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INNOVATIVE PROPOSAL FOR WIND-SOLAR POWER PLANT

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The use of renewable energy sources can help solve the problem of energy supply. One of the ways of such a solution is to develop a wind - solar power plant called a hybrid, which simultaneously uses the energy of both wind and the sun. It is proposed to use a new type of medium-speed vertical axial wind power installation in a hybrid power plant with original blades with a high coefficient of utilization of wind energy and with improved characteristics in terms of strength. The wind wheel models offered in wind power installation are investigated using a wind tunnel. The power characteristic of the wind wheel was obtained, which showed the efficiency of the original blades at the level of world samples. Coefficient of use of wind energy ≈0.3. The wind wheel has a self-start and can operate at low speeds in different wind directions. The average speed of the wind wheel provides a lower value of centrifugal force on the blades. The ways of expediency and cost-effectiveness of using solar cells, which depend on the insolation value determined by the latitude of the location and on other factors, are given.

Key words: *a wind - solar power plant, a wind wheel, solar cells*
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Introduction

At the present stage of development there are global problems, the solution of which depends on the future of all mankind. One of such problems is energy and resource saving, as energy needs increase many times over, the cost of energy increases, and the reserves of traditional energy sources are depleted. Added and the ecological crisis due to the use of planetary resources. Climate change can lead to catastrophe for humanity. The solution to this problem is the use of alternative and renewable energy sources, as well as the maximum use of the generated thermal energy discharged.

Such sources directly include wind energy, solar energy, low-temperature thermal energy of various environments, both natural (land, air, reservoirs, etc.) and artificial, secondary resources (sewage, waste hot water, etc.). Thus, the introduction of power plants that use the above mentioned sources of energy in enterprises of various branches of industry can be justified both economically and in terms of ecology. In some developed countries there is a boom in the construction of wind plans. According to the World Energy Association (WEAR of 16 May 2013), the world produces electricity from wind energy. Basically, are large indoor power parks with indoor power plants high power with high-speed wind turbines with horizontal rotation axis. Of course, obtaining electricity in wind farms can be economically justified in certain wind conditions. At present, the total volume of energy wind in the EU is 142 GW, representing 11.4% of all energy needs. Most new wind turbines were in Germany and Poland, the first leader in the EU overall size Set chopped power - 45 GW. Thus, the viability of renewable energy is beyond doubt, including in Ukraine.

As experience gained during the implementation of low-capacity wind turbines (WT) has shown that they can be the most promising in Ukraine. Small wind energy, depending on the capacity can have the following consumers (Onipko O.F. et. al., 2008):

0.020-0.024 kW - local backup lighting;
0.060-0.075 kW - yachts;
0.20-0.24 kW - suburban summer residents;
0.60 - 0.75 kW - the average Ukrainian family;
2,0-2,4kVt - small families under private agricultural enterprises;
6.0-7.5 kW - small farms;
20 kW - small villages, hamlets, medium and large farmers 'state lands';
50 kW - agricultural and food private mini-enterprises.

Thus, small-scale wind energy can be quite useful in the direction of decentralization and the possibility of energy supply to consumers, both individuals and legal entities, ie enterprises. Nowadays in Ukraine there are a number of manufacturers of small wind turbines, in particular, such well-known firms as "Energodar", PE "Wind World" (Kharkov); STC "Altex" (Kyiv), "ECO", DKB "Southern" (Dnepropetrovsk). These companies produce VU mainly with a horizontal-axial impeller.

Materials and method

Materials and methods consist in the comparative characteristics of blades of different configuration on an arrange-

ment of a wind wheel and dependence of the power factor Cp on the speed θ. Currently, uses low power wind turbines both along the horizontal and vertical axis of rotation. She we used the most, according to Twidell J. and Weir A. (1990), WT shown in Fig. 1, and power characteristics - in Fig. 2.

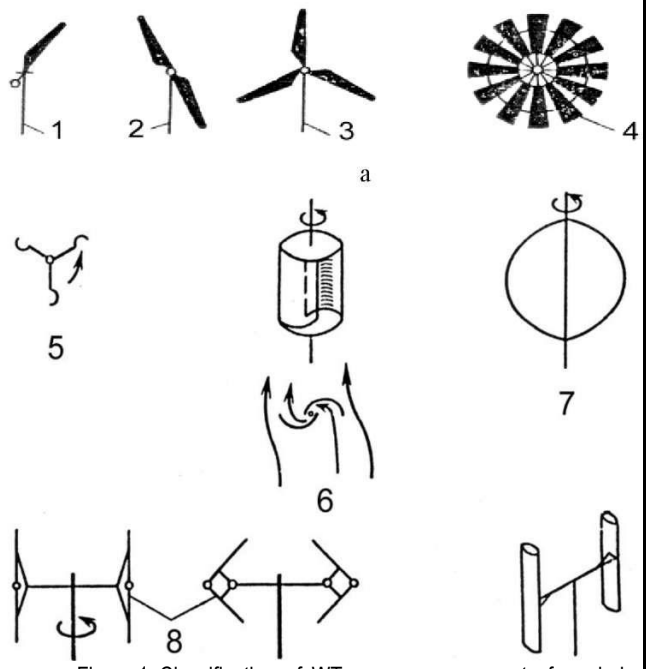

Figure 1. Classification of WT on an arrangement of a wind wheel: 1 - a single-bladed wind wheel; 2 - two-bladed; 3 - three-bladed; 4 - multi-bladed ("chamomile"); 5 - cup anemometer; 6 – Savona's rotor; 7 – Darya's rotor; 8 – Musgrove's rotor; 9 – Evans's rotor.

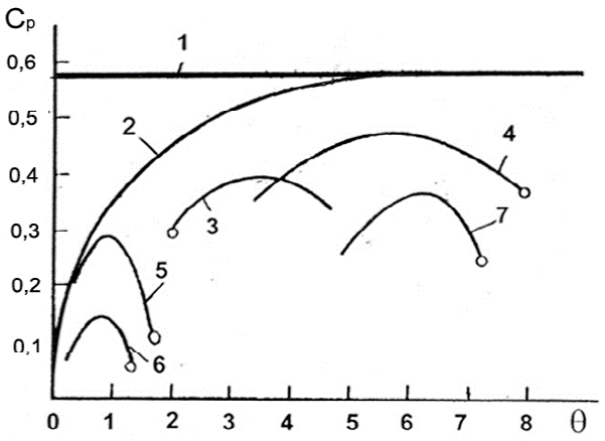

Figure 2. Dependence of power factor Cp on speed θ for WT with horizontal axis and vertical-axial (Twidell J. and Weir A., 1990): 1 - Betz test, 0.59; 2 - Gluer's criterion; a) with a horizontal axis: 3 - three-bladed wind wheel; 4 - two-bladed; 5 - multi-bladed ("chamomile"); b) with a vertical axis: 6 – Savona's rotor; 7 – Darya's rotor

Results and discussion

Analysis of the proposed types of vertical-axis WT small to powers showed that mostly used Slavonia's wind turbine propeller, wing blades and combination Savona's rotor blades and Kreyol. Indicators of wind energy efficiency are mostly in the range Cp <0.35. An exception may be windmills with a wind concentrator. The cost of 1 kW installed capacity clause reportedly ranges from 4,000 to 7,000 EUR.

In our opinion, in Ukraine as an independent clause low power, and particularly in the food industry expedient implementation of a new type of vertical-axis WT with an average speed with blades having profiles original form, called wings not closed (Rozhkova L.G., 2005). These are characterized by WT to light in whole self, the ability to work at low speed (2 m / s) and any - where the wind direction. The studied model and experimental samples of rotors of vertical-axial WT with these blades confirmed this. In addition, the current demonstration model of such a WT also testified to the presence of self-starting, operation in a wide range of wind speeds and showed the absence of high noise and icing. In addition, the most important thing is that these data have a fairly high efficiency. Comparison of power characteristics of wind turbines of vertical-axial wind turbines shows that the wind wheel with blades wings not closed has a very high utilization of wind power (Cp) at an average rapidity θ=1,5 (Fig.2). $\theta=\frac{U_{per.}}{U_{\infty}}$, where $U_{per.}$ - peripheral speed of the blade, U_{∞}- the speed of the flow rushing on the wind wheel .

Thus, having the results of research for a wind wheel with blades KN- M, we obtain the following approximating formulas (Dzendzersky V.A. et. al., 2011):
the left part of the power characteristic

$$C_p = 20{,}14\theta^2\left(3-1{,}66\theta\right)$$

builds part b characteristics-power

$$C_p = 29\left[1-\frac{\left(\theta-1{,}2\right)^2}{0{,}4225}\right]$$

The calculated values of C_P obtained by these formulas correspond to the experimental results (Fig.3).

In addition, the average fast speed causes a reduction in requirements for durability and reliability design WT compared with fast speed, and the vertical position of the shaft improves performance characteristic WT simplifies obtaining not only electricity but heat and mechanical energy, which is important in terms of businesses. Matching capacity and performance clause with the consumer has some people opportunities to that instability is caused by the characteristics of the wind. If the rotor clause directly connected with the equipment necessary will provide wool compliance not only power WT and equipment, but the chief of thawing torque and speed.

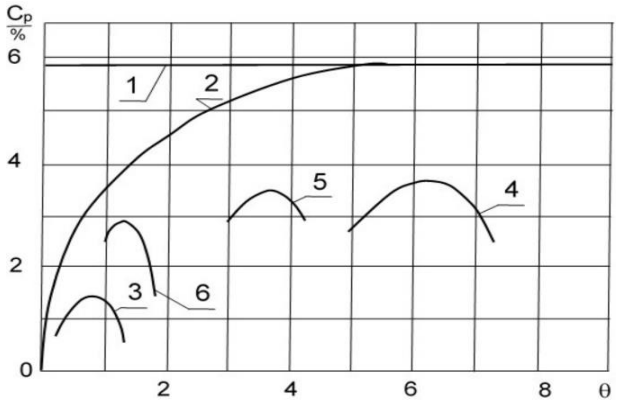

Figure 3. The location of the power characteristics of the vertical axial wind power installation in terms of speed (θ) relative to the Betz (1) and Gluer's (2) criteria: 3 – Savona's rotor; 4 – Darya's rotor; 5 - rotor with straight wing blades NACA0018; 6 - rotor with blades KN-M.

Conclusion

Thus, the relevant characteristics of the equipment that

consumes energy, causing the selection clause of the provision of the rotor within the specification, where the utilization of wind energy is the maximum or the value of its decline is permissible. It is clear that when the wind speed changes and parameters of the clause. Therefore, there may be pauses in the consumer's work, which is sometimes extremely unacceptable. Therefore, it is advisable to implement storage devices. If you focus on getting heat, the dock flax heat accumulators use the installation as propose done in article Rozhkova L.G. et. al., 2012. Recently, there has been an increase in activity in the development of thermal energy accumulators. For example, adsorption thermos-transformers are proposed, where thermal energy is accumulated in the form of thermochemical potential of the sorbent and can be stored for a long time with almost no losses (Korinchevska T.V. et.al., 2009). The authors emphasize that the above heat accumulators are an effective tool for energy conservation, which contributes to the involvement in the energy cycle of renewable energy sources with unstable characteristics (Yevlash V.V. et. al., 2016).

The use of model samples of the rotor of the vertical - axial WT of medium speed with a new type of blades, will create an effective in the wind conditions of Ukraine and relatively cheap wind turbine, the introduction of which will be appropriate as an autonomous. It is necessary to conduct a study of the experimental sample of the rotor to clarify the characteristics in the conditions of Ukraine and with several options for the number of blades. The basis for the project is the results of research of model samples of rotors of vertical-axial wind turbines of medium speed with blades of a new type.

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Інноваційний проект вітро-сонячної електростанції

Використання відновлюваних джерел енергії може допомогти вирішити проблему енергопостачання. Одним із шляхів такого рішення є розробка вітрової сонячної електростанції, яка називається гібридною, яка одночасно використовує енергію вітру і сонця. Запропоновано використовувати новий тип середньошвидкісної вертикальної осьової вітроенергетичної установки на гібридній електростанції з оригінальними лопатями з високим коефіцієнтом використання енергії вітру та з покращеними характеристиками щодо міцності. Моделі вітрових коліс, що пропонуються для вітроенергетичної установки, досліджуються за допомогою аеродинамічної труби. Отримано силову характеристику вітрового колеса, яка показала ефективність оригінальних лопатей на рівні світових зразків. Коефіцієнт використання енергії вітру ≈0,3. Вітрове колесо має самозапуск і може працювати на низьких швидкостях в різних напрямках вітру. Середня швидкість вітрового колеса забезпечує нижче значення відцентрової сили на лопаті. Наведено шляхи доцільності та економічної ефективності використання сонячних елементів, які залежать від величини інсоляції, що визначається широтою місцезнаходження та від інших факторів.

***Ключові слова:** вітро-сонячна електростанція, вітрове колесо, сонячні елементи*

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