

# Design & Fabrication of Helical Coiled Solar Water Heater with Auto Tracking Device

Vikas MMahale

Department of Mechanical Engineering  
Shivajirao S Jondhale College of Engineering And Technology  
Asangaon 421604  
Mahale4585@gmail.com

Prof. AnveshVirkunwar

Department of Mechanical Engineering  
Shivajirao S Jondhale College of Engineering And Technology  
Asangaon 421604  
anveshvirkunwar@gmail.com

**Abstract** - This paper is worried with Design and Fabrication of Helical Coiled Solar Water Heater with auto GPS beacon under the neighbourhood climatic condition. Sunlight based Parabolic Dish is at present utilized for the Water warming and cooking applications. For the most part Solar Parabolic Dishes are altered centre point concentrators, yet so as to accomplish higher warm productivity we attempted to make itline centre concentrator by utilizing a one of a kind beneficiary (copper tube as helical loop) mounted at central point. We are utilizing copper helical curled through which water will circle. Helical loop as more warm proficiency contrasted with straight tube curl. This paper presents trial stage in view of the configuration, improvement and execution qualities of direct boiling point water era via auto-following sun powered illustrative dish concentrating framework. Because of auto following framework in daytime consistent boiling point water will be accessible.

**Index Terms**– Absorber, Parabolic Dish, recipient, solar water heater, Auto Tracking Device

\*\*\*\*\*

## I. INTRODUCTION

Sun oriented vitality is the essential wellspring of vitality for our planet. The normal sun based vitality achieving the earth in the tropical zone is around 1 kwh/m<sup>2</sup> and aggregate radiation over a day is, best case scenario around 7 kwh/m<sup>2</sup>. The sunlight based steady Isc is the rate at which vitality is gotten from the sun on a unit range opposite to the beams of the sun, at the mean separation of the earth from the sun the estimation of Isc is 1353 w/m<sup>2</sup>. Expanded usage of sun oriented vitality in our nation would bring about all around advantages, both as far as cleaner environment and money related addition. The vitality from the sun is utilized for different purposes principally as force era known as sun based power era framework and modern procedure heat applications [1].

The vitality utilization in private division is generous as it records for roughly 33% of general conveyed vitality use and carbon dioxide discharges of this conveyed vitality use, around a quarter is for water warming. Water warming is by and large given by blazing non-business fills, in particular kindling as in provincial zones and for this application country people groups are slicing trees to incomplete satisfaction of their day by day vitality necessities, this makes consumption of woods and along these lines it impact on environmental change and business energizes, for example, lamp oil, melted petroleum gas LPG), coal; through either their immediate burning or using power in urban ranges this employments of fossil powers make air contamination and as the expenses of normal asset exhaustion. The sun is the main star of our nearby planetary group situated at its inside. The sun is a circle of seriously hot vaporous matter with a measurement of 1.39x10<sup>9</sup>m and is around 1.5x10<sup>11</sup>m far from the earth, the sun turns on its hub once about like clockwork. The power of sunlight based radiation per unit time on a unit surface outside the world's air is known as "sun based consistent". Its quality is 1353 W/m<sup>2</sup>.

Over the previous century fossil energizes have given the majority of our vitality on the grounds that these are much less expensive and more helpful than vitality from option vitality sources. Be that as it may, the principle issue is that demonstrated stores of regular gas to keep going for a long time, oil to keep going for 30 to 50 years and coal to keep going for 200 to 300 years at current rates of consumption. Another difficult issue identified with ignition of Non-renewable vitality like fossil energizes has brought on genuine air contamination issues as a result of vast measure of hurtful gasses into the air. It has likewise brings about an unnatural weather change. The arrival of a lot of waste warmth from force plants has created warm contamination in lakes and streams prompting the decimation of numerous types of plant and creature life. On account of atomic force plants, there is likewise worry over the likelihood of radioactivity being discharge into the environment and long haul of issues of transfer of radioactive squanders from these plants.

In this way, sunlight based vitality is elective wellspring of vitality. Notwithstanding, there are numerous issues connected with its utilization. The principle issue is that it is a weaken wellspring of vitality. Indeed, even in the most sweltering locales on earth, the sun powered radiation flux accessible once in a while surpasses 1kw/m<sup>2</sup>. These are low values from the purpose of innovative use [02]. Along these lines, expansive gathering range is required in numerous applications and this outcome in unnecessary expense. Another issue connected with sun powered vitality usage is its accessibility fluctuates broadly with time. The variety in accessibility happens every day in view of the day-night cycle furthermore regularly on account of the world's circle around the sun.

An allegorical trough sunlight based gatherer utilizes a mirror or aluminium foil sheet fit as a fiddle of an illustrative chamber to reflect and think sun radiations towards a beneficiary tube situated at the centre line of the explanatory

barrel. The collector retains the approaching radiations and changes them into warm vitality, the last being transported and gathered by a liquid medium circling inside the beneficiary tube. This method of concentrated sun powered gathering has the benefit of high effectiveness and ease, and can be utilized either for warm vitality accumulation, for creating power. In this manner it is a critical approach to abuse sun oriented vitality straightforwardly. Illustrative trough is the most develop innovation for extensive scale misuse of sunlight based vitality. The safeguard tube is either made of stainless steel or copper or iron covered with a warm safe dark paint. By and large tube is encompassed by a concentric glass spread and the space between the tube and the glass spread is emptied. The reflecting surface is direct allegorical bended shape. It is settled on a light-weight structure typically made of aluminium segments. The execution model of the sun powered gatherer is centred around a covered safeguard channel encased in a glass envelope: the receiver of the parabolic trough solar collector (PTSC). The test model is an enduring state, single dimensional model and depends on central material and vitality equalizations. Occurrence sunlight based vitality on the sun based authority is dispersed among valuable vitality increase, optical misfortunes, and warm misfortunes. The model manages the warm misfortunes coming about because of conduction, convection and radiation heat exchange to the surroundings, from the collector.

## II. LITERATURE REVIEW

In 2005, Cédric Philibert [1] studied present and future use of solar thermal energy. The main technologies belong to either "passive" and "active" solar energy forms. Passive solar energy relates to the design of buildings collecting and transforming solar energy for day lighting and natural ventilation. Active solar energy relates to the use of solar collectors for water or space heating purposes, active solar cooling, heat pumps

In 2007, Adel M. Al-Nasser [2] said that Hourly values of useful energy gain are calculated after considering the optical and thermal losses of the collector. The months of April and August offer the largest irradiation and useful solar energy rates compared to other months. The prediction hours starts from 5 a.m. to 8 p.m. to account for variation in sunrise and sunset times of different months. It is observed that thermal losses provide low proportion to the absorbed radiation predicted at 3.5%.

In 2009, Joshua Folaranmi [3] carried out design, construction and testing of a parabolic dish collector, where heat from the sun is concentrated on a black absorber located at the focus point of the reflector in which water is heated to a very high temperature to form steam. The whole arrangement is mounted on a hinged frame supported with a slotted lever for tilting the parabolic dish reflector to different angles so that the sun is always directed to the collector at different period of the day. On the average sunny and cloud free days, the test results gave high temperature above 200°C.

In 2013, Meenakshisundaram Arulkumaran and William Christraj [4] experimentally investigated with the water

circulated as heat transfer fluid. The concentrated heat is absorbed by a copper tube which is made up of coil in a curved shape and it is fixed on solar trace path in which, it eliminates tracking the sun to obtain maximum solar energy. The test results were measured 215°C with solar steam conversion efficiency is 60-70% measured.

In 2012, Ibrahim Laden Mohammed [5] carried out design and development of a parabolic dish solar water heater for domestic hot water application (up to 100°C) is described. The heater is to provide 40 litres of hot water a day for a family of four. Thermal efficiencies of 52% - 56% were obtained, and this range of efficiencies is higher than the designed value of 50%.

In 2012, M. Mohamed, Auatf. S. Jassim, Yaseen. H. Mahmood [6], carried out design and fabrication of solar dish concentration with diameters (1.6) meters for water heating application and solar steam was achieved. The dish equipped with tracking system and measurement of the temperature and solar power. Water temperature increased up to 80°C, and the system efficiency increased by 30% at mid noon time.

In 2014, Mayank Vyas, Shailendra Sharma, Surendra S. Dua and Pranay Sharma [7]. The work presented in this paper deals with the question of how solar energy might most effectively and efficiently be used in supplying energy for water heating. For this an experimental model based performance analysis is carried out between two models. The water temperature is raised from 20°C to 68.7°C with glass-covered ½ copper tube and 20°C to 62.4°C with glass-covered ½ aluminium tube. The thermal performance analysis is carried out through a mathematical modelling of the system for optimize results.

In 2015, Manav Sharma, Jaykumar Vaghani, Nitesh Bihani, Niranjanshinde, Vijay. C. Gunge [8]. The discrete small scale solar powered systems generally low cost are used for medium temperature applications including laundry, boiler feed water, dish washer and for water heating purpose in steam generation applications. The solar parabolic dish concentrator has a fixed focus with concentration ratios in the range of 20-200 which is the best among all the solar collectors. In present study, the parabolic dish of opening diameter 1.4 m was fabricated using galvanized steel and its interior surface covered with reflective surface of ionized aluminum with a reflectivity of 92.5%. The system is equipped with a receiver fabricated using copper metal positioned at the focal point. The working fluid is water. The research focuses on the temperature variations achieved from changes in the geometry of the helical receiver. This paper reveals the temperature variations achieved with a bare tube helical receiver with zero pitch and with black coated helical receiver with non-zero pitch and capped. The maximum attainable temperature with non-zero pitch helical receiver coated with black paint and capped was approximately 43% higher than that of bare tube helical receiver with zero pitch.

III.OBJECTIVES

- i) Design of the Helical Coiled Solar water heater system.
- ii) Fabrication of Helical Coiled Solar water heater system.
- iii) Cost Reduction.

IV. PROBLEM DEFINITION

Over the past century fossil fuels have provided most of our energy because these are much cheaper and more convenient than energy from alternative energy sources. But the main problem is that proved reserves of natural gas to last for 70 years, oil to last for 30 to 50 years and coal to last for 200 to 300 years at current rates of consumption Another serious problem related to combustion of Non-renewable energy like fossil fuels has caused serious air pollution problems because of large amount of harmful gases into the atmosphere. It has also results in global warming. In the case of nuclear power plants, there is also concern over the possibility of radioactivity being release into the atmosphere and long term of problems of disposal of radioactive wastes from these plants. So, solar energy is alternative source of energy. In this work solar energy is used to heat the water for household & small scale industries. System performance analysis is conducted through a set of experiments.

V. PROPOSED SYSTEM

A. Main component

SR. No.	Description
1	Parabolic dish solar collectors
2	Copper Helical Tube
3	Pump
4	Auto-Tracking Device
5	Valves
6	Water Storage tanks

3.1.1 Parabolic trough collector

A parabolic trough concentrator consists of a reflecting surface mounted on a reflector support structure having the profile of a parabola. A receiver assembly comprising a circular absorber tube with suitable selective coating and enclosed in a concentric glass envelope is centered along the reflector focal line. Maintain focusing of solar radiation on the receiver assembly. The incident energy is absorbed by a working fluid circulating through the absorber tube. The mirrors track the sun on one linear axis from north to south during the day. The pipe is seated above the mirror in the centre along the focal line and has a heat-absorbent medium running in it. The collector is generally composed of one bent glass mirror, with either silver or aluminum coated on the backside of the glass. The glass is about 4mm thick and low in iron, maximizing the

reflectance of incoming sunlight. Parabolic trough collectors are a low cost implementation of concentrated solar power technology that focuses incident sunlight onto a tube filled with a heat transfer fluid. The efficiency and cost of the parabolic trough collector designs is influenced by structural stiffness, choice of materials, assembly tolerances, mirror cleanliness and wear. Various solar energy concentrators are available in the market today from which parabolic troughs and linear Fresnel reflectors are the most common. The design parameter of a parabolic trough collector can be classified as geometric and functional. The geometric parameters of a PTC are its aperture width and length, rim angle, focal length, diameter of the receiver diameter of the glass envelope and the concentration ratio.

The functional parameters of a PTC are optical efficiency, instantaneous and all day thermal efficiency and receiver thermal losses. These parameters are largely influenced by the absorptive of the absorber

Experience large variation in optical efficiency with the largest decrease in efficiency is during the winter season. Parabolic troughs are more appropriate for small scale applications due to their simplicity, ease of fabrication and higher energy collection efficiency per unit cost over other collectors' methods. A parabolic trough operates by reflecting and concentrating the thermal energy it receives from the sun into a pipe carrying a heat transfer fluid (HTF) appropriately placed at the trough's focal length and consequently absorbed by the HTF. The HTF then flows to the storage tanks where it will be stored for further use. Fig. shows the model and actual parabolic trough.

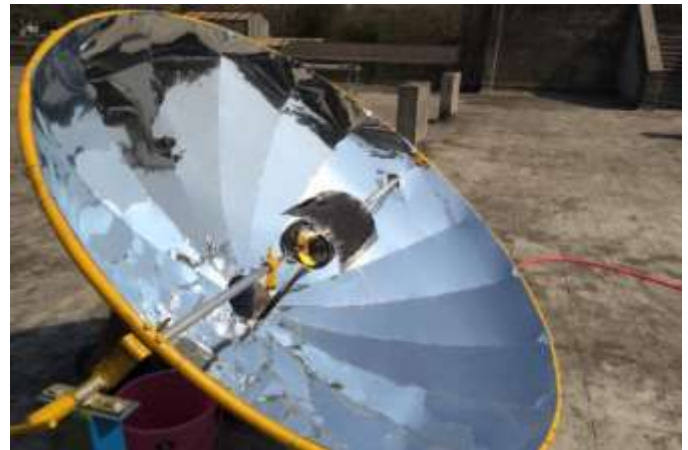


Fig. 3.1 Parabolic Dish Collector.

3.1.2 Copper Helical Tube

Copper metal was selected for receiver designing due to its high thermal conductivity ( $k=401W/mK$ ). A copper tube was procured from the market of O.D 10mm and thickness 1mm for testing purpose. The helical coil was manufactured using bending process in which sand is inserted in the tube and the tube is enclosed on both sides by a cork. In this study we have used two helical coils as receivers, the first one was

manufactured with zero pitch and its surface was kept bare as shown in fig. 3.2



Fig. 3.2 Copper Helical tube

### 3.1.3 Pump

A pump is a gadget that moves liquids (fluids or gasses), or once in a while slurries, by mechanical activity. Pumps can be characterized into three noteworthy gatherings as indicated by the technique they use to move the liquid: direct lift, dislodging, and gravity pumps. Pumps work by some component (regularly responding or turning), and expend vitality to perform mechanical work by moving the liquid. Pumps work by means of numerous vitality sources, including manual operation, power, motors, or wind power, come in numerous sizes, from tiny for use in therapeutic applications to substantial mechanical pumps.

### 3.1.4 Tracking Mechanism

A programmed straight actuator (Super Jack) run of the mill of the one being used in the satellite dish industry was chosen over the manual following instrument. The Super jack gives a moderate, relentless movement to the allegorical dish as it turns on its hub from East to West. The water driven arm is controlled by a 36V-Motor fitted toward one side of the jack. Sunlight based vitality radiation sensors (see Plate 1) fitted on the opening of the dish send electric signs to the engine which, thus, modify the position of the dish until most extreme sun oriented radiation force is gotten at the gap.

### Development of the Electrical Control Circuit for the Tracking Mechanism

The Super jack comprises of a water driven arm, an electric engine, and sun oriented photograph sensors circuit. The water powered arm comprises of two chambers, one fitted into the other in a telescopic way. The width of the internal chamber is 14cm and its length is roughly 30cm. At the point when completely expanded the aggregate length of the two barrels is around 95.5cm. The prolongation and constriction of the internal barrel inside the external chamber gives the dish its development from east to west. The external surface of the

inward barrel and the internal surface of the external chamber are isolated by an amazingly thin film of greasing up oil, which make the relative development of the two barrels smooth. An oil seal gave at the top end of the external barrel keeps the greasing up oil from spilling outside. The external chamber is secured to the tube shaped part of the vertical backing through an affixing gadget, which inflexibly holds the Super jack at an edge of around 45o with respect to the vertical backing. The Super jack is associated with the body of the illustrative dish through an opening on a bit of metal at the highest point of the internal barrel. The operation of the following system can be controlled either physically or naturally. For both methods of control, an electric circuit must be produced. In this manner when the switch is turned in one bearing, the control of the dish is programmed, utilizing the two sunlight based sensors. At the point when the switch is turned the other way, the control of the dish is manual.

### 3.1.5 Valves

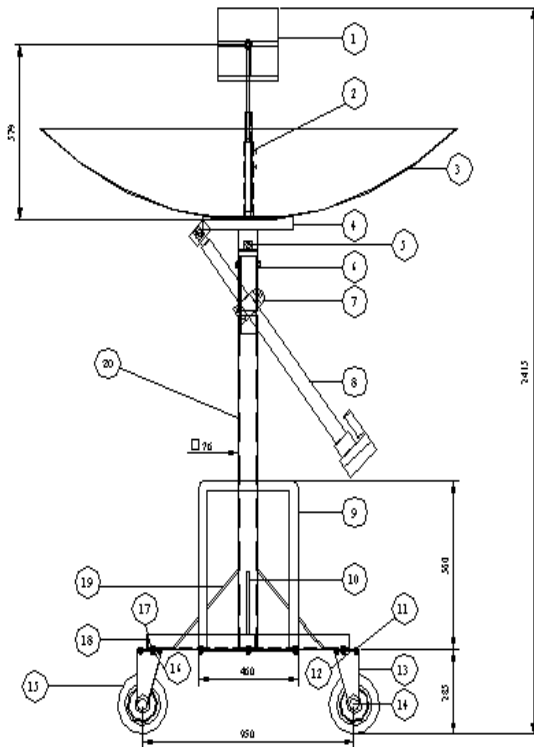
A valve is a gadget that manages, coordinates or controls the stream of a liquid (gasses, fluids, fluidized solids, or slurries) by opening, shutting, or somewhat discouraging different paths. Valves are actually fittings, however are normally examined as a different class. In an open valve, liquid streams in a course from higher weight to lower weight.

### 3.1.6 Water Storage Tank

The capacity tank is the gadget which is utilized to store the boiling hot water originating from the helical curl. The top surface of the tank is covered with warmth resistance material to keep the loss of warmth from put away boiling point water to encompassing by conduction, convection. The limit of capacity tank is rely on upon the limit absolute exploratory set up.

## 3.2 Experimental set up of Solar Water Heater System

Fig. demonstrates the amass drawing of the explanatory dish sunlight based water radiator. In this the water is going through copper helical loop which going about as a safeguard get warmed by sun powered vitality. As appeared in Fig. The entire get together is mounted on the base upheld by Wheel and Wheel Bracket. It comprise of copper helical curl as a safeguard with illustrative dish authority which assimilate sun oriented vitality and exchange the same to its point of convergence i.e. copper helical curl, because of which the water going through it get warmed which we advance store in protected stockpiling tank. Programmed direct actuator (Super jack) goes about as a following instrument to track the position of Sun and modify the position of explanatory dish gatherer. The boiling point water gathered away tank can be utilized for little scale application.



auxiliary stream in helical loops and additionally because of auto GPS beacon, high temp water will accessible entire day. as utilizing of helical curl proficiency of the framework will be more. Helical Coiled Solar Water Heater is smaller in size and manufacture expense is likewise less.

REFERENCES

- [1] C.Philibert, "The Present and Future Use of Solar Thermal Energy as a Primary Source of Energy", Inter Academy Council, 2005.
- [2] Ali man, I. Daut, "Simplification of Sun Tracking Mode to gain High Concentration Solar Energy", A J. of App. Sc.4
- [3] Folaranmi J. "Design, Construction and Testing of a Parabolic Solar Steam Generator", Leonardo Electronic Journal of Practices and Technologies, issue 14, pp 115-133,2009
- [4] Meenakshisundaram Arukumaran and William Christraj "Experimental analysis of Non tracking parabolic dish concentrating system for steam generation", International Journal of Engineering Research and Applications (IJERA) Vol. 3, Issue 1, pp. 930-931,2013.
- [5] Ibrahim Laden Mohammad, "Design and Development of Parabolic Solar Dish Water Heater", International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 1, pp. 822-830, 2012.
- [6] Mayank Vyas, Shailendra Sharma, Surendra S. Dua and Pranay Sharma "Thermal Performance Analysis of Water Heating System for a Parabolic Solar Concentrator: An Experimental Model based design" International Journal of Current Engineering and Technology E-ISSN 2277 – 4106, P-ISSN 2347 - 5161
- [7] Manav Sharma, Jaykumar Vaghani, Nitesh Bihani, Niranjanshinde, Vijay.C. Gunge "Design, fabrication and analysis of helical coil receiver with varying pitch for solar parabolic dish concentrator" ISSN (Print): 2319-3182, Volume -4, Issue-2, 2015

Sr. No.	Item	Material	Nos
1	Absorber	Copper	1
2	Screw Lock	Steel	2
3	Parabolic Dish	Aluminum	1
4	Ring Connector	Steel	1
5	Swing Rod	Stainless Steel	1
6	Boltlock	Steel	3
7	Clamp	Brass	1
8	Superjack		1
9	Handle	Steel	1
10	Short-Bar Support	Steel	2
11	Bolt	Steel	16
12	Nut	Steel	16
13	Wheel Bracket	Steel	4
14	Wheel Axle	Steel	4
15	Wheel	Rubber	4
16	Bolt	Steel	8
17	Nut	Steel	8
18	Base Support	Steel	1
19	Long Bar Support	Steel	1
20	Trunk	Steel	1

3.3 Result & Discussion

From writing audit, Helical loops are minimized in size and gives particular advantage like higher film coefficient, more compelling usage of accessible weight drop, which results in effective and less costly plan. Helical loop has more warm proficiency contrasted with straight u-tube curl as there is