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TRADITIONAL AND NONCONVENTIONAL RENEWABLE ENERGY SOURCES

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SUMMARY: The modern development of energy sources should be based on highly effective non-polluting power technologies. The non-traditional energetic uses renewable energy sources (geothermal heat of the Earth, the Sun, wind, inflow etc.) and are ecologically friendly. High economic efficiency and environmental awareness became main reasons of using widely non-traditional power technologies in the remote regions of the World. The constant reduction of the mineral fuels on the Earth and the perspective of their price increase and also the rise o of the environmental pollution caused by harmful wastes are the reasons for the active search and development of the alternative energy sources. At the time being the world community has recognized that in the recent years and possibly, centuries, the discovery and development of the totally new source of energy will not succeed. That's why the main hopes and nearest plans on the development of the world energetic complex are directed to the renewable sources of energy, including geothermal one, the energy of the sun, wind , bio-mass.

Keywords: *Energetic, power supply, renewable energy sources, electric and heat energy.*

INTRODUCTION

The search for new forms of energy has always been one of the main tasks of the humanity. There was always lack of energy. To obtain steady harvests, produce goods, learn to manage space technologies we are all in need of different types of energy: electrical, heat, optical and others. The continuing progress of the world community is connected with the growth of energy consumption in it's different final forms. During 80 years of the last century the world's power consumption increased more than 110 times and reached the consumption which equals to 10 billions of tons of equivalent

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fuel (Amerhanov et al., 2002; Kirushatov, 1991). The problems with the energy supply which have recently become obvious, can be explained by the growth of the primary energy consumption per capita, depletion of resources convenient for using traditional types of mineral fuels (oil, natural gas), the growth of the expenses for extracting them, worsening ecological conditions because of their burning in various heat-energetic installations.

The growth of power consumption on average makes up 4,5 % annually. It means that the power consumption doubles every 15 years. Up to middle of the 1970th the speedy growth of the world energetic depended on the cheapness of oil and other mineral fuel production. The important role was given to the detection of efficient oilfields in the Persian Gulf's region. For example, one oil well can produce up to 500-1000 tons of oil (Harchenko, 1991)

The analyses of the modern situation in energetic makes us draw a conclusion that the problem of the reliable and economical energy supply cannot be successfully solved without a considerable change of the energetic structure, without introducing new types of energy sources. Considering the exhaustion of mineral resources trend and the price growth of energy carriers the issues of energy saving are the recent problems. The important role in improving the efficiency of using of traditional energy resources and mineral fuel saving is given to nontraditional renewable energies. The global transfer to the renewable sources of energy doesn't take place only because the industry, machinery and equipment in the past were intended to use a cheap mineral fuel. Existing technologies and equipment using mineral fuels at a large extent are rather developed and they were economically beneficial for us. At the same time, the problems of exhaustion of the mineral fuels and also the problems of the environment caused by its burning, issues of transporting fuels into the zones with decentralized energy supply show the necessity of searching for the alternative sources of energy and fuels. The main advantages of renewable energy sources (RES) are inexhaustibility and ecological compatibility. Energy technologies based on RES are related to "soft" technologies which practically don't harm the environmental and don't change the energetic balance of the Earth. RES plays a considerable role in solving of 3 global problems which the humanity faces: energetic, ecology, food producing issues. The important advantage of the renewable sources of energy is that they are able to provide the humanity with the energy for many centuries to come. Many types of the RES at present are competitive at the energy market, especially the geothermal energy. Paces of RES development in developed countries are so high, that they will have replaced 70% of traditional sources up to 2050 year, according to Bansal et al. (1994) and Erikson (1990).

The issues of the RES development and using are one of the main problems in foreign policy of different countries. Countries with developed RES technologies will get obvious and considerable ecological and economical advantages. Many countries at present are profoundly concerned with the perspectives of their own energy supply.

From short review mentioned above it is clear that engineering solutions of energy problem can be concluded as the following:

1) Considering the small density of the solar radiation, which doesn't make it possible to heat the carrier to the consumer' temperature (90°C), it is necessary to develop concentrators of solar radiation which will be able to work in negative temperature. These plants can be used for heating of buildings.
2) Developing of low-powered (2…4 kW), simple, reliable constructions of wind tur-

bines and organization of their production.

3) Developing of devices using the solar radiation for different technological processes, for example- water feed from water sources.

MATERIALS AND METHODS

Working on the engineering solution of the energy supply problem in Stavropol State Agrarian University a pilot plant of conical solar concentrator was developed and made. The distinctive peculiarity of the conical solar concentrator (figure 1) is in the fact that the sunlight rays which get into cone's aperture are reflected to heat absorber and fully transformed to heat. The advantages of conical solar concentrator will be realized only with the special construction of heat absorber and water feeder which will make it possible to reduce heat leakages as a result of the convective heat transfer, thermal radiation and thermal conductivity.

These abilities are provided by the heat absorber (figure 2) presenting by itself absorber- converter 2 which is connected to the truncated cone 1. The absorber-converter includes annular closed cavities 3 located concentrically towards axe of the truncated cone. Cavities are connected with each other pipelines 4 and extreme annular cavity 3 is provided with the input 5 and output 6 fittings.

From other side, the absorber-converter 2 is covered by low-profile cavity 7 connected by joining pipelines 8 and 9 to 5 and 6 fittings. The inlet of the absorber-converter 2 from the truncated cone side 1 is closed by the transparent doubled glass 10. The outer side of the glass is covered by the heat insulator 11. Constructively, the absorber-converter is made with the possibility of filling cavities 3 and 7 by the heat carrier 12.

Figure 1. Conical solar concentrator

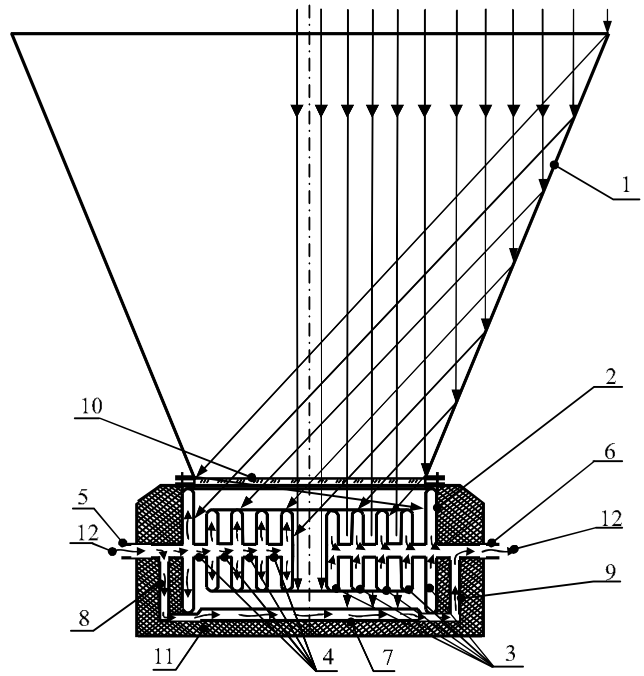

Figure 2. Principal scheme of conical solar concentrator
1 – cone reflector, 2 – absorber-converter, 3 – annular closed cavities, 4 – pipelines, 5 – inlet fitting, 6 – outlet fitting, 7 – low-profile cavity, 8, 9 – joining pipelines, 10 – transparent cover, 11 – heat insulator, 12 – heat carrier.

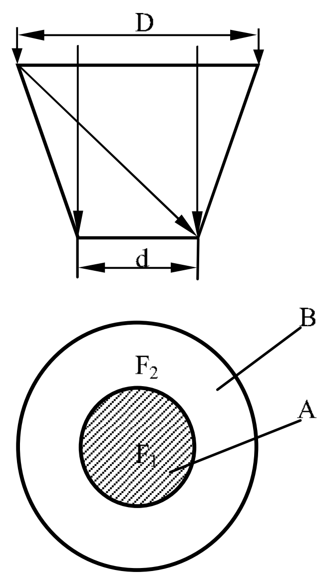

Figure 3. Solar radiation distribution on solar concentrator

Solar flux $\hat{O}_{conc}$, falling to heat absorber of conical solar concentrator, will be formed from direct solar flux which falls to active surface A and reflected by cone's surface B (figure 3) solar flux, i.e

$$\hat{O}_{conc} = \hat{O}_A + \hat{O}_B, \tag{1}$$

where $\hat{O}_A$ - power of solar radiation on surface A, kW

$\hat{O}_B$ - power of solar radiation on surface B, kW

The power of forward flow of solar radiation calculated in the following way:

$$\hat{O}_A = \mathring{A}_D \cdot \frac{\pi \cdot d^2}{4}, \tag{2}$$

where $\mathring{A}_D$ - density of solar radiation, kW / m^2;

d – diameter of small bottom of the cone, m;

$\frac{\pi \cdot d^2}{4} = F_1$ - square of small bottom of the cone, m^2;

The power of reflected flow of solar radiation calculated in the following way:

$$\hat{O}_B = \mathring{A}_E \cdot \frac{\pi(D^2 - d^2)}{4}, \tag{3}$$

where $\mathring{A}_E = \mathring{A}_D R^n$ – density of solar radiation without concentration, with a glance to loss in the time of n- multiple solar beam's reflection, kW / m^2.

R - reflectivity factor; n - quantity of reflections; d – diameter of large bottom of the cone, m; So, the power of solar concentrator will be:

$$\hat{O}_{conc} = \frac{\mathring{A}_E \cdot \pi}{4}\left[(D^2 - d^2)R^n + d^2\right], \tag{4}$$

The density of the solar radiation will be:

$$E_E = \frac{4 \cdot \Phi_{conc}}{\pi \cdot [(D^2 - d^2)R^n + d^2]} \tag{5}$$

The solar flux $\hat{O}_{conc}$ changing of solar radiation density $\mathring{A}_E$ of the cone concentrator subject to reflectivity factor R and quantity of reflections n presented in a table 1 ($D = 1m$).

Table 1. The solar flux $\hat{O}_{conc}$ changing of solar radiation density $\mathring{A}_E$ of the cone concentrator subject to reflectivity factor R and quantity of reflections n

Quantity of reflections n	$\frac{d}{D}$	F_1, m^2	F_2, m^2	R=0,8		R=0,9		R=0,97	
				Φ_{conc}, kW	E_E kW/m^2	Φ_{conc}, kW	E_E, kW/m^2	Φ_{conc} kW	E_E, kW/m^2
0	1	0,78	0,78	0,51	0,65	0,51	0,65	0,51	0,65
1	0,42	0,14	0,78	0,42	3,03	0,46	3,32	0,49	3,54
2	0,32	0,08	0,78	0,34	4,23	0,42	5,22	0,48	5,84
3	0,24	0,05	0,78	0,27	5,97	0,38	8,41	0,46	10,17
4	0,17	0,02	0,78	0,21	9,20	0,34	14,55	0,45	19,40
5	0,13	0,013	0,78	0,17	12,80	0,30	22,60	0,43	32,40
6	0,12	0,011	0,78	0,13	11,50	0,27	23,58	0,42	36,68

Having regard to the state of changing of the solar radiation density $\mathring{A}_E$ for the cone solar concentrator with reflective surface (reflectivity factor R=0,8), quantity of reflections $n \leq 3$. For the reflectivity factor R=0,9 $n \leq 4$ and for reflectivity factor R=0,97 $n \leq 5$. Having regard to loss of energy subject to quantity of reflections n of sunbeam it's reasonable to take R=0,8 and n =1, for R=0,9 n=2 and for R=0,97 n=3.

RESULTS AND DISCUSSION

The renewable sources of energy, particularly the use of the electric- magnet solar energy, are gaining the increasing popularity in the world. One of the directions of using of the solar radiation is the use of the cone solar concentrator. The mathematic model of the cone solar concentrator was worked out; it includes energetic, optical geometrical parameters. The said model allows calculating the parameters of the concentrator depending on the applied mass expenditure and the final temperature of the carrier. Using the cone solar concentrator helps to increase the density of the stream of the solar radiation with the number of the reflection of the sun ray from 1 to 4 and the index of reflection from 0,8 to 0,97 up to 16 times. The practical number of reflections is n=3, in which the density of the solar radiation increases up to 8 times, while the loss of the ray energy is 18 %.

In the solar concentrator testing time the water in the accumulator box (volume 65 liters) had been heated up to 95°C for 40 minutes. In winter time with the outside temperature of - 8°C, the temperature of water in the capacity of the accumulator (volume 85 liters) was heated up from 15°C to 80°C. for 120 minutes. We think that the solar concentrator has good perspectives for using it in a system of winter heating of building. For the purpose of improving of developed equipment in Stavropol State Agrarian University the training ground where the concentrator is placed was created which is open for viewers.

CONCLUSION

The solar radiation utilization factor in the cone solar concentrator amounted 75% when for low-profile collector it is only 40%.

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The developed cone solar concentrator can be used for heating and hot water supply of individual houses.

The issues of developing of low-power devices which work from renewable sources should be long term scientific program and independent branch of energetic.

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TRADICIONALNI I NEKONVENCIONALNI IZVORI OBNOVLJIVE ENERGIJE

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Izvod

Savremeni razvoj izvora energije treba da se zasniva na visoko efikasanoj tehnologiji, koja ne zagađuju okolinu. Netradicionalni izvori energije (geotermalna toplotni izvori, Sunce, vetar, snaga vode, i td.) su ekološki, jer ne zagađuju okolinu. Visoka ekonomska efikasnosti i ekološka svest postaju glavni razlozi za široko korišćenje netradicionalnih energetskih tehnologija u udaljenim regionima sveta. Konstantno smanjivanje mineralnih goriva na Zemlji i perspektive rasta njihove cena, kao i sve veći porast rizika od zagađenja životne sredine, usled štetnog energetskog otpada, su razlozi za aktivno iznalaženje i razvoj alternativnih izvora energije. U ovom trenutku svetska zajednica je prepoznala da u narednih nekoliko godina, a možda, i tokom ovog veka, neće uspeti otkriće i razvoj potpuno novog izvora energije. Zato su glavne nade i najviše planova, o razvoju svetskog energetskog kompleksa, usmereni na obnovljive izvore energije, uključujući geotermalne izvore, energiju sunca, vetra i bio-mase.

Ključne reči: energetika, snabdevanje energijom, obnovljivi izvori, električna i toplotna energija.

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