Problem-solving recycling of renewable energy waste based on the technology of energy production using the temperature difference

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Abstract. The paper discusses the problems of waste disposal of renewable energy technologies and the method of their solution. The amount of green energy waste is huge. The paper discussed the importance of recycling blades with wind power because of their enormous size. We propose a technology for generating energy based on the use of the temperature difference between day and night to solve these problems. The design of such a system includes aluminum (2-3% of the composition), which easily goes into remelting, and ordinary plastics, which are also easily remelted. Using this waste-free technology can solve the problem of renewable energy waste.

1 Introduction

Renewable energy technologies are a promising and important source of energy today. Any production, including the production of energy based on the use of renewable sources, cannot be without negative consequences.

Renewable energy sources are the disposal of waste renewable energy technologies. The potential amount of green energy waste is enormous. Waste batteries by some estimates will weigh 600,000 tons by 2030 and about the same amount as old solar panels. We also expect solar panel waste to reach 78 million tonnes by 2050. Wind energy highlights the challenge of disposing of the blades because of their enormous size. Even now, over 3,800 blades will be dismantled annually in Europe, and about 8,000 in the USA. The three 50-meter blades of a low-power wind turbine contain about 20 tons of fiber-reinforced polymers (FRP). The Re-Wind research project estimates that 40 million tons of wind turbine blade composites will wait for recycling by 2050. It is not possible to recycle them today.

The technology of obtaining energy from renewable sources using the temperature difference between day and night can solve these problems. This difference ranges from 4 ºC to 15 ºC and more. The effect of temperature change on various materials causes a change in the physical state, in particular, the linear dimensions, that we can use to generate energy.

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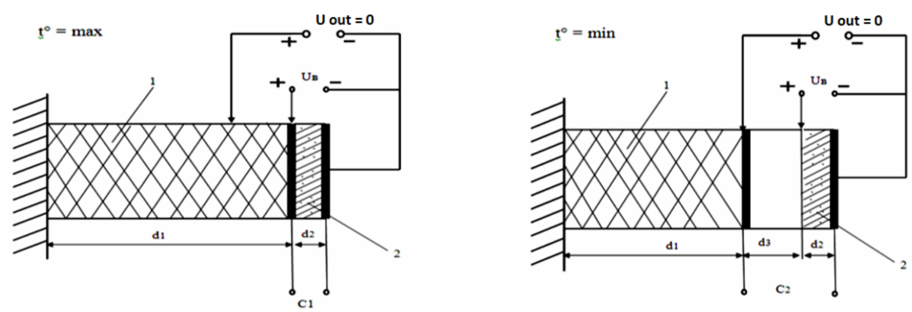
2 Research results

The physical-theoretical basis of the proposed technology is as follows [1-3]. If a capacitor is charged and disconnected from the power supply, the charge on it remains constant. Increasing the distance between the plates of the capacitor because of external forces, we get an increase in energy, and voltage growth because of the work of these external forces. Figure 1 shows the general scheme of such a capacitive converter.



1 - dielectric bar (active dielectric), which changes linear size when the temperature changes
2 - dielectric with a large value of dielectric permittivity (ferroelectric)
C1 - capacity, which has a maximum value when charging from the excitation voltage
C2 - capacity, which has a minimum value when discharging into the load

Fig. 1. The power part of the temperature differential system.

The bar (active dielectric) at high temperature increases its length, presses the mobile plate tightly against the dielectric (Figure 1; left part), the capacitance will be maximum, and the capacitor is charged. As the temperature decreases, the bar decreases its linear dimensions and pushes the movable plate away, creating a gap between it and the dielectric (Figure 1; right side). The capacitance drops by leaps and bounds, and the voltage rises to a maximum and discharges to the load. Then the process repeats.

The methods for calculating the parameters of the converter and numerical evaluation of its energy efficiency will be as follows [4].

The expression for the energy through the charge Q on the plates is
W = C1U2/2= Q2/(2C1) (1)

$$W = C_1U^2/2= Q^2/(2C_1) \quad (1)$$

where you can see that the energy as the capacity of C1 decreases increases to the same extent as the capacity decreases.

Since the charge of the plates disconnected from the source does not change when they move apart, the work of external forces will be equal to the change in energy of the system:

$$A=\Delta W=W2 - W1 - Wpv, \quad (2)$$

where W_{pv} - energy losses on the excitation systems.

$$Wpv = U1I1 \quad (3)$$

where U_1 – field voltage,

I_1 – capacitor charging current

By substituting here W_2=Q_2/(2C_2) and W_1 =Q_2/(2C_1), we get the last expression for the energy gain in the system:

$$\Delta W = \frac{C_2U_2^2}{2} - \frac{C_1U_1^2}{2} - U_1I_1 = \frac{(U_2^2 - U_1^2)}{2}(C_2 - C_1) = \frac{(U_2^2 - U_1^2)}{2}\left(\frac{\varepsilon\varepsilon_0 S}{d_2} - \frac{\varepsilon\varepsilon_0 S}{d_1}\right) = \frac{(U_2^2 - U_1^2)\varepsilon\varepsilon_0 S}{2}\left(\frac{1}{d_2} - \frac{1}{d_1}\right) \quad (4)$$

The energy gain in the device based on the temperature difference, as we see in the above expressions, takes place as a transformation of the mechanical energy of the motion of charged bodies into electrical energy by changing the length of the active rod.

Works [5-9] give provided a more detailed mathematical calculation of such systems.

The problem of waste disposal of the proposed technology of temperature difference is not as acute as for other renewable energy sources. This is because of the operating principle and physical laws, based on which the proposed renewable energy technology works. The operation of the converter comprises the capacitor's movement plate by an active dielectric bar, which changes its linear dimensions when the temperature changes (Figure 1).

As we mentioned earlier, the bar (active dielectric) at high temperature increases its length, presses the moving plate tightly against the dielectric, the capacitance is maximum, and the capacitor is charged. As the temperature decreases, the bar decreases its linear dimensions, pushing back the moving plate, and creating a gap between it and the dielectric. The capacitance drops by leaps and bounds, and the voltage rises to a maximum and discharges to the load. The process then repeats.

As you can see from this process, the design of the power part of a temperature drop system has only capacitor plates, dielectrics between its plates, and dielectrics (active and passive). These devices include aluminum (capacitor covers, 2-3% of the total composition), which easily goes into melting, and common plastics, which can also be melted down into other plastic products.

For example, we can use organic glass (plexiglass) or polymethylmethacrylate as an active dielectric. The disposal of Plexiglas trimmings and waste does not require additional highly specialized equipment. All processes take place at the units producing the primary polymer, the secondary raw material is used as an additive.

All other plastics are also recyclable.

With use as an active dielectric liquid also does not cause difficulties.

When using gas, such as sulfur hexafluoride [10], recycling is not a problem either. The electrical industry has long used the technology of working with this gas.

3 Conclusion

The advantages of obtaining energy from the proposed technology are obvious - the stability of operation, the possibility of placing the installation in any place, and the ease of its technical implementation. Waste disposal of devices of such technology is not dangerous and does not pose any problems, since there are no toxic materials, radioactive substances, etc.

We can install such a converter in any place on the Earth, and also on other planets, for example, on the Moon [11].

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