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THE PROSPECTS OF WIND POWER ENGINEERING IN INDUSTRIAL REGIONS OF UKRAINE

The necessity to turn to resource-saving technologies and the use of alternative sources of power, wind power in particular, demands optimal and rational solutions of the wind power problems. In Donetsk basin it is very promising to locate autonomous wind power electrical stations on waste heaps of mining enterprises. The researches carried on in this sphere confirm that this innovation will solve a lot of problems of an industrial region. It will help to utilize the spaces of flat waste heaps rationally, to make the power source more convenient for a consumer, to decrease the metal capacity of wind power constructions, to disengage arable lands occupied by wind power stations at present.

alternative power sources, wind power engineering, wind power stations, artificial rock relief, resuming power

At the result of irrational human activities the mankind has come up to exhaustion of traditional power resources. Moreover, due to fuel utilization, a lot of toxic pollutants waste to the atmosphere which has a negative impact on biosphere state. All these activities cause catastrophic effects that are irreversible. That is why it is necessary to implement alternative power sources. Among them the most perspective is wind power. Its total potential is estimated in 20-25 % of the world electricity production. The growth rate of wind power utilization was more than 25 % in 1990-1997. Meanwhile in other power industry branches such as gas, coal, oil industries this exponent was 2-3 %. Beginning from 1995 the total power wind output increased in 487 % or, in other words, in five times. At the same period, coal consumption (the major alternative for power production) decreased in 9%.By the end of 2003 the total power of all world wind power electrical stations reached 35000 Megawatt. More than 30000 wind turbines of different capacities are operating in the world. Despite this impressive growth, the wind power utilization has just begun. The European Wind Power Engineering Association has already reconsidered the growth plans of wind power engineering in Europe from the current figures of 40000 Megawatt to 60000 Megawatt by 2010.

Wind power engineering has spread in many countries. The leaders in the wind power consumption are Germany, the USA, Denmark, the Netherlands, and Italy. They are going to reach the total capacity of their wind power electrical stations to 16000 Megawatt by 2010.

The two thirds of wind power stations mounted in 2001 are now situated in three countries: Germany fixed 1890 Megawatt; the USA – 1700 Megawatt; Spain – 1065 Megawatt.

Germany, the global leader in wind power consumption, has 8 Megawatt of wind electrical generators having been fixed which provides almost the third of their total electrical output. They are planning to close their electric power stations which provide about 30 % of electric power by 2030 and construct and exploit new wind power electrical stations.

The wind power of three states of the USA(Northern Dakota, Kansas, Texas) is enough to satisfy the demand in the electrical power of the whole American population. The new wind power stations have begun operating in the states of Colorado, Iowa, Kansas, Minnesota, New- York, Oregon, Pennsylvania, Texas, Washington and Wyoming. The 300 Megawatt project “Stateline Wind Project” which is being constructed at present on the border area between the states of Oregon and Washington was designed.

Denmark has approximately 2500 Megawatt of wind power and about 6000 of operating wind turbines and it gets 18 % of electrical power from the wind. The operating wind power electrical stations give 15.7 billion kilowatt of electricity per hour in a year that satisfies almost 12 % of the whole national demand. By 2020 Denmark is going to increase the share of wind power in the national power balance to 50 %, Germany – to 30 %, The USA – to 24 %, China – to 15 %. Besides, Denmark made a decision to construct wind power electrical stations instead of power electrical stations in the 60s.

France declared about the intentions to increase wind power capacity to 5000 Megawatt during this decade in December 2000.

On the whole in Europe 75 % of wind power electrical stations are made and 70 % of them are mounted.

To compensate the wind changeability in the USA, France and England huge “wind farms” which demand much space for their high-productive work are constructed. In Denmark such “wind farm” was settled in coast shallow water place where it does not disturb anybody’s activities and the wind there is

steadier than anywhere in the dry land. Nowadays such wind farms produce altogether about 70000 Megawatt of electrical power which is compared to the capacity of 70 thermal electric power stations.

Wind power engineering is also developing in Ukraine. The perspective areas of wind power electrical stations location are mountainous regions of the Carpathians and Crimea, the seaside regions with high wind intensity, the valley of the Dnepr, the surface of the Azov and the Black seas. In Crimea 80 wind power stations were constructed in 2003. Thus the number of such stations in Ukraine is 355 with the total capacity of 38.95 Megawatt.

In 2006 in Kherson the construction of Askania wind power electrical station was going to be completed. Near Borislav seven wind power electrical stations are operating with the capacity of 107 kilowatt each. The largest of the stations being constructed are Novoazov wind power electrical station with the capacity of 16 Megawatt in Crimea. So, by 2010 it is supposed to bring the total capacity of the Crimean wind power stations to 480 Megawatt that allows economizing 290000 of ideal fuel per year on organic fuel.

However there are factors that hamper wind power engineering development in the industrial regions in Ukraine. These factors are: the lack of vast open areas for wind power stations, insignificant number of coastline areas, and the hardships caused by the wind power stations location near town housings and big losses of wind power in the land area when wind power stations are located in built-up areas. The necessity to turn to resource-saving technologies and use of, alternative sources of power, wind power in particular, demands optimal and rational solutions of the given problems. In Donetsk basin it is very perspective to locate autonomous wind power electrical stations on waste heaps of mining enterprises. The researches carried on in this sphere confirm that this innovation will solve a lot of problems of an industrial region. It will help to utilize the spaces of flat waste heaps rationally, to make the power source more convenient for a consumer, to decrease the metal capacity of wind power constructions, to disengage arable lands occupied by wind power stations at present. It will also assist to utilize predominant wind flows above the built-up area level and to solve the problem of infrasound oscillations (dispersion, damping in the mellow surroundings)

The researches carried on by the authors are directed to study redistribution and concentration of a wind flow on the relieves of flat and cone waste heaps for rational location of wind power stations. Measuring a wind flow speed on waste heaps were taken to investigate the mechanism of re-distribution of wind power while a wind flow meets a waste heap.

As a result of our investigations we determined that the angle of a waste heap side's slope is in the rages between 34 to 38 degrees. The height of a waste heap is in the ranges between 30 to 100 meters. The shape of a waste heap does not have a significant impact on the dependence of a wind flow relative speed on a relative height of a waste heap. The given researches are directed towards revealing the existing dependences and optimizing re-distribution of wind flow power and rational location of wind power turbines on waste heaps.

In Fig.1 the isolines of a wind flow speed distribution on waste heap surface on the model waste heap. The maximum wind loading area considered as the maximum effective location of wind power stations is shaded.

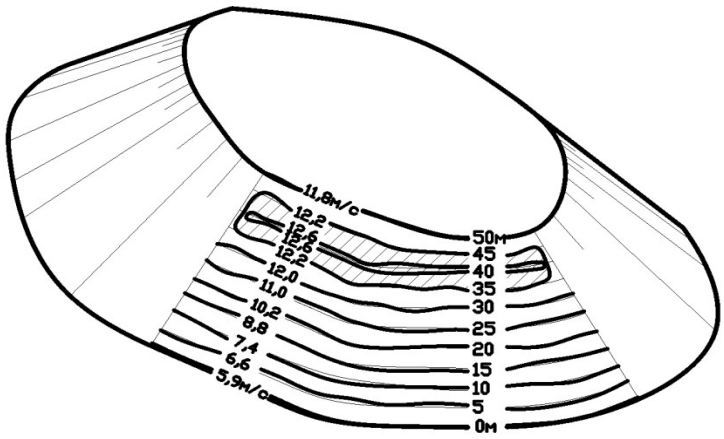

Fig.1 – Wind flow speed distribution on waste heap surface (on the waste heap with the height of 50 m)

As the result of our researches of a wind flow dependence on a waste heap height we determined that there are three typical zones in which wind power are distributed according to different regularities. The first zone (from 0 to 30 % of a waste heap height) is the zone of a gradual flow speed increase. In the second zone (from 30 to 75 % of a waste heap height) there is a significant growth of speed increase of a wind flow, here we can see the maximum speed and this zone is considered as a potential placing for wind power stations. With the help of partial re-forming of a waste heap relief it is also possible to reach the maximum concentration and accumulation of power at the given site to increase electric power production. In the third zone (from 75 to 100 % of a waste heap height) there is speed decrease as a result of wind flowing round the top of a waste heap. The partial re-forming of a relief and wind power control will help to decrease the third zone and achieve more rational wind flow power utilization.

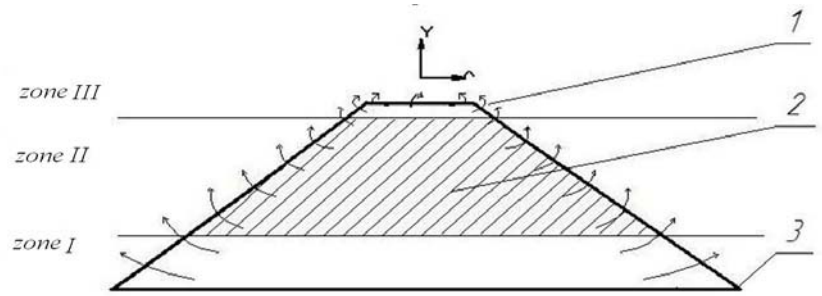

Fig. 2 - The chart of wind flow distribution on waste heap surface
1– the wind flow bending round the waste heap; 2- maximum wind loading area (hitched);
3-the contour of waste heap

For maximum wind flow utilization of Area 2 shown in Fig.2 it is offered to construct artificial rock relieves which fulfill the functions of concentrated flow on ***a*** waste heap and wind power station location in maximum wind speed area.

In Fig. 3 a variant of autonomous wind power stations on a waste heap in artificial aerodynamic channels directed towards predominant winds is presented.

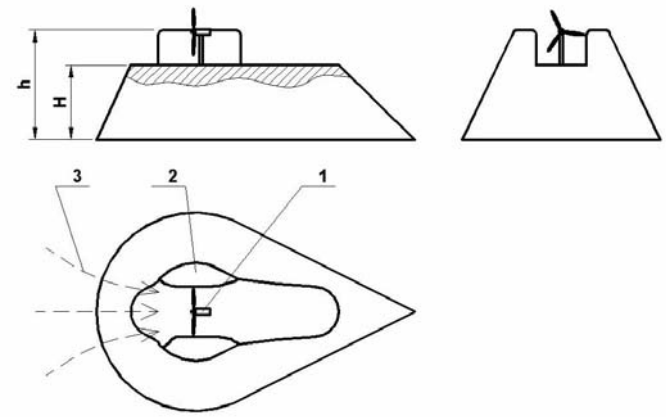

Fig.3 - Wind power station location in the artificial relief aerodynamic channel.
1-wind power electrical station; 2-aerodynamic channel of a definite form; 3-wind flows; h- the height of a waste heap; H-the height of a wind power electrical station.

A wind flow comes to a wind flow concentrator zone increasing its speed. After the air current has come out, the speed decreases in the opposite wind flow concentrator which operates as decelerator of a wind flow. Thus, the wind speed is constant in relation to the initial one when the wind leaves the operating zone. The location of concentrators in different directions allows utilizing wind flows in the most effective way irrespective of their direction. A wind power station location on the waste heap surface will allow solving problems connected with whirlwinds in the boundary air layer. The technical

result of the innovation is steady and effective speed increase of a wind flow near the wind turbine and it also will escape predominant wind directions.

Wind power engineering is attractive not only because it is environment-friendly and it saves traditional power resources. Wind power stations can be mounted rather quickly in the places where other power resources are not available or there are not enough of them.

The analysis of wind power engineering world trends allows making a conclusion that this environment-friendly and resuming power is going to satisfy power demand of the mankind in the near future. And increasing the number of wind power electrical stations will permit to decrease the cost of alternative electrical power and improve power production in case of maximum loading.

On the basis of experimental researches having been described in the article, we made a conclusion as for rationality of wind power stations location on waste heaps of mining enterprises. Moreover, making artificial rock relieves operating as confusers, diffusers and re-distributors of a wind flow. Their utilization will allow achieving more effective wind power exploitation and preserving the environment more effectively. It will also assist to realizing the following tasks:

1. To utilize flat waste heap areas rationally.
2. To make wind power more accessible to a consumer.
3. To reduce the metal capacity of wind power constructions as there is no need to construct 50cm mast for wind generators.
4. To disengage arable lands which are occupied by wind power stations at present.
5. To utilize effectively predominant wind flows above the level of built-up area.
6. To solve the problem of infrasound oscillations availability (dispersion, damping in the mellow surroundings).

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ПЕРСПЕКТИВЫ РАЗВИТИЯ ВЕТРОВОЙ ЭНЕРГИИ В ИНДУСТРИАЛЬНЫХ ОБЛАСТЯХ УКРАИНЫ

Необходимость перехода на ресурсосберегающие технологии и использование альтернативных источников энергии, в частности энергии ветра, в настоящее время очень актуальна и требует поиска оптимальных и рациональных решении. В Донбассе весьма перспективным представляется размещение автономных ВЭУ на породных отвалах горнодобывающих предприятий. Исследования, которые проводятся в этой области дают возможность утверждать, что данный шаг поможет в комплексе решить немало проблем промышленного района: рационально использовать площади плоских породных отвалов, приблизить источник энергии к потребителю, снизить металлоёмкость ветроэнергетических конструкций, высвободить пахотные земли, занимаемые ныне ветроэнергетическими станциями, оптимально использовать преобладающие ветровые потоки над уровнем городской застройки, решить проблему наличия инфразвуковых колебаний.

альтернативные источники энергии, ветровая энергия, ветроэлектростанции, искуственные рельефы, возобновляемая энергия

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ПЕРСПЕКТИВИ РОЗВИТКУ ВІТРОВОЇ ЕНЕРГІЇ В ІНДУСТРІАЛЬНИХ ОБЛАСТЯХ УКРАЇНИ

Необхідність переходу на технології, що зберігають ресурси та використання альтернативних джерел енергії, зокрема вітрової енергії, є дуже актуальною і потребує пошуків оптимальних та раціональних рішень. В Донбасі дуже перспективним є розміщення автономних вітроенергетичних установок на породних відвалах гірничовидобувних підприємств. Дослідження, що проводяться в цій області, надають можливість стверджувати, що цей крок допоможе в комплексі вирішити чимало проблем промислового району: раціонально використовувати площини плоских породних відвалів, наблизити джерело енергії до споживача, знизити металоємність вітроенергетичних конструкцій, звільнити землі сільськогосподарського призначення, що зайняті нині вітроенергетичними станціями, оптимально використовувати вітрові потоки переважних напрямків, вирішити проблему інфразвукових коливань.

альтернативні джерела енергії, вітрова енергія, вітроелектростанції, штучні рел'єфи, відновлювальна енергія