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Original Contribution

IMPORTANCE OF PROJECTING IN APPLICATION OF WATER HEATING SYSTEMS WITH SOLAR ENERGY

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ABSTRACT

In this work which purposes to define the importance and the necessity of benefitting in a most productively way, whatever the aim, while benefitting from the solar energy which is a new and renewable energy source, inside of the water heating systems with solar energy which has a very common use in our country, the systems served to application as a package system by the producer companies are investigated and the relation of the problems which we meet in these applications with projecting is explained.

The problems that the application of package systems which are produced by the firms with an exemption arisen from that there is no obligation for project in the application of water heating systems with solar energy in our country, and which are served to application for every region having the same m2 collective field, deficiency of training of operators and knowledge deficiency of consumers as they care the cost first of all in the system choices and doing these applications in an uncontrolled and without inspection way bring out are determined.

Furthermore, numerically, for the purpose of providing the daily water necessity of four people, a closed system with natural circulation and warms water with solar energy and another closed package system with natural circulation and two solar energy collector, -designed considering the clime conditions of September month for İzmir and Edirne cities, extensively served to application by the producer firms in our country and claimed by these firms that the daily water necessity of between four and five people will be provided by this system- are compared, explained which one could be more efficient, and the importance of projecting is stressed.

Key Words: *package systems, solar energy*

INTRODUCTION

In this work, water heating systems with solar energy which is applied in Edirne and neighbourhood are investigated, all of these applications, some of the a lot of technical deficiencies and technical mistakes caused by idleness arises from that there is no project obligation in applications and obligation of responsibility of technical application (T.U.S.), in other words, there is not any control are defined below:

These are;

1.A Mistakes experienced while determining assembly places of the systems;

1. Wrong choice of direction
2. Wrong choice of grade angle
3. Choice of shadowy place

1. B Wrong system choice of the application

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place as clime conditions

1. Open system applications in Edirne and neighbourhood which have cold clime conditions
2. Compressive system applications in places where there are deficient water pressure and frequent water cut.
3. Deficient or wrong installment and system isolation are seen in applications.

1.C Choosing collector type and collector surface material which are not suitable and using of package systems which have deficient collector field in Edirne and neighbourhood.

Because all technical mistakes and deficients which we explained in groups until here affect the system efficiencies negatively, it is seen that efficiencies of all systems used in this kind of applications are very low. But, the most common in the technical mistakes and deficients expalined above and the same collector fields are used in every region since projecting isn't done in the applications of systems served in all Turkey. In order to explain this section, when the technical documents and brochures of the systems of the firms which have applications in Edirne and neighbourhood are viewed, for example; it is defined that a package system with one collector will provide for 2-3 people and a package system with two collectors will provide hot water necessity of 4-6 people all along the year. Whereas it is explained in technical documents and brochures that how these systems will work in which regions, with which capacity, which efficiency, and these capacity and efficiency values will change as different clime conditions.

MATERIALS AND METHODS

Eq.1 equation is used to calculate the necessary collector field to provide this capacity in the applied systems.

$$F = \frac{Q_h}{Q_f} \qquad (1)$$

In above equation

Q_h : Heat amount to provide necessary water need

Q_f : Heat amount that can use solar energy

If useful heat Q_f is investigated (1)

$$Q_f = Q_l.\eta_k.\eta_m \qquad (2)$$

where

Q_l : average ray intencity (kcal/m2day)

η_k : collector efficiency (%)

η_m : mechanical efficiency (%)

Q takes different values for every region and takes also different values to be applied all along the year.

Nk collector efficiency changes according to collector type, property of material of swallowing surface, property of surface coat (like selective surface), properties of glass cover. The efficiency in collectors with glass which have 6-10 pipes,1930x930x150 mm dimensions black coloured copper or aluminium winged pipe changes about 40%-60%, in collectors with selective surface changes about 70%-85% (3). The clime conditions of application region must be considered to get high efficiency for nm mechanical efficiency in Eq.2 or system efficiency. It must be decided to apply whether an open or closed system, system with natural or algebric circulation, and whether the installment elements and isolation of system elements are enough are not.

By this information, if we study how much hot water a closed system package unit that have two collectors -each one has net 1,6 m2 collector field- and have 8 copper pipes, coper winged, 1930x930 dimensions, namely 3,2 m2 total collector field, 170 litres compressed hot water tank, can provide in Edirne and İzmir along a year.

Necessary values for Edirne;

Q_l : 2745 $kcal/m^2 day$ (yearly average),

$\eta_k = 0{,}45$, $\eta_m = 0{,}60$, $F_k : 3{,}2 m^2$

$$Q_f = Q_l \eta_k.\eta_m = 2745.0{,}45.0{,}60$$
$$= 741{,}15 kcal/day$$

If we take heat amount Q_h that will provide necessary water need from Eq.1

$$Q_h = F_k.Q_f \qquad (3)$$

is obtained and substituting values

$$Q_h = 3{,}2.741{,}15 = 2371{,}68 kcal/day$$

is found. Q_h in Eq.1 is a formula which gives necessary heat amount to get wanted temperature for total water amount which is necessary depending on number of people [3];

$$Q_h = m.c_p.(t_{is} - t_{se}) \qquad (4)$$

Formula which gives water amount that will be heated along the day is given as below;

$$m = \frac{Q_h}{c_p.(t_{is} - t_{se})} \qquad (5)$$

In order to calculate water amount that the system can warm at 45 C

$t_{is} = 45^0 C, t_{se} = 15{,}9^0 C, c_p = 1 kcal/m^2 h^0 C$

from [1]

$Q_h = 200.1.(45 - 15{,}9) = 5820 kcal/day$

is found. To find usable heat Q_f in Eq.2; intensity of yearly average daily heat is taken as Q_l =2745 cal/day [1].

If we take the same efficiency values ($\eta_k = 0{,}45, \eta_m = 0{,}60$) using the collectors in the package system used before;

$Q_f = 2745.0{,}45.0{,}60 = 741{,}15 kcal/day$

is found. Substituting these values in Eq.1;

$$F_k = \frac{Q_h}{Q_f} = \frac{5820}{741{,}15} = 7{,}85 m^2$$

collector field is obtained. Considering net collector field of collectors used in a package system is 1,6 m^2; from this collector;

$$n = \frac{F_K}{f_K} \text{ (number)} \qquad (6)$$

is obtained, where;

n: number of collectors

F_K: net field of used collector (m^2/collector)

f_K: total necessary collector field m^2

$$n = \frac{7{,}85 m^2}{1{,}6 m^2} = 4{,}9 = 5$$

collector is needed.

If we do these calculations again using collectors with 2,13 m^2 selective surface, 80% efficiency, (1215x1906m) dimensions;

$Q_h = 5820 kcal/day$

was obtained before;

$Q_f = 2745.0{,}80.0{,}60 = 1317{,}16 kcal/m^2 day$

is found. If these values are substituted in Eq.1

$$F_k = \frac{Q_h}{Q_f} = \frac{5820}{1317{,}16} = 4{,}41 m^2$$

in Eq.6, f_k is taken as

$f_k = 2{,}13 m^2/collector$

and;

n=4,41/2,13=2,07=2

collectors are needed.

If these determined values are substituted in Eq.5;

$$m = \frac{2371{,}68}{1(45 - 15{,}9)} = 81{,}5 lt/day$$

is obtained.

If we repeat our calculations assuming that we use the same package system for İzmir;

$Q_l : 3089 kcal/m^2 day$

and

$\eta_k = 0{,}60, \eta_m = 0{,}60, F_k = 3{,}2 m^2$

are taken from [1]

$Q_f = Q_l \eta_k . \eta_m = 3089.0{,}60.0{,}60$

$= 1112{,}04 kcal/day$

Substituting these values in Eq.3;

$Q_h = F_k . Q_f = 1112{,}04.3{,}2$

$= 3558{,}528 kcal/day$

is obtained.

$t_{is} = 45^0 C, t_{se} = 20{,}9^0 C, c_p$

$= 1 kcal/m^2 h^0 C$

from [1]

If we substitute these values in Eq.5;

$$m = \frac{3558{,}528}{1(45 - 20{,}9)} = 147{,}656 lt/day$$

is found.

As seen from these values; when the water that a package system with 3,2 m2 collector field can warm is used Edirne and neighbourhood, this system respond to half of the values given in technical documents and brochures, even when this system is applied in İzmir, system can provide the values in technical documents and brochures improving system efficiencies and collector efficiencies.

For this reason; if all calculations are performed to design a system that can provide daily water necessity of a family with four people and can be applied in Edirne and neighbourhood;

Daily water necessity per person is taken as V=50lt/day; total hot water necessity for four people;

$V_T = 4xV = 4x50 lt/day = 200 lt/day$

$m = 200 lt/day . 1 kg/lt = 200 kg/day$

are obtained. Substituting this value in Eq.5, in order to determine necessary heat need to provide desired water temperature warming this amount of water; and after assuming

$t_{is} = 45^0 C, t_{se} = 15{,}9^0 C, c_p = 1 kcal/m^2 h^0 C$

from [1].

Substituting in Eq.5; a closed system package unit that has a collector field with approximately 2,13 m^2 selective surface will be enough.

RESULTS AND DISCUSSION

As the results of all of these investigations and calculations, the subjects which must be surely applied and suggestions which must be taken into consideration in applicaitons of

water heating systems with solar energy are explained below;

1. The system which has appropriate efficiency for clime conditions of application region
2. Efficiency of the collectors in chosen system must be appropriate type for clime conditions of application region, namely collectors with high efficiency must be chosen and, the systems with adequate collector field must be applied.
3. Applications must be performed depending on the values of projects which will be done by authorized machine engineers with sufficient information on this subject.
4. Applications must be done by authorized, sufficiently qualified and experienced people, it must be checked whether the application is done appropriate for information defined in project or not, responsible person for technical application which is charged by machine engineeres association in that region must approve and check the application.

If the suggestions above aren't taken into consideration for applications of water heating systems with solar enegry, it isn't possible to generalize the application of solar energy.

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