DOI: https://doi.org/10.5281/zenodo.11253573

THE EFFECT OF SOLAR RADIATION INTENSITY ON THE PERFORMANCE EFFICIENCY OF FLAT SOLAR AIR HEATERS

Umurqulov Sh.X
Fergana polytechnic institute

Xakimov M.Sh
Fergana polytechnic institute
xakimovmirkomil7@gmail.com

Abstract: *In this paper, the influence of solar radiation intensity on the efficiency of flat solar air heaters for solar heat recovery is discussed and three different effects of radiation are considered: direct radiation, back radiation and total radiation. how to calculate radiation and its formulas are fully explained*

Key words: *solar energy, radiation, flat solar air heater, beam, reflected radiation, horizontal surface, collector, scattered radiation*

Аннотация: *В данной статье обсуждается влияние интенсивности солнечного излучения на эффективность плоских солнечных воздухонагревателей для рекуперации солнечного тепла и рассматриваются три различных эффекта излучения: прямое излучение, обратное излучение и полное излучение. как рассчитать радиацию и ее формулы полностью объяснены*

Ключевые слова: *солнечная энергия, излучение, плоский солнечный воздухонагреватель, луч, отраженное излучение, горизонтальная поверхность, коллектор, рассеянное излучение.*

Annotatsiya: *Ushbu maqolada, quyosh energiyasidan issiqlik energiyasini olish uchun quyosh radiatsiyasi intensivligini yassi quyosh havo isitgichlari ishlash samaradorligiga ta'siri,haqida bayon qilingan va radiatsiyaning uch xil ta'siri ko'rib chiqilgan bular to'g'ri radiatsiya, qaytgan radiatsiya va yig'indi radiatsiyalarni qanday hisoblash va formulalari haqida to'liq bayon qilingan.*

Tayanch so'zlar: *quyosh energiyasi, radiatsiya, yassi quyosh havo isitgich, nur, qaytgan radiatsiya, gorizontal sirt, kollektor,* sochilgan radiatsiya.

Correct radiation: Correct solar radiation is of primary importance in the radiation balance. Direct solar radiation refers to the radiation that falls directly from the Sun to the surface in the form of a bundle of parallel rays. The direct radiation flux falling on a horizontal surface is determined according to (1): [1.2]

$$S_g = S_\perp \sinh . \quad (1)$$

Direct radiation flux incident on an arbitrarily chosen inclined surface

$$S_k = S_\perp \cos i ; \quad (2)$$

here $\cos i = \cos\alpha \sinh + \sin\alpha \cosh \cos\psi$; $\psi = \psi_o + \psi_k$; (3)

$$\cos\psi_o = \frac{\sinh \sin\phi - \sin\delta}{\cosh \cos\phi} ; \quad \sin\psi_o = \frac{\cos\delta \sin\tau^o}{\cosh} ; \quad (4)$$

The azimuths pso of the sun and psk of the inclined surface are calculated from the meridian plane and are positive when counted clockwise from the south point.

Figures 1 and 2 show the annual and daily variation of direct solar radiation for the city of Karshi (φ=39).[3]

Scattered radiation refers to the radiation of the Sun that is scattered in the atmosphere. The amount of scattered radiation that falls on a unit of surface in a unit of time is called the scattered or diffuse radiation flux. Since scattered radiation is caused by the scattering of direct radiation, it is found in quantities that depend on the factors that determine direct radiation. [4.5]

$$D_\perp = b\,(J_\perp - S_\perp) \sinh ; \quad D_g = b\,(J_g - S_g) \sinh . \quad (5)$$

In an ideal atmosphere b = 1/2, and in real conditions b = 1/3 .

For sloping surfaces $D_k = D_g \cos^2(\alpha/2)$. (6)

For practical calculations, the scattered radiation is assumed to be isotropic (does not depend on the direction of radiation).

The distribution of scattered radiation in the open sky without clouds cannot be isotropic [6]. The maximum of the scattered radiation intensity is observed in the area of the sky dome facing the sun (up to 70%), and the minimum is observed in the opposite area (up to 30%). Scattered radiation in fully cloudy air will have isotropic characteristics.

Figures 1 and 2 show the annual and diurnal variation of possible scattered radiation under average cloud conditions..[7]

Returned radiation: Total reflected radiation describes the part of the radiation returned from the incident surface. The ratio of the reflected radiation to the total amount of radiation that has passed is called the reflectivity of the incident surface or albedo.

When the albedo is known, the reflected radiation is calculated by the following formula [3]

$$R = Q / A . \quad (7)$$

Albedo itself is determined by the following relationship

$$A = R / Q .$$

(8)

Albedo is usually expressed as a percentage. Reflected radiation and albedo depend on the angle of incidence of the sun's rays, so these quantities have a pronounced diurnal variation when the correct radiation is present. The albedo of the surface depends on its color, roughness, humidity and cloudiness.

Figure 1 shows the annual variation of possible return radiation under average cloud conditions. [8]

Cumulative radiation: Cumulative radiation is the main radiation description. Information about it is most used by consumers. The total radiation flux is the sum of direct, scattered and returned radiation fluxes.

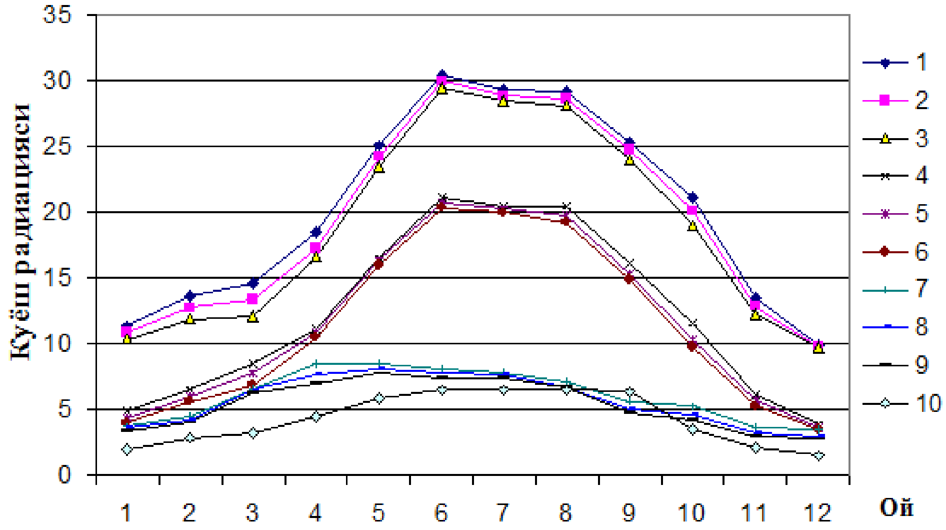
$$Q_g = S_g + D_g + R_g ; \quad Q_\perp = S_\perp + D_\perp + R_\perp . \quad (9)$$

For sloping surfaces

$$Q_k = S_k + D_g \cos^2(\alpha/2) + R_g \sin^2(\alpha/2) . \quad (10)$$

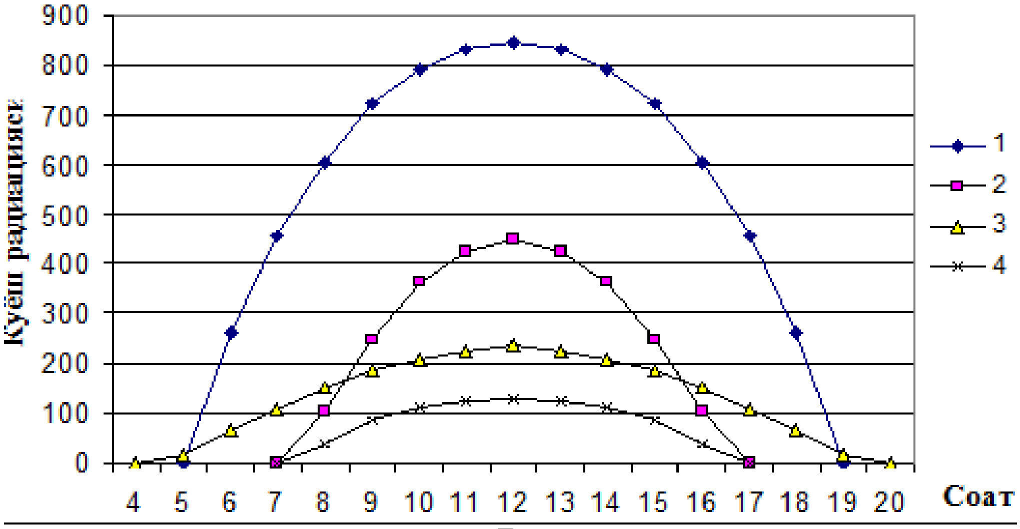
The relationship between direct and scattered radiation in the total radiation depends on the altitude of the Sun, cloudiness and pollution of the atmosphere. When the sky is cloudless, the percentage of scattered radiation decreases with the increase of the height of the Sun. The clearer the atmosphere, the smaller the percentage of scattered radiation. When the sky is covered with clouds, the total radiation is completely scattered radiation. In the presence of cloudiness, the decrease in the amount of total radiation varies over a large range. The maximum fall of radiation is observed in the open sky without clouds. The annual change of possible total radiation in cloudy conditions is given. [9.10.11]

The daily amount of scattered and reflected radiation for all surfaces except for denser (a=30o) surfaces is practically scattered and reflected radiation for horizontal surfaces.



Picture 1. Potential annual change in solar radiation with average cloud cover, MJ/(m2 sut), Vs.:1 - $S_\perp$-mak.; 2 - $S_\perp$- medium; 3 - $S_\perp$-min.; 4 - S_g-mak.; 5 - S_g-medium;

6 - S_g-min.; 7 - D_g-mak.; 8 - D_g- medium; 9 - D_g-min.; 10 - R_g- medium



Picture 2. Daily variation of the intensity of solar radiation, W/m2,

Qarshi sh.:1 - $S_\perp$-15/VI; 2 - $S_\perp$-15/XII; 3 - D_g-15/VI; 4 - D_g-15/XII

is equal to the sum of their amounts. This is due to the fact that the reduction of the radiation falling on the inclined surface is almost completely compensated by the arrival of the returned radiation. In practical calculations, the returned radiation is not taken into account.

Flat solar collectors consist mainly of light-absorbing, transparent and heat-insulating layers. The absorption layer is called an absorber and it is connected to the heat transfer layer.

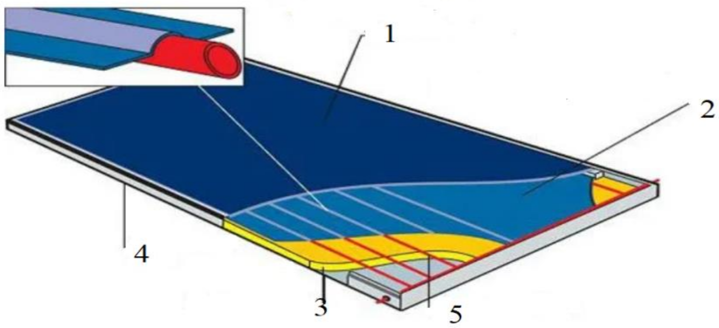
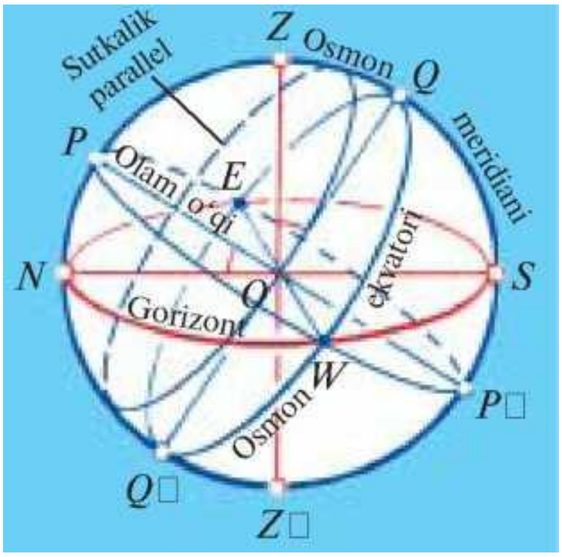


Figure 1. Structure of a flat solar collector.

1. Transparent glass layer. 2- Heat absorbing panel (absorber). 3- Thermal insulation layer. 4- Flat collector housing. 5- water outlet.Shaffof element ya'ni, kam miqdorda metall The mixture is made from imported and recycled glass. Flat collectors can heat water up to 190-200°C. It is used to get hot water from flat collectors. Basically, the surface of flat collectors is darkened to absorb all the rays. **Vertical reception area oriented to South, West or East, North.**

The points of intersection of the Earth's axis with the celestial sphere are called the poles of the universe. The intersection point of the earth's north pole continuum with the celestial sphere is called the north pole of the world P, and the intersection point of the south pole continuum with the sphere is called the south pole of the universe. The axis connecting the poles of the universe is called the axis of the universe. The great circle passing through the center of the celestial sphere and intersecting it with a plane perpendicular to the axis of the universe is called the celestial equator. The celestial equator lies in the same plane as the Earth's equator. The circles formed by the intersection of the sphere with planes parallel to the plane of the celestial equator are called diurnal parallels. The large circles formed by the intersection of the planes passing through the axis of the universe and the celestial sphere are called deviation circles.[12.13]

The main lines and circles of the celestial sphere lie on the projected plane, and the great circle passing through the poles, zenith and nadir points of the universe is called the meridian of the sky. Its points of intersection with the mathematical horizon are called the North (N, near the north pole of the world) and South (S, near the south pole of the world) points of the horizon.



Principal points, lines and circles of the celestial sphere.

The points of the mathematical horizon lying at a distance of 90° from these points are called East (E) and West (W) points. The cross section of a straight line connecting the North and South points along the mathematical horizon plane is called the meridian.

After studying the above points and lines of the celestial sphere, it is not too difficult to study different coordinate systems of the sky based on them.

The effect of area latitude on the flux of total solar radiation.

The energy and heat of the sun falling on the earth is called solar radiation. The amount of solar radiation is represented by the amount of light energy falling on the surface of 1 cm. sq. of the earth during a certain time. The distribution of solar radiation on the earth's surface depends on the geographical latitude, because the angle at which the sun's rays fall on the earth's surface and the length of the day in different places depend on the geographical latitude. The more direct the sun's rays fall on the earth's surface, the more heat the same place receives at a certain time. The biggest difference in the length of the day between the northern and southern parts of Central Asia is during the summer and winter solstice. For example, at the end of December in the extreme southern parts of the country, the day is about 1 hour and 10 minutes longer compared to the north, and at the end of June, on the contrary, it is 1 hour and 50 minutes shorter. The geographical latitude of a place determines the amount of solar energy that can reach the surface of the earth located in this area. But not all the energy from the sun reaches the earth's surface. About 20 percent of it does not fall to the earth's surface, but returns to space through the atmosphere. Some of the sun's rays are absorbed and scattered by water vapor, dust, and clouds in the air. As a result, scattered radiation occurs in the atmosphere. Direct radiation from the sun to the earth's surface is called direct radiation. Both direct radiation and diffuse radiation fall on the earth's surface. Direct radiation and diffuse radiation falling on the Earth's surface are called total radiation. Total radiation is equal to 150 kcal of heat on 1 cm.2 surface in the south of the Karakum desert. The total radiation decreases towards the north. In order to determine the geographic location of a place on Earth, it is necessary to know its geographic latitude and longitude. The geographic latitude and longitude of a place are together called the geographic coordinate of that place.

You can learn how to determine the geographic coordinates of a place from a globe and map using the following examples: It is necessary to determine the geographic coordinates of London, the capital of Great Britain. To do this, it is necessary to first determine the geographical latitude of the city of London from a globe or a map of the Eastern Hemisphere. From the globe, it can be seen that London is north of the equator, that is, between 50 degrees and 60 degrees north latitude. In order to know more precisely the geographical width of the city, we measure between the parallels of 50 degrees and 60 degrees with the help of a ruler and divide it into 10 parts. Each part consists of 1 level. It can be determined that the city of London corresponds to the first part of these 10 parts. Therefore, we add 10 to 50 degrees. This means that the geographic latitude of the city is 51 degrees N. shows that Since the capital of Great Britain is located on the Prime Meridian, its longitude is 0 degrees. So, the geographical coordinate of the city of London is 51 degrees N. and 0 degrees is the geographic longitude. Let's determine the geographical coordinates of the city of Tashkent. Our capital is also north of the equator. Therefore, it has a northern latitude. It can be seen from the map that the city of Tashkent is located approximately 10 degrees above the parallel of 40 degrees and 50 degrees, that is, at 41 degrees of latitude.

Summary

There are three different ways to calculate the current power of direct solar radiation, these are

It consists of 1. direct radiation, 2. reflected radiation, 3. total radiation.

REFERENCES:

1. Mohit B. Modeling, analysis, evaluation, selection and experimental investigation of parabolic trough solar collector system, M. Sc. Thesis, Thapar University, 2012. 107 p.
2. Абдукаримов Б.А., Акрамов А.А. , Абдухалилова Ш.Б. Исследование повышения коэффициента полезного действия солнечных воздухонагревателей // Достижения науки и образования научно-методический журнал № 2 (43), 2019. 13-14 с.
3. Умурзакова М.А. Исследование теплоотдачи и гидравлического сопротивления солнечных воздушных нагревателей с интенсификацией теплоотдачи: Диссертация на соискание ученой степени кандидата технических наук: спец. 05.14.05 – Теоретические основы теплотехники. Фергана, 2009. 116 с

4. Харченко Н.В. Системный подход к разработке гелиотеплонасосных систем теплоснабжения. - Киев, 1987. — 158с. Деп. вИнформэнерго 01.03.88. № 2639ЭН.

5. Амерханов Р. А., Бутузов В. А., Гарькавый К. Ю. Вопросы теории и инновационных решений при использовании гелиоэнергетических систем// Энергоатомиздат Москва, 2009 г. 150-158 с

6. Вардияшвили А.Б., Теймурханов А.Т., Товарных Г.Н. Приближённый метод определения скорости движения теплоносителя в термосифонной установке / / Гелиотехника. - 1991. - № 1. - С.57-61.

7. Попель О.С., Фрид С.Е. Солнечные водонагреватели. Возможности использования в климатических условиях средней полосы России / / Теплоэнергетика. - 2001. - №7. - С.44-47.

8. Системы солнечного тепло- и хладоснабжения. Под ред. Сарнацкого Э.В. и Чистовича С.А. - М.: Стройиздат,1 9 9 0 .- 2 1 7 с.

9. Исследовать теплопоступления солнечной радиации и разработать рекомендации по выбору рациональных типов гелиоустановок для целей горячего водоснабжения и отопления в Приморском крае: Отчёт о НИР (заключит.) / Дальневост. НИИ по строительству. Руковод. работы В.П.Рудаков.- № ГР 01.83.0041142, инв. №0286. - 0-008090 - Владивосток, 1985. - 112 с.

10. Андерсон Б. Солнечная энергия (Основы строительного роектирования). - М.: Стройиздат, 1982. - 372 с.

11. Харченко Н.В. Критерии оценки энергетической эффективности елиотеплонасосных систем теплоснабжения / Киев, инж.-стр. инст. Деп. в УкрНИИНТИ 13.04.87. - Киев,1 9 8 7 .- 1 6 0 с.