Innovations in Mechanical Engineering: Solar Water Heater with Active tracking

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Abstract— This research explores a groundbreaking innovation in mechanical engineering – a Solar Water Heater (SWH) with Active Tracking. Unlike traditional SWH systems, this design incorporates a dynamic tracking mechanism that adjusts the solar collector in real-time for optimal energy absorption. The study includes a thorough review, design principles, and performance analysis under various conditions. The proposed system shows potential for significant efficiency gains, making it a promising advancement in renewable energy technology.

Index Terms- Concentrator, Active Tracking, Heater, Solar, Water.

I. INTRODUCTION

A solar water heater with active tracking is a type of solar thermal system that uses motors and sensors to track the sun throughout the day, maximizing the amount of sunlight that is collected by the solar panels. This can significantly increase the efficiency of the system compared to a fixed-mounted solar water heater.

There are two main types of active tracking solar water heaters: single- axis trackers and dual-axis trackers. Single-axis trackers typically rotate the solar panels on a east-west axis, following the sun as it moves across the sky from east to west. Dual-axis trackers can also rotate the panels on a north-south axis, which can be especially beneficial in locations with high solar declination angles. [1]

II. CYLINDRICAL CONCENTRATOR THROUGH SOLAR WATER HEATER

Cylindrical concentrator through solar water heater for water heating was executed. The procedure employed includes the design, construction and testing stages. The equipment which is made up of the reflector surface (curved mirror), reflector support, absorber pipe and a stand was fabricated using locally sourced materials. This work presents a reproducible cylindrical concentrator trough solar water heater as a suitable renewable technology for reducing water-heating costs and solar water heating systems with optical concentrating technologies as important entrants for providing needed bulk solar energy [2]. Cylindrical concentrator through power plants are the only types of solar thermal power plant technology with existing commercial operating systems

III. BENEFITS OF ACTIVE TRACKING

Active trackers Most tracking systems out there are active systems – this means that the tracking system is provided with energy to run a motor or other mechanical device that tilts the attached solar panels the right way. In general, active solar trackers are more well-suited for large and complex installations. such as Watt Sun track the sun from east to west using electronic sensors and motor or actuator drives. During partly cloudy conditions, the tracker fixes on the brightest area of the sky, capturing the maximum amount of sunlight available. While trackers are advantageous in that they have little components to fail we have found that in some locations with extreme cold temperatures the trackers are slow to follow the sun in the morning until the liquid heats up.

IV. IMPLEMENTATION

Below are the components used in Solar Water Heater with Active tracking.

COMPONENT	PRICE
plywood 18 mm thickness sheet	950
MDF sheet 12 mm	850
Aluminium 2 mm thickness sheet	500
copper pipe	300
3×16 nut bolt	150
1/8 screw	30
4 mm thickness studs	600
Planks	100
Bush bearing	100
Foam sheet	550
glasses or reflector	350
rubber based adhesive	450
PVC tube	300
Reservoir	250
PVC pipe	250
belt and pulley	1500
permanent magnet DC motor	100
reduction gear box	250
Jumper Wire	100
Ribbon wire	100
motor driver unit	250
micro controller unit	850
Battery	500
solar panel	1100
voltage regulator ICs	20
Button	20
temperature sensors	1125
LDR sensors insulating tapes	140
Cable tie	20

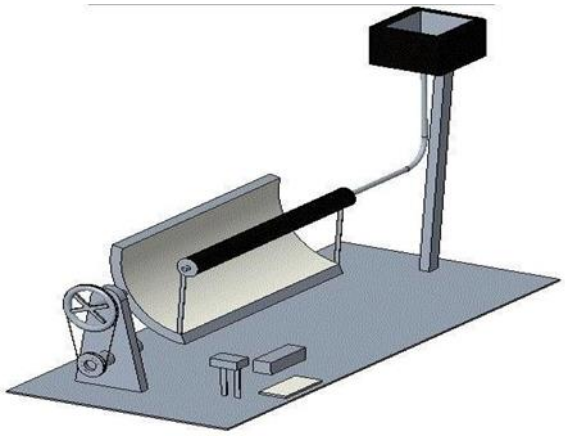

Fig. CAD model

V. TESTING SETUP

- The fabricated solar water heater. The collector is tilted at an angle of 9 with respect to the horizontal plane.
- The ambient temperature, the inlet and outlet temperature from the collector were measured every hour from 8:00 am to 6:00 pm on two different days. It should be noted that incessant rainfalls prolonged test duration.
- The flow rate was determined by using a stopwatch and a calibrated container to obtain the volume of flow per minute.
- The hygrometer shows the humidity of water measure that also.
- This was done repeatedly

VI. OBSERVATIONS

- Observation with Active Tracking Device

Observations of Solar Water Heater and Steam Generator Using Cylindrical Concentrator with Active Tracking device and Data Update are tabulated below.

Table: Observation with tracking device

Time	T1 Ambien	T2 Inlet	T3 Metallic	T4 Tempof	Toutlet Outlet temp	Humi dity

	t Temp	Temp Pre- heated Wat er	Base Reflect or Temp	Receive r plate			
					T5 Hot Wat e r Temp	T6 Stea m	
08:0 0	32º	33.5º	36.1º	85º	65º	Nil	54%
09:0 0	34º	35.6º	39.1º	98º	69.5 º	100	48%
10:0 0	35º	36.5º	41.3º	98.5º	73º	100. 1	43%
11:0 0	37º	38.5º	44.8º	99º	78º	100. 2	39%
12:0 0	38º	39.8º	46.5º	99.5º	83º	100. 3	34%
01:0 0	39º	41.2º	47.9º	100º	86º	100. 4	30%
02:0 0	40º	41.3º	49.0º	102º	93º	100. 6	29%
03:0 0	39º	41.0º	47.4º	100º	87º	100. 4	28%
04:0 0	38º	39.9º	46.2º	98º	80º	100. 3	27%

- Observation Without Active Tracking Device

Observations of Solar Water Heater and Steam Generator Using Cylindrical Concentrator Without Active Tracking device and Data Update are tabulated below.

Table: Observation without tracking device

Time	T1 Ambien t Tem p	T2 Inlet Tem p Pre-	T3 Without Meta llic Base	T4 Temp of Rece ive r plate	Toutlet Outlettemp	Hu mi dity

		he ated W ater	Reflector Tem p		T5 Hot Wate r Te mp	T6 Stea m	
08:0 0	32º	33.5 º	36.1º	84º	65º	Nil	54 %
09:0 0	34º	35.6 º	38.1º	95º	68. 5º	10 0	48 %
10:0 0	35º	36.5 º	40.3º	96. 5º	72º	10 0.1	43 %
11:0 0	37º	38.6 º	43.8º	98º	78º	10 0.2	39 %
12:0 0	38º	39.8 º	45º	98.5º	82º	10 0.3	34 %
01:0 0	39º	41.2 º	49º	100º	85º	10 0.4	30 %
02:0 0	40º	41.3 º	48º	102º	92º	10 0.5	29 %
03:0 0	38º	39º	46.4º	99º	85º	10 0.2	28 %
04:0 0	36º	37º	44.2º	96º	77º	10 0	27 %

Prototype

Fig. Model of Solar Water Heater with Active tracking

CONCLUSION

At present, in most of the cases fossil fuel are used to produce superheated steam, but solar energy that renewable energy, can be a great source of heat in this purpose. The use of renewable energy provides our environment clean and comfortable without the cost of electricity. But this concentrator is capable of producing superheated steam from water of ambient temperature.

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