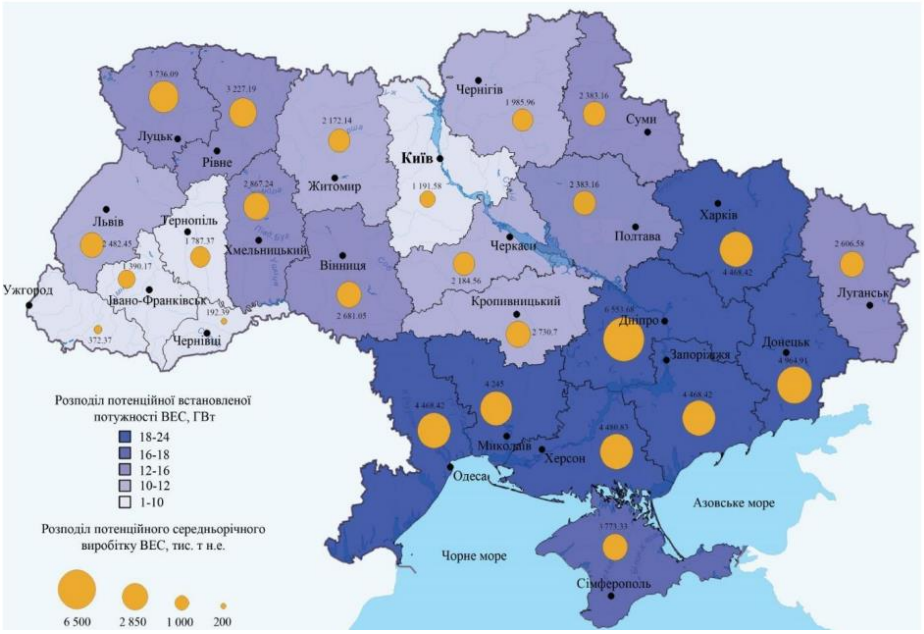

Figure 2: Available potential capacities of wind turbines

To help consumers decide on the installation of this design, we offer the use of small mobile prototypes

Temporary operation of leased structures will allow you to independently assess the

feasibility of using such wind farms for consumer purposes. In addition, a unit with automatic fixation of the generated electrical energy can be installed in the resistance. This will allow you to create diagrams of the distribution of electrical energy depending on the time of operation. Such information can be useful not only for the user of the leased structure, but also for residents of neighboring territories. The creation of a special mobile application will provide access to all potential consumers to the results of the structure. This can be ensured by creating active virtual maps, where the power of the wind farm will be displayed in different time intervals.

Such information on the state of radioactive contamination of the environment has been repeatedly used to create interactive maps. For example, at the Institute for Nuclear Research (IRSN) in France, this was implemented using special dosimeters and the "Open Radiation" application.

Mobility of the structure with the Onipko rotor will be ensured by using a lightweight material – a basalt-based composite.

4. BASALT COMPOSITES

Composites obtained by adding basalt fibers will receive a number of properties characteristic of basalt. These include high strength, resistance to aggressive media, heat and sound insulation and high heat resistance. Electric poles are an important component of the infrastructure of the power system, so the requirements for the reliability of their design characteristics are quite high. [3,4]

The issue of safe operation of the power grid can be solved by using materials with the addition of basalt fibers.[5] The composite proposed for the prototype of the wind farm consists of polypropelene and basalt filament with a thickness of 13 microns, which is 17%. The structure of the composite at a scale of 1:30 is presented in Figure 3.

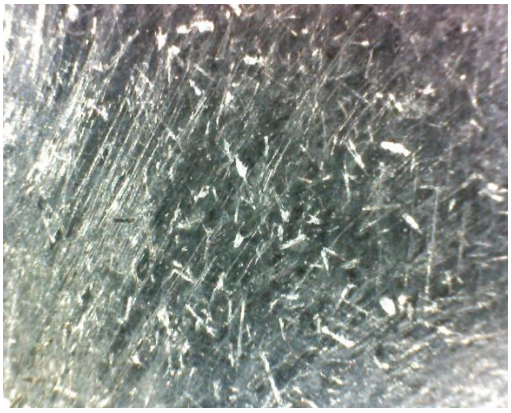

Figure 3: Basalt filament with a thickness of 13 microns

The choice of such a composite is due to the following reasons. Since the location of the structures assumes the presence of adverse weather conditions, the materials of the structure must be resistant to physical influences and chemically active media, as well as have high anti-corrosion properties. The stability and strength of the structure

will ensure its reliability in operation. The lightness of the materials will make the design mobile. High dielectric performance of basalt provides electrical protection for wind farms.

5. METHODOLOGICAL SCHEME

Proposed methodological scheme (Figure4) will include next steps:

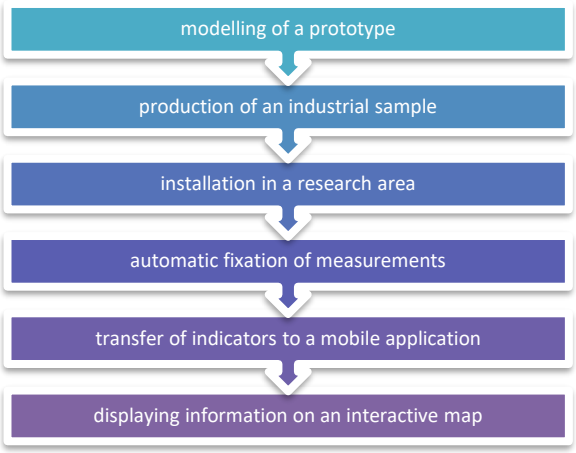

Figure 4: Methodological scheme

To visualize one of the possible mobile prototypes 3D model was created using the Blender program.

Figure 5: Model of a mobile prototype

At the base of the pillar will be the heaviest part of the structure, in which the electrical and technical equipment will be placed. If necessary, there may be an emergency call button, sockets for charging various devices (gadgets, electric cars, etc.). In addition, various light sources can be installed. Also, during the production of columns from basalt composite, phosphor can be added to create light accents. The height of the pole can be adjusted depending on the operating conditions. A solar panel can be both an additional and a main source of energy. (Figure 5)

6. CONCLUSIONS

For solving the problem of autonomy and distribution of the source of renewable energy is proposed using of wind power stations in combination with solar panels. Onipko rotor which is effective at low wind speeds was considered as a component of a wind turbine. Creating an interactive map using small mobile prototypes for the validity of the decision to install Onipko rotors was proposed. For the production of structural elements of industrial samples of such prototypes basalt composites due to their high strength, resistance to aggressive environments and environmental friendliness was substantiated.

7. Acknowledgments We want to express our gratitude to Derevianovskyi Artem for visualization of a mobile prototype.

8. References

1. ONIPKO, O. *Onipko rotor.* UA Patent 102689, 2013. Patent UA 102689 of 12.08.2013.
2. Nacionalnyi plan diy z energoefectyvnosti na period do 2030 roku, skvalenyi rozporiadzhenniam Kabinetu Ministriv Ukrayiny vid 29.12.2021 № 1803-p.
3. KRAYUSHKINA, K., BIELIATINSKYI, A. Perspectives of Usage of Seamless and Fiber Basalt Filament for Construction and Rehabilitation of Motor Roads and Airfields. In: *11th International Conference "Environmental Engineering" – 2020,* Vilnius Gediminas Technical University Lithuania, 21–22 May 2020. Vilnius: Vilnius Gediminas Technical University Lithuania, 2020, pp. 321-324.
4. SERGEYEV, V.P. *Bazaltovi voloknysti materialy ta komponenty na yih osnovi – materialy XXI stolittya.* Nauka ta innovaciyi..2005. V 1.№ 6. pp. 91–101.
5. RAKHIMOV, F.Kh.. *Basic development of constructions and technologies of knitted and armored polyfunctional composites*. "New Century Generation", Tashkent. 2013, p. 190.