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The Use of Electromagnetic Pulses for Pre-Softener in Solar Desalination Plants

Ildar Rakhmatulin

South Ural State University, Chelyabinsk, Russia
ildar.o2010yandex.ru

Abstract

In the article describes the use of electromagnetic pulses for pre-softening in solar desalination plants. Shows the results of tests on solar desalination plant.

Water - the source of all life, the most important element of our planet, without which it can not do any day of the life of every person, regardless of age or place of residence. Obviously, the availability of fresh water is one of the most important factors in determining the economic and environmental situation in the country.

To solve the problem of water scarcity was created solar desalination plant with high performance and low cost. The scheme of arrangement is shown in Figure 1.

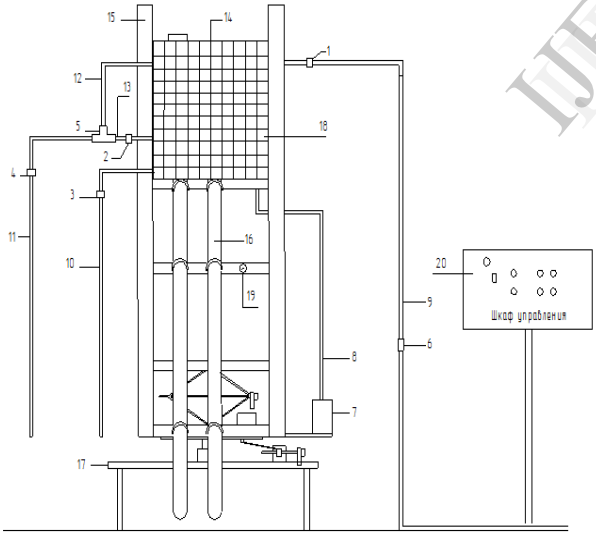

Figure 1 - General view of the solar desalination plant :

1,2,3,4- solenoid valves, 5 - tee pipe, 6 - adapter, 7 - the capacity of distillate, 8 - supply pipeline distillate, 9 - supply pipeline salt water, 10 - pipeline discharge of salt water with a high salt content, 11 - supply pipeline water with high temperature, 12 - supply pipe salt water from the condensing section , 13 - supply pipeline salt water in the desalination section, 14 - desalination , 15 – profiles, 16 - vacuum tube collector , 17 – platform, 18 - solar battery, 19 – photosensor, 20 – cabinetThe principle of operation is based on the supply water between sections due to the free fall water, when open solenoid valves.

Desalination in the section for desalination by the thermal energy produced by vacuum tubes. On Fig. 2 shows a photograph of the solar desalination plant.

Fig. 2. Photo of solar desalination plant

For performance results over the installation tests have been performed.

For the experiments have been used hollow glass vacuum tubes and vacuum tubes with copper core inside.

Experimental conditions:

- The temperature of the salt water entering the desalination plant - 24 0C;

- Installation is located to the south at an angle of - 400 to the horizon;

- The volume of salt water in the section for distillation to the start time of the test is 1.5 l;

- The volume of salt water in the section for condensation on the initial time of the test is 7 liters;

- Sensor salt water for the condensation section is set at 1.2 liters. Sensor salt water for the condensation section is set at 5 liters.

Plant capacity is largely dependent on the characteristics of vacuum collectors, since the smaller the transmission losses of solar energy into thermal energy, the greater the efficiency of the solar distiller.

Specifications of vacuum tube solar collector:

- Transmittance of borosilicate glass: ≥ 0,92;

- The ability to selectively absorbed by the absorbent coating: ≥ 0,94;

- Hemispherical emissivity: ε ≥ 0,08

- The quality of the vacuum: <5x10-5 Pa.

Experimental study of solar desalination plant were carried out in the period from 31.08.2013 to 01.08.2013 at 9.00 am to 19.00 in the coordinates 54019'00" N 59023'00" E

The capacity solar desalination plant when using hollow glass tubes is shown in Fig. 3.

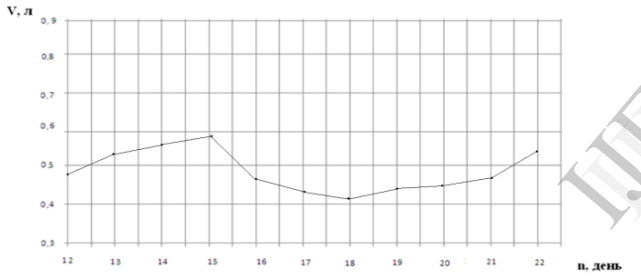

Fig. 3. Performance of solar desalination plant in operation with vacuum glass tubes

Performance of solar desalination plant in operation with vacuum glass hollow tubes remained at a low level and does not economically justifiable use of solar desalination plant for water desalination.

Performance of solar desalination plant when working with vacuum tubes with copper core inside, is shown in Fig. 4.

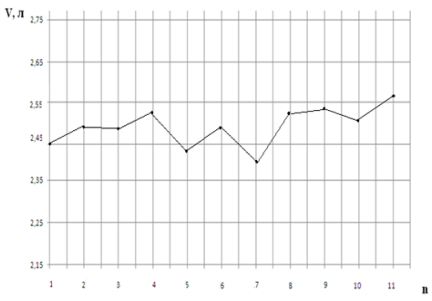

Fig. 4. Performance of solar desalination plant when working with vacuum tubes with copper core inside

The capacity of the vacuum tubes using a copper rod inside several times bigger than using vacuum performance of the hollow tubes. This is due to the fact that the copper vacuum tube collector can bring water to the boiling point, and maintain the necessary state of boiling during the day.

The results of laboratory tests indicate the possibility of using vacuum tube solar collector with copper core inside for the desalination of water in temperate regions. Performance can be raised by increasing the number of vacuum tubes, the performance increase will be almost linear relationship, or by the use of a tracking device for the sun to be able to raise the productivity of the plant by 10 - 30%.

As a source of electrical energy used, solar panels, due to a number of positive factors: solar battery has the ability to be installed on the desalination plant, the use of tracking devices increases the performance of solar panels. Solar panels work, how and desalination on the sun's energy, which eliminates the possibility of no electricity at work distiller.

Deterrent installation of solar panels on the desalination plant is a shortage of space. Since at normal functioning solar distiller needed area exceeds solar panels the area of solar desalination, thus making it impossible to install the battery on the desalination plant. To implement this action, a special algorithm, the purpose of which is to reduce the consumption of electricity and as a consequence the size of solar panels.

The main idea of this algorithm is that at any given time may not operate for more than 1 device, thereby the peak power consumption remains fixed and does not exceed consumption of the power one device in the installation.

Based on laboratory tests and calculations for increase productivity when using an electric heater for the production of 4 liters/day in the southern Urals enough to use 2 vacuum solar collectors and solar panel size of 425 mm × 300 mm × 42 mm.

The calculated data [1], [2] and data from experimental studies are shown in Figure 5.

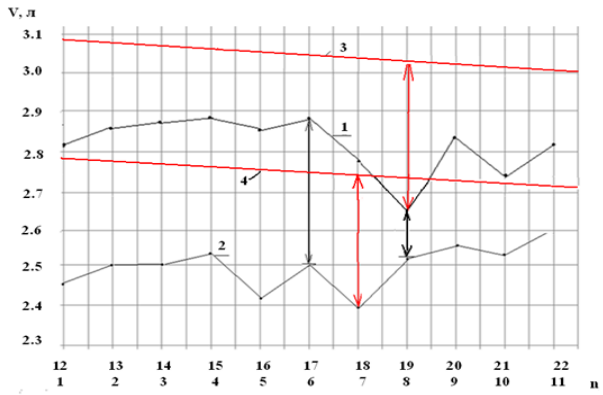

Fig. 5. Performance of solar desalination plant tracking device - 1 without a tracking device - 2 by way of trials, the performance of the solar desalination plant tracking device - and 3 without tracking devices - 4 obtained by calculation

The difference in the readings for the installation without a tracking device is 0.1 liters. (4%) and 0.15 liter for tracking device. (5%). Based on the results, concluded that the possibility of using a mathematical model to calculate the performance of the solar desalination plant. To increase the accuracy of the final result it is advisable to use the value of the intensity of solar radiation considering with the clouds.

The main problem of autonomous solar desalination plants is the formation of deposits on the heating elements, which significantly shortens the life and necessitates periodic human intervention in the desalination process.

To combat the deposits can be involved the following methods:

- Mechanical, for that could damage the device;

- Chemical cleaning, a variety of reagents, such as acetic acid, the downside is that you must stop the installatio and need time for maintenance;

- Electronic water treatment.

To solve the problem of deposit the decision to use electromagnetic pulses to pre softening desalination of water. The electrical energy generator of electromagnetic pulses produced by solar panels.

Control of the generator of electromagnetic pulses is performed through a microcontroller. Time of work the generator depends on the amount of water desalination. The microcontroller begin to turn on generator when the water detection sensor in the tank for condensation will give signal, and operates the internal timer from the time of closing the water supply valve to a container for condensation.

As a source of electromagnetic radiation is proposed to use a standard device which contains a power source, the pulse generator, the switching element and the electromagnet. Power supply of the electromagnet coil (inductor) by the control unit is a pulse current. The inductor is rigidly mounted on the outside of the capacity for desalination.

Under the influence of an alternating magnetic field in the core of the electromagnet in the capacity to desalinate arise oscillations are caused by the effect of the magnetic anisotropy. These oscillations with a frequency of pulses and their harmonics are transmitted through the liquid.

As a result, solar desalination unit is completely autonomous and can work in temperate regions.

[1] Solar power plants with sun tracking system for power supply to agricultural consumers: Dis. ... Candidate. those. Sciences: 05.20.02 / WR Yarmuhometov - Ufa, 2008 - 178 p.

[2] Energy-saving agricultural consumers from renewable sources. dis. ... Doc. those. Sciences: 05.20.02 / Saplin LA Chelyabinsk, 1999 -318 p.