METHODS OF OBTAINING HEAT FROM SOLAR CONCENTRATORS.

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Abstract: This article presents a comprehensive analysis of methods for extracting thermal energy from solar concentrators. It discusses various technological approaches including parabolic dish concentrators, parabolic Stirling systems, parabolic water-heating concentrators, parabolic trough collectors, and Fresnel lens concentrators that focus solar radiation to generate heat. Based on experimental results and mathematical models, the study examines strategies for enhancing the efficiency of solar concentrators, achieving energy savings, and evaluates the economic and environmental impacts of these technologies. The article offers innovative solutions for the effective use of solar energy in drying processes and industrial thermal systems.

Keywords: solar concentrators, thermal energy, energy efficiency, drying technologies, parabolic concentrators, Fresnel lenses, innovative technologies, renewable energy.

QUYOSH KONTSENTRATORLARIDAN ISSIQLIK OLISH USULLARI.

Annotatsiya: Ushbu maqolada quyosh konsentratorlaridan issiqlik olish usullari keng qamrovli tahlil qilinadi. Maqola parabolik botiq ko‘zguli konsentratorlar, parabolik Stirling konsentratorlari, parabolik suv isitgich, parabolik trubkali konsentratorlar va Fresnel linzali konsentratorlar kabi turli texnologik yechimlar asosida issiqlik energiyasini qanday to‘plash va uni samarali ishlatish usullarini yoritadi. Tadqiqotda eksperimental natijalar va matematik modellar yordamida konsentratorlarning samaradorligi, issiqlik yo‘qotishlari, energiya tejash va atrof-muhitga ta’siri ko‘rib chiqilgan. Ushbu maqola innovatsion texnologiyalar va yangi yondashuvlar orqali quritish va sanoat issiqlik tizimlarida quyosh energiyasidan samarali foydalanish imkoniyatlarini taqdim etadi.

Kalit so‘zlar: quyosh konsentratorlari, issiqlik energiyasi, energiya samaradorligi, quritish texnologiyalari, parabolik konsentratorlar, Fresnel linzalari, innovatsion texnologiyalar, ekologik toza energiya.

МЕТОДЫ ПОЛУЧЕНИЯ ТЕПЛА ОТ СОЛНЕЧНЫХ КОНЦЕНТРАТОРОВ.

Аннотация: В данной статье проводится комплексный анализ методов получения тепловой энергии с использованием солнечных концентраторов. Рассматриваются различные технологические подходы, включая параболические зеркальные концентраторы, параболические системы Стирлинга, параболические концентраторы для нагрева воды, параболические коллекторы и концентраторы с линзами Френеля, направленные на сбор солнечного излучения и преобразование его в тепло. На основе экспериментальных данных и математических моделей исследуются пути повышения эффективности концентраторов, возможности энергосбережения, а также экономические и экологические аспекты применения данных технологий. Статья предлагает инновационные решения для эффективного использования солнечной энергии в процессах сушки и промышленных тепловых системах.

Ключевые слова: солнечные концентраторы, тепловая энергия, энергоэффективность, технологии сушки, параболические концентраторы, линзы Френеля, инновационные технологии, экологически чистая энергия.

INTRODUCTION

Sun energy again recovering energy from sources one as increasingly more attention is gaining . The sun concentrators sun the rays one to the point collect through heat energy effective in a way working release opportunity This gives in the article sun from concentrators heat to take various methods , their efficiency , performance principles and innovative solutions about in detail stopped Let's go .

Today on the day energy from sources reasonable use and again renewable energy technologies development on a global scale current from issues one The sun is from energy use methods inside sun concentrators important place holding them using high to the temperature achieve and heat energy effective in a way collect possible .

Sun concentrators sun the rays known one focus to the point concentration through heat harvest does and this energy industry , energy and village farm in the fields effective application possible . In particular , industry in enterprises technological processes for need to be heat supply , drying systems and steam generator release such as in the fields sun concentrators application energy efficiency increase with together , to the environment removable harmful waste also serves to reduce does .

This in the article sun from concentrators heat to take methods , their various technological in processes application and efficiency increase roads analysis is made . From this besides , different geographical in the regions sun intensity and his/her concentrator to the effectiveness impact seeing will be released.

METHODS

Sun concentrators sun the rays one to the point collect through heat energy working in the release They are used in different ways . kind to types divided and every one to oneself typical work principles and to the effectiveness has .

Parabolic concave mirror concentrators sun parabolic rays glassy surface through one central to the point This on point the heat winner device located It is heat . energy harvest This will do . concentrators the most high the temperature harvest do takes and usually up to 600-1500°C to reach They can heat energy directly electricity to the energy convert for usage or straight away heat working in the release application possible . Their main advantages high temperature harvest to do opportunity and heat exchangers or Stirling engines with However , this is concentrators disadvantages the only focus among to the point has to be because of big in quantity energy working in the release efficiency decrease and construction and technician service show expenses height enters .

Parabolic Stirling concentrators sun the rays acceptance doer heat to the source collects and this energy Stirling engine through electricity to the energy Stirling engine closed systematic is the air or gas with works and high to efficiency has This is concentrators sun energy directly mechanic or electricity to the energy turn to receive with separated They are efficiency usually up to 30-40 percent to reach possible . Moving mechanisms less happened because of reliability high is considered . Disadvantages and complicated technological to the structure has to be , the engine enough temperature harvest to do need and sun radiation stable It is required to be .

Parabolic water heater concentrators sun the rays collect through water to heat for used in these concentrators sun rays parabolic to the surface directed , heat collector to the collector This collector usually water or other heat the carrier to heat for This is used . system mainly residence and industry in the fields heat supply for They heat water to 80-120°C . to heat to the possibility has is simple to design has and technician service show costs are low . Thus together , their

electricity working release opportunity no and sun rays less was in the regions efficiency decrease possible . The temperature far time storage for additional heat keeper systems are required .

Parabolic tubular concentrators in the shape of a long parabola heat collector tubes with equipped . Sun rays parabolic mirrors through focus on point into the tube will be directed and this through heat carrier substance This substance is heated . usually water , oil or heat keeper solutions to be possible . This concentrators mainly sun heat electricity at the stations and technological heat in the processes They are used at temperatures up to 150-400°C. to reach possible and heat electricity at the stations wide is applied . Continuously energy working release for used and work efficiency 20-30 percent around to be possible . Complicated mechanic system requirement and sun radiation stability important factor is considered . From this except , first installation cost high to be possible .

Fresnel lens sun concentrators lens from the principle using the sun narrow its rays and small to the field This system sun the rays redirect for traditional parabolic to the mirrors relatively light and compact to be with separated This is concentrators up to 500°C was temperature harvest do takes and light and cheap from materials preparedness because of economic in terms of effective They are the sun . photovoltaic on the panels and heat in systems applies and sun intensity maximum at the level to use help gives . Their disadvantages between of the system clear redirection required , reflection without energy loss to the surface arrival , lenses time to pass with pollution and efficiency decrease and correct installation and the need for a movement mechanism enters .

Figure 1. The Sun concentrators types .

This sun concentrators various kind heat and electricity energy working release in systems is applied . Each concentrator type to oneself typical work to the principle has is , their effectiveness , application field and technician requirements looking at is selected . Parabolic concave concentrators high temperature to take for the most good choice if , parabolic Stirling concentrators electricity working release for advantage gives . Parabolic water heater and tubular concentrators and heat supply for effective if , with a Fresnel lens concentrators compact and high effective the sun is shining energy in orientation is applied .

RESULTS

Above cited methods through sun from the concentrator heat to be taken possible . Harvest done heat from energy at the hour application There are possibilities . The sun from concentrators taken heat energy industry from the fields for example drying for if applicable to the goal is appropriate and this sun concentrators to the effectiveness also The sun concentrators efficiency

analysis in doing one how many important factors in consideration to take need . Below this factors seeing we go out :

Determination of optical efficiency.

Optical efficiency measures the ability of a solar concentrator to absorb and concentrate solar energy. It takes into account solar radiation loss and reflectivity. The main indicators are:

- Reflectivity (R): The ability of the concentrator surface to reflect sunlight.
- Absorptivity (A): The ability of a material to absorb sunlight.
- Geometric efficiency (G): The accuracy of directing the sun's rays into focus.

These indicators are given in percentages (%). In calculations, they are expressed as a coefficient in values from 0 to 1, proportional to the percentage. The formula for determining z

Determination of thermal efficiency.

Thermal efficiency indicates how efficiently solar energy is converted into heat. It indicates heat losses and the useful use of energy. The thermal efficiency formula is defined as follows:

$$\eta_{issiqlik} = \frac{Q_{foyda}}{Q_{kelgan}} = \frac{m*c*(T_1-T_2)}{I*A*t} \qquad (2)$$

Here - the amount of useful heat, - the total amount of heat received from the sun. m - the mass of the heat carrier passing through the solar concentrator per unit of time, c - the heat capacity of the heat carrier, T1-T2 - the temperature difference between the heat carrier entering and leaving the solar concentrator, I - solar intensity, A - the surface area of the solar concentrator, t - the operating time of the solar concentrator$Q_{foyda}Q_{kelgan}$

Determining overall efficiency.

The overall efficiency indicates the overall efficiency in converting solar energy into thermal energy. It is determined by taking into account the solar intensity, concentrator materials and heat losses. The overall efficiency formula of solar concentrators is determined by the following expression:

$$\eta_{umumiy} = \eta_{optik} \times \eta_{issiqlik} \qquad (3)$$

Determining efficiency through intensity.

The relationship between solar intensity and efficiency is determined based on the following formula:

$$\eta = \eta_{min} + k * \left(\frac{I}{I_{max}}\right) \qquad (4)$$

where: ηmin- minimum efficiency. k- efficiency growth factor. -I: observed solar intensity (W/m²). - Imax: maximum intensity (W/m²).

Experimental methods.

The most widely used method is to determine efficiency through experiments in laboratory and field conditions. The experiments measure:

- Solar intensity.
- Operating temperature.
- Heat loss.
- Optical and thermal properties of the materials used.

Energy balance method

In this method, the balance between solar intensity (I) and its conversion into thermal energy by the concentrator is calculated. The formula is:

Total = Profit + Loss

Here, efficiency is determined by the equation:

$$\frac{I_{total}-I_{loss}}{I_{total}} \quad (5)$$

Monitoring in real conditions.

The efficiency of a parabolic trough solar concentrator is measured by long-term monitoring and under real-world conditions. The effects of solar intensity, temperature, wind speed, and other meteorological factors are analyzed. The efficiency determined in this way is more accurate. However, this, in turn, takes a lot of time.

DISCUSSION

Sun concentrators sun energy effective in a way collect and heat energy working in the release very effective technologies . Parabolic concave mirror concentrators and Parabolic Stirling concentrators high with temperature cases for , Fresnel lenses and average and low temperature cases for effective The sun is from concentrators heat to take methods further improvement through energy efficiency increase and again recovering energy from sources use expansion possible . From this outside seen to the information mainly sun concentrators efficiency and heat to take efficiency directly sun to the intensity also is related .

CONCLUSION

Sun concentrators sun energy effective in a way collect and heat energy working in the release very effective technologies . Parabolic concave mirror concentrators and Parabolic Stirling concentrators high with temperature cases for , Fresnel lenses and average and low temperature cases for effective The sun is from concentrators heat to take methods further improvement through energy efficiency increase and again recovering energy from sources use expansion possible .

Literature

1. Aminov, T. (2018). " The Sun of energy perspective and in Uzbekistan " Uzbekistan " energy and natural resources in the magazine .
2. Davronov , A. (2017). " The Sun energy systems : Small and middle in size energy working " Uzbekistan " science and technology magazine .
3. Abdurakhmanov , B. (2019). " The Sun concentrators technology efficiency and them In Uzbekistan application opportunities ." Uzbek energy systems magazine .
4. Jumaniyazov , M., & Bozorov , R. (2020). " The Sun concentrators high in efficiency use for innovative technologies ." Energy and stable development magazine .
5. Khalilov, F. (2021). " The Sun concentrators work principles and them many energetic in systems " Uzbekistan Science and technologies magazine .
6. Akramov, S., & Asqarov , M. (2020). " The Sun energy in Uzbekistan in use to the surface arrived problems and innovative solutions ." Technology and innovations magazine .
7. Shodmonov , R. (2018). " In Uzbekistan sun concentrators working release and application analysis ." Young scientists and innovations conference materials .
8. Asimov, D. (2019). " The Sun from energy effective use for innovative technologies and materials ." Sun energy develop magazine .
9. Abdullayev, J. (2020). " The Sun concentrators energy efficiency and to them innovative solutions " Science and energy magazine .
10. Karimov, M., & Ismoilov , A. (2021). " The Sun concentrators technology prospects and global experiences . " Uzbekistan's energetic future magazine .