IMPROVING THE EFFICIENCY OF THE FLAT PLATE SOLAR COLLECTOR SYSTEM WITH A NEW DESIGN

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Abstract: *Solar collectors are one of the most promising renewable technologies for energizing future systems. Solar collectors are used for a variety of heating systems such as domestic hot water systems and industrial application. Increasing the collector efficiency is an important factor in terms of unit cost. In this study is to increase efficiencies of flat plate solar collectors. For this purpose, various apparatus was place into collector tubes which increase the heat transfer between plate and fluid, thus it developed a new collector. In addition, a new collector hot water tank was designed. The changes in warehouse and collector were compared with the classical systems and the change in the usage water was calculated.*

Keywords: SOLAR SYSTEM, SOLAR COLLECTOR, ENERGY EFFICIENCY

1. Introduction

Technological advances and the increasing human population have increased in the last century energy needs. As a result of this increased use of fossil fuels is the main energy source. However, these sources are limited. Therefore, mankind has turned its attention to renewable energy sources. Renewable energy sources include solar energy is the most widely used source.

Solar energy has an important place among the renewable energy sources. Solar hot water supply in residential heating and cooling applications in the process industry in the provision of heat, agriculture irrigation, drying and cooking, electricity is an energy source that can be used in producing. In Turkey, a country with solar energy potential is very high. The annual average sunshine time is 2640 hours, the average annual solar radiation value 1311kwh / m^2 value [1].

Recently, detailed thermal applications related to energy storage and solar energy in the literature review studies [2]. Advances again saved the day in the heat system in the year have been revealed a study review [3]. The widespread use of solar energy in Turkey is to meet the housing needs of hot water. Solar collectors angle of for residential which should be established has been demonstrated studies [4, 5, 6].

The systems used in order to meet the hot water needs from solar energy works in two ways, on and off. The water circulating in the water collectors with open systems are the same as the system. Closed systems are the system with water is different of heating water. Water heated in the collector heat with the heat exchanger, it transferred the use of water.

The apparatus also relates to the use of copper tubing in the system, various studies have been made. Kumar [7], a rate of 18 to 70% of the bent strip for use in planar collector in the study was observed by increasing the heat transfer. The thermal performance was observed with increasing Reynolds number increases. Pipes, an increase in the pressure loss due to resistance by 87-132% create a flow of bent strip that is inserted into the rotary motion to the stream was observed. However, experimental work flow in the collector is arranged to circulate as in the coil from a single pipe collector. Kumar [7] this has been tried in the 5000-23000 range of the Reynolds number.

2. System Description and Methods

In the study, the effects on the system performance of using the apparatus inside the pipe in the natural circulation, closed system solar collectors were investigated experimentally.

Three different experimental setups have been established for this. For the normal collector, it is used with a natural circulating, closed system, a pressurized flat collector system storage. The plane collector is 2 pieces and each piece is 93 cm x 193 cm in size. Hot water storage of the system is 300 l capacity. There are 11 copper pipes with a diameter of 1.6 cm in each collector.

Two planar solar collectors, one 93 cm x 193 cm and one 186 cm x 193 cm, were designed in the scope of the study. Both collectors have 300 l of hot water storage. Pipes were prepared horizontally in plane collectors designed in the scope of the study. Copper pipes with a pipe diameter of 5 mm were placed at intervals of 3 cm and 52 horizontal pipes were used. The horizontal lengths of the pipes are 80 cm for the short collector system, 170 cm for the long collector system and 3 cm diameter half pipes are connected.

For both long and short collector systems in horizontal tubes, 52 pieces and 3 mm thick aluminum bars were bent. Bent aluminum rods are shown in Figure 1.

Fig. 1 *Aluminum Bars*

Flat plate collectors system schematic representation of the actual system and the external appearance are shown below in the Figure 2 and 3.

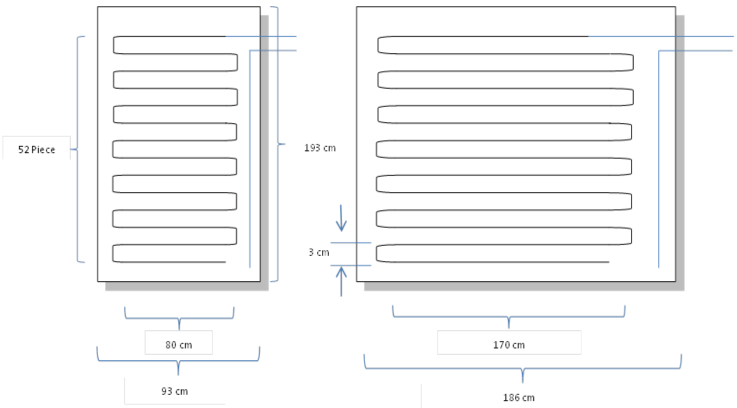

Fig. 2 *Collector dimensions*

Fig. 3 *Collector overview*

In order to compare the three systems in an objective way, these systems were run under the same operating conditions and the results were compared and examined in detail. Temperature measurements were made within the scope of the study. A temperature data logger is placed at the inlet and outlet of the collector to determine the temperature change in the collectors. By means of these data loggers, how much the fluid circulating in the collector has been measured. Measurements start at 8:00 in the morning and finish at 8:30 in the evening. The measurement range is set to 30 minutes.

Phase change material was used in the tank which was developed to extend the duration of hot water usage. In order to investigate the effect of the phase change material system developed for hot water storage, the system performance was examined by operating the hot water storage system in both a lean state and a phase change material system. The phase change system consists of a phase change material filled into copper pipes of different diameters. Paraffin wax, which is widely used in the literature and easy to fabricate, has been used as phase change material.

The general view of the collector hot water tank and heat exchanger is given in detail in figure 4, 5 and 6.

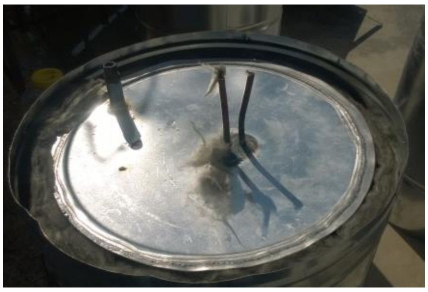

Fig. 4 *Tank overview*

Fig. 5 *Heat exchanger overview*

Fig. 6 *Heat exchanger in tank*

3. Results

Three solar collectors were used in the study. These collectors are designed and manufactured under study. Table 1 shows monthly changes in collectors temperatures. When the table 1 is examined it is seen that there is a difference of 3-4°C between the shorted collector and the long collector. The difference between the normal collector and the short type collector is 5-7°C. There is a temperature difference of 9-10°C between the normal collector and the long collector. The developed long collector has been increased by 21%. It was found that the long collector developed within the scope of the study was the most efficient.

Table 1. *Collector output temperatures averaged by monthly*

Months	April	May	June	July
Apparatus Collector	44,5	40,6	50,1	50,9
Apparatus Collector (long)	47,8	44,6	53	53,7
Normal Collector	38,3	35	43,8	45,4

One type of hot water storage was used in the study. The developed hot water storage has been used in apparatus long and short collectors. Table 2 shows monthly changes in hot water tank temperatures.

When the table 2 is examined it is seen that there is a difference of 5-6°C between the developed and normal hot water tank. The developed hot water storage has been increased by 15%. Especially in the summer months, the efficiency increase is higher.

Table 2. *Average temperature change according to hot water tank monthly*

Months	April	May	June	July
Normal Tank	32,83	35,34	35,5	35,5
Developed Tank	33,79	40,46	40,99	41,69

4. Conclusion

In this study, it was aimed to increase the efficiency of the solar collectors used to utilize solar energy from renewable energy sources. From here, the effect of the insertion of the planar solar collectors into the pipe is investigated. Depending on collector size, a temperature increase of 8-9°C compared to normal systems has been achieved. This temperature increase is not enough to increase the efficiency. However, because solar energy is the most important source of renewable energy resources, this efficiency increase will be a guide for future work.

5.References

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